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QUALITY ASSURANCE PROJECT PLAN SAMPLING ANALYSIS PLAN FOR MUNITIONS RESPONSE PROGRAM SITE AT TEN MUNITIONS RESPONSE RANGES INSPECTIONS VOLUME 1 AND 2 NSWC INDIAN HEAD MD

9/1/2009

NAVFAC WASHINGTON

Quality Assurance Project Plan
Sampling Analysis Plan
for
Munitions Response Program
Site Inspections at
Ten Munitions Response Program
Ranges

VOLUME I OF II

Naval Support Facility
Indian Head-Stump Neck Annex
Indian Head, Maryland

Naval Facilities Engineering Command
Washington

Contract Number N62467-04-D-0055
Contract Task Order 423

September 2009

SAP Worksheet #1 -- Title and Approval Page
(UFP-QAPP Manual Section 2.1)

SAMPLING AND ANALYSIS PLAN
FOR
MUNITIONS RESPONSE PROGRAM
SITE INSPECTIONS AT 10 MUNTIONS RESPONSE PROGRAM RANGES
MUNITIONS CONSTITUENTS INVESTIGATION
NAVAL SUPPORT FACILITY INDIAN HEAD-STUMP NECK ANNEX
INDIAN HEAD, MARYLAND

SEPTEMBER 2009

Prepared for:
Naval Facilities Engineering Command Washington
1314 Harwood Street, SE
Washington Navy Yard, D.C. 20374-5018

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Prepared under:
Comprehensive Long-Term Environmental Action Navy Contract
No. N62467-04-D-0055
Contract Task Order 423

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Approval Signatures:

NAVFAC QAO/Chemist Signature
Printed Name/Title/Date
Approval Authority

Jonathan Tucker see next page

Blanken, Michelle

From: Rail, Joseph P CIV NAVFAC Washington [joseph.rail@navy.mil]
Sent: Wednesday, September 23, 2009 11:52 AM
To: Basinski, Ralph; Blanken, Michelle
Subject: FW: Response to Government Chemist Comments - Stump Neck, 10 site QAPP

FYI: read below for approval of the Stump Neck SAP by Navy chemist. I have already signed and returned the signature page for your use.

-----Original Message-----
From: Tucker, Jonathan P CIV NAVFAC Lant
Sent: Tuesday, September 22, 2009 16:48
To: Rail, Joseph P CIV NAVFAC Washington
Subject: RE: Response to Government Chemist Comments - Stump Neck, 10 site QAPP

Joe,

I have completed review of the Stump Neck SAP including 10 MEC sites. All comments were resolved and it is ready for signature. If you have any questions please feel free to contact me.

Jon Tucker

Chemist
NAVFAC Atlantic EV32
6506 Hampton Blvd
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Appendix B: Conceptual Site Model (on CD)
Appendix C: Soil Background Concentrations and Worksheet 15 Reference Limits and Background Tables (on CD)
Appendix D: Field Standard Operating Procedures
Appendix E: Laboratory Standard Operating Procedures (on CD)

ACRONYMS

AA	Atomic Absorption
AA&D	Advances Access and Disablement
ALSI	Analytical Laboratory Services, Inc.
AR	Administrative Record
BFB	Bromofluorobenzene
bgs	Below ground surface
BTAG	Biology Technical Assistance Group
CA	Corrective Action
CAS	Chemical Abstract Service
CCB	Continuing Calibration Blank
CCV	Continuing Calibration Verification
CD	Compact Disk
CEC	Cation Exchange Capacity
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CHSO	Company Health and Safety Officer
CLEAN	Comprehensive Long-Term Environmental Action Navy
COC	Chain of Custody
COPC	Chemical of Potential Concern
CPR	Cardiopulmonary resuscitation
CRDL	Contract Required Detection Limit
CSM	Conceptual Site Model
CTO	Contract Task Order
CWAP	Comprehensive Work Approval Process
DAF	Dilution attenuation factor
DMM	Discarded Military Munitions
DoD	Department of Defense
DPT	Direct-push technology
DQI	Data Quality Indicator
DQO	Data Quality Objective
DVM	Data Validation Manager
EDD	Electronic data deliverable
EOD	Explosive Ordnance Disposal

ESS	Explosive Safety Submission
ESSL	Ecological Soil Screening Level
FOL	Field Operations Leader
FS	Feasibility Study
FTMR	Field Task Modification Request
GC/MS	Gas Chromatograph/Mass Spectrometer
GIS	Geographic Information System
GPS	Global Positioning System
HASP	Health and Safety Plan
HAZWOPER	Hazardous Waste Operations and Emergency Response
HMX	cyclotetramethylene tetronitroamine
HPLC	High Performance Liquid Chromatograph
HSM	Health and Safety Manager
ICB	Initial Calibration Blank
ICP	Inductively Coupled Plasma
ICV	Initial Calibration Verification
ICS	Interference Check Sample
IDW	Investigation-Derived Waste
IED	Improvised Explosive Device
IND	Improvised Nuclear Device
IRCDQM	Navy Installation Restoration Chemical Data Quality Manual
IS	Internal Standard
ITS	Instrument Test Strip
LC/MS	Liquid Chromatograph/Mass Spectrometer
LCS	Laboratory control sample
LCSD	Laboratory Control Sample Duplicate
LQL	Laborator Quantitation Limit
MC	Munitions Constituents
MCB	Marine Corps Base
MCL	Maximum Contaminant Level
MD	Munitions Debris
MDE	Maryland Department of the Environment
MDL	Method detection limit
MEC	Munitions and Explosives of Concern
MI	Multi-Increment
MIS	Multi-Increment Sample

MPPEH	Material Potentially Presenting an Explosive Hazard
MRA/S	Munitions Response Area or Munitions Response Site
MRP	Munitions Response Program
MS	Mass Spectrometer
MS/MSD	Matrix Spike/Matrix Spike Duplicate
NA	Not Available
NAVFAC	Naval Facilities Engineering Command
NELAP	National Environmental Laboratory Accreditation Program
NEW	Net Explosive Weight
NFA	No Further Action
NFESC	Naval Facilities Engineering Service Center
NIRIS	Naval Installation Restoration Information Solution
NOSSA	Naval Ordnance Safety and Security Activity
NQA	National Quality Assurance
NSF	Naval Support Facility
NSF-IH	Naval Support Facility-Indian Head
NTU	Nephelometric turbidity unit
ORNL	Oak Ridge National Laboratory
OSHA	Occupational Safety and Health Administration
PA	Preliminary Assessment
PAL	Project Action Limit
PARCC	Precision, Accuracy, Representativeness, Completeness, and Comparability
PARCCS	Precision, Accuracy, Representativeness, Completeness, Comparability, and Sensitivity
PDF	Portable Document Format
PETN	Pentoerythrol tetronitrate
PID	Photoionization detector
PM	Project Manager
POC	Point of Contact
PQL	Project Quantitation Limit
QA	Quality Assurance
QAM	Quality Assurance Manager
QAO	Quality Assurance Officer
QAPP	Quality Assurance Project Plan
QC	Quality Control
QL	Quantitation Limit

QSM	Quality Systems Manual
RBC	Risk-Based Concentration
RDX	cyclo-1,3,5-methylene-2,4,6-trinitromine
RI	Remedial Investigation
RPD	Relative Percent Difference
RPM	Remedial Project Manager
SAP	Sampling and Analysis Plan
SDG	Sample Delivery Group
SI	Site Inspection
SOP	Standard Operating Procedure
SPCC	System Performance Check Components
SQL	Structured Query Language
SSL	Soil Screening Level
SSO	Site Safety Officer
SVOC	Semivolatile organic compound
SWMU	Solid Waste Management Unit
TAL	Target Analyte List
TBD	To Be Determined
Tetra Tech	Tetra Tech NUS, Inc.
TNT	Trinitrotoluene
TOC	Total Organic Carbon
U.S. EPA	United States Environmental Protection Agency
UFP	Uniform Federal Policy
UXO	Unexploded Ordnance
VI	Visual Inspection
VOC	Volatile organic compound
VP	Vice President
WMA	Wildlife Management Area
XRF	x-Ray Flourescence

EXECUTIVE SUMMARY

Tetra Tech NUS, Inc. (Tetra Tech) has prepared this Quality Assurance Project Plan (QAPP) Sampling and Analysis Plan (SAP) under the Comprehensive Long-Term Environmental Action Navy (CLEAN) Contract No. N62467-04-D-0055 Contract Task Order (CTO) 423. This plan has been prepared for a Site Inspection (SI) at ten Munitions Response Areas (MRAs) located at the Stump Neck Annex of the Naval Support Facility (NSF) located in Indian Head, Maryland. The general locations of NSF-Indian Head (IH)-Main Installation and the NSF-IH-Stump Neck Annex are shown on Figure 1-1. The Stump Neck Annex covers approximately 1,100 acres on the Stump Neck peninsula at the confluence of the Potomac River and Chicamuxen Creek in Charles County, Maryland. The Main Installation is northeast of the Stump Neck Annex, across Mattawoman Creek. Much of Stump Neck peninsula lies within the Valley Impact Fan (Figure 1-2). General Smallwood State Park and private property are east of Stump Neck Annex.

The Navy has conducted various testing, training, and disposal activities related to military munitions at the Stump Neck Annex since the Indian Head NSF was established in 1890 as a Naval Ordnance Station. As a result of these activities, munitions and explosives of concern (MEC) and munitions constituents (MC) may be present at various sites throughout the Stump Neck Annex. The term MEC includes Discarded Military Munitions (DMM), Unexploded Ordnance (UXO), and MC in high enough concentrations to pose an explosive hazard. The Department of Defense (DoD) has established the Military Munitions Response Program (MRP) to address MC and MEC at closed ranges. The DoD is following the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) process for the investigation and remediation of these sites. The Navy is responsible for implementing the MRP at the Stump Neck Annex.

The initial phase of the CERCLA process, the Preliminary Assessment (PA), was completed in September 2005 and identified 10 MEC sites or Munitions Response Areas or Munitions Response Sites (MRA/Ss) for further investigation at the Stump Neck Annex. The 10 MRA/Ss and their locations are described in the Stump Neck Annex Preliminary Assessment (PA) Report and are shown on Figure 1-3. The PA used five primary sources of information to support the facility data collection effort, including historical archives, personal interviews, installation data repositories (including the Administrative Record), visual surveys, and off-facility data sources and repositories, such as local libraries and museums.

The primary objective of this SI is to determine whether further response actions or remedial investigations are appropriate for any of the sites identified in the PA to restore the sites to an acceptable

environmental condition. The SI considers the background information provided in the PA and collects supplemental site-specific environmental data to further characterize the nature and extent of MEC and MC at the sites identified in the PA Report.

This QAPP-SAP has been prepared in accordance with the DoD requirements for developing QAPPs for the management of environmental data collection and the use of environmental data as described in the Uniform Federal Policy for Quality Assurance Project Plans (UFP-QAPP aka UFP-SAP). Therefore, this UFP-SAP consists of the 37 UFP-SAP worksheets, with text, figures, maps, and appendices added as necessary to provide the required information.

The SI for the ten MEC sites consists of two distinctly different investigations, which will be conducted in two phases. The first phase consists of the MEC investigations which include detector-aided surface sweeps for MEC followed by a subsurface geophysics investigation. The SAP for the MEC investigation is described in Appendix A to this SAP. The second phase consists of the MC investigation. The results of the geophysics investigation will be used to determine the locations where samples will be collected in the MC investigation. This SAP describes the MC investigation.

The information provided in the worksheets was developed based on the results of four project scoping meetings among the planning team, which consists of representatives of the Navy, United States Environmental Protection Agency (U.S. EPA) Region 3, Maryland Department of the Environment (MDE), and Tetra Tech (see Worksheet #9 for attendees). Worksheet #10 contains summaries of the site-specific Conceptual Site Models (CSMs) for each of the 10 sites, and Appendix B contains detailed descriptions of the CSMs. The CSMs were used as the basis for the development of the site-specific project Data Quality Objectives (DQOs), which are contained in Worksheet #11. The remainder of the worksheets describe the sampling, analytical, and data evaluation procedures including quality requirements.

SAP Worksheet #2 -- SAP Identifying Information

(UFP-QAPP Manual Section 2.2.4)

Site Name/Number: Naval Support Facility (NSF) Indian Head (IH)-Stump Neck Annex, Maryland
Operable Units: UXO-01, 02, 04, 05, 10, 12, 21, 23, 26, and 28
Contractor Name: Tetra Tech NUS, Inc.
Contract Number: N62467-04-D-0055
Contract Title: Comprehensive Long-Term Environmental Action Navy (CLEAN)
Work Assignment Number (optional): Contract Task Order (CTO) 423

1. This Sampling and Analysis Plan (SAP) was prepared in accordance with the requirements of the *Uniform Federal Policy for Quality Assurance Project Plans (UFP-QAPP)* (U.S. EPA, 2005) and *U.S. EPAGuidance for Quality Assurance Project Plans, EPAQA/G-5, QAMS (2002)*.

2. Identify regulatory program: DoD MRP using the general CERCLA process.

3. This SAP is a **project-specific SAP**.

4. List dates of scoping sessions that were held:

Scoping Session	Date
Meeting No. 1 - Development of CSM and DQOs	November 7 to 9, 2007
Meeting No. 2 - Development of CSM and DQOs	December 18 and 19, 2007
Meeting No. 3 - Development of CSM and DQOs	January 28 and 29, 2008
Meeting No. 4 - Site Walk	February 11, 2008
Meeting No. 5 – DQO Discussion	May 14, 2008

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

Title	Date
Not applicable – This is the initial MRP SI	

6. List organizational partners (stakeholders) and connection with lead organization:

U.S. EPA Region 3 – Regulatory Oversight
MDE – Regulatory Oversight

7. Lead organization (see WS 7 for detailed list of data users)
Naval Facilities Engineering Command (NAVFAC) Washington
NSF-IH

8. 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:

UFP-QAPP Worksheet #	Required Information	Crosswalk to Related Information
A. Project Management		
Documentation		
1	Title and Approval Page	NA
2	Table of Contents SAP Identifying Information	NA
3	Distribution List	NA
4	Project Personnel Sign-Off Sheet	NA
Project Organization		
5	Project Organizational Chart	NA
6	Communication Pathways	NA
7	Personnel Responsibilities and Qualifications Table	NA
8	Special Personnel Training Requirements Table	NA
Project Planning/Problem Definition		
9	Project Planning Session Documentation (including Data Needs tables) Project Scoping Session Participants Sheet	NA
10	Problem Definition, Site History, and Background. Site Maps (historical and current)	NA
11	Site-Specific Project Quality Objectives	NA
12	Measurement Performance Criteria Table	NA
13	Sources of Secondary Data and Information, Secondary Data Criteria and Limitations Table	NA
14	Summary of Project Tasks	NA
15	Reference Limits and Evaluation Table	NA
16	Project Schedule/Timeline Table	NA
B. Measurement Data Acquisition		
Sampling Tasks		
17	Sampling Design and Rationale	NA
18	Sampling Locations and Methods/Standard Operating Procedure (SOP) Requirements Table Sample Location Map(s)	NA
19	Analytical Methods/SOP Requirements Table	NA
20	Field Quality Control Sample Summary Table	NA
21	Project Sampling SOP References Table, Sampling SOPs	NA
22	Field Equipment Calibration, Maintenance, Testing, and Inspection Table	NA
Analytical Tasks		
23	Analytical SOPs, Analytical SOP References Table	NA
24	Analytical Instrument Calibration Table	NA
25	Analytical Instrument and Equipment Maintenance, Testing, and Inspection Table	NA

UFP-QAPP Worksheet #	Required Information	Crosswalk to Related Information
Sample Collection		
26	Sample Handling System, Documentation Collection, Tracking, Archiving, and Disposal Sample Handling Flow Diagram	NA
27	Sample Custody Requirements, Procedures/SOPs Sample Container Identification Example Chain-of-Custody Form and Seal	NA
Quality Control (QC) Samples		
28	QC Samples Table, Screening/Confirmatory Analysis Decision Tree	NA
Data Management Tasks		
29	Project Documents and Records Table	NA
30	Analytical Services Table Analytical and Data Management SOPs	NA
C. Assessment Oversight		
31	Planned Project Assessments Table, Audit Checklists	NA
32	Assessment Findings and Corrective Action Responses Table	NA
33	Quality Assurance (QA) Management Reports Table	NA
D. Data Review		
34	Verification (Step I) Process Table	NA
35	Validation (Steps IIa and IIb) Process Table	NA
36	Validation (Steps IIa and IIb) Summary Table	NA
37	Usability Assessment	NA

SAP Worksheet #3 -- Distribution List

(UFP-QAPP Manual Section 2.3.1)

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To be determined (TBD)	Geophysical Subcontractor	***TBD***	***TBD***	***TBD***	NA
TBD	Direct-Push Technology (DPT)/ Driller	***TBD***	***TBD***	***TBD***	NA

UXO - Unexploded Ordnance
MEC - Munitions and Explosives of Concern

SAP Worksheet #4 -- Project Personnel Sign-Off Sheet

(UFP-QAPP Manual Section 2.3.2)

Name	Organization/Title/Role	Telephone Number (optional)	Signature/E-Mail Receipt	SAP Section Reviewed	Date SAP Read
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Matt Kraus	Project Chemist	412.921.8729	matthew.kraus@tetratech.com	WS #s 12, 14, 15, 19, 20, 23-28, 30, 34-37	
Jim Coffman	Project Geophysicist	412.921.8244	james.coffman@tetratech.com	All	
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Name	Organization/Title/Role	Telephone Number (optional)	Signature/E-Mail Receipt	SAP Section Reviewed	Date SAP Read
Joseph Samchuck	Data Validation Manager (DVM)	412.921.8510	joseph.samchuck@tetratech.com	WS #s 12, 14, 15, 19, 20, 23-28, 30, 34-37	

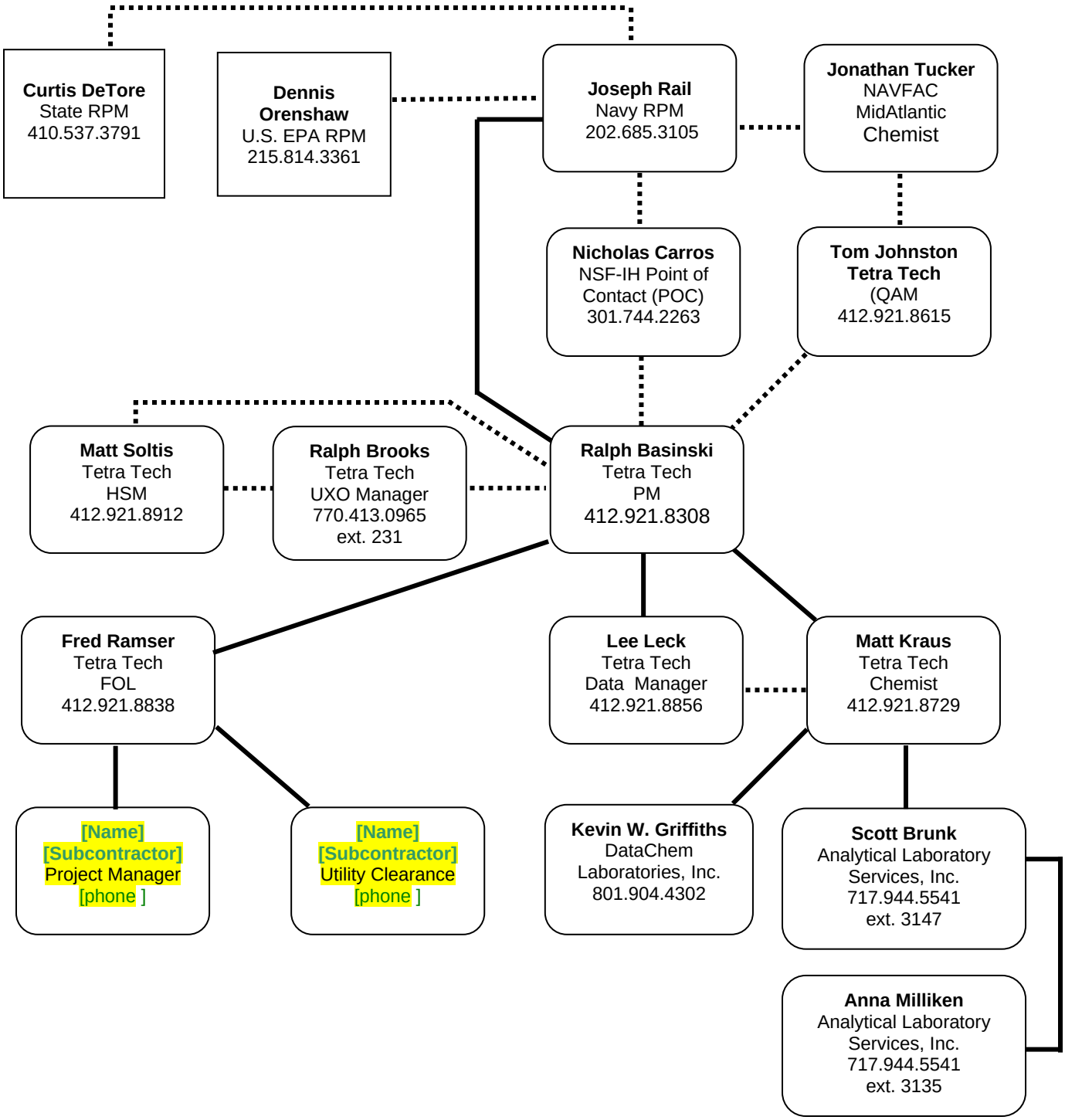
Subcontractor Personnel

Scott Brunk	Analytical Laboratory Services, Inc. (VP Corporate Operations)	717.944.5541 ext. 3147	sbrunk@analtyicallabs.com	WS #s 12, 14, 15, 19, 20, 23-28, 30, 34-37	
Anna Millken	Analytical Laboratory Services, Inc. (Operations Manager)	717.944.5541 ext. 3135	amilliken@analyticallabs.com	WS #s 12, 14, 15, 19, 20, 23-28, 30, 34-37	
Kevin W. Griffiths	DataChem Laboratories, Inc. (Project Manager)	801.904.4302	griffiths@datachem.com	WS #s 12, 14, 15, 19, 20, 23-28, 30, 34-37	
TBD	DPT (TBD) Supervisor	***TBD***	***TBD***		
TBD	Geophysical Contractor (TBD) Supervisor	***TBD***	***TBD***		

SAP Worksheet #5 -- Project Organizational Chart

(UFP-QAPP Manual Section 2.4.1)

Lines of Authority ——— Lines of Communication ·····



SAP Worksheet #6 -- Communication Pathways

(UFP-QAPP Manual Section 2.4.2)

Communication Driver	Responsible Affiliation	Name	Phone Number and/or E-Mail	Procedure
MEC Find	Tetra Tech Field Staff Tetra Tech UXO Staff Tetra Tech UXO Manager Tetra Tech PM Navy RPM Indian Head POC	TBD TBD Ralph Brooks Ralph Basinski Joe Rail Nicholas Carros	TBD TBD 770.413.0965 x 231 412.921.8308 202.685.3105 301.744.2263	Field staff will immediately inform Tetra Tech UXO Manager and Base POC. Tetra Tech UXO Manager will inform Tetra Tech PM on the same day. Base POC will immediately make Base emergency notifications Tetra Tech PM will inform Navy RPM on the same day. Navy RPM will inform Naval Ordnance Safety and Security Activity (NOSSA) on the same day as informed.
Field issues that require change in field tasks	Tetra Tech FOL Tetra Tech Project Geophysicist	Fred Ramser (MC issues) Jim Coffman (MEC issues)	412.921.8838 412.921.8244	The responsible person will verbally obtain approval from Tetra Tech PM on the same day that the issue is discovered and document any change via Field Task Modification Request (FTMR) form within 2 days.
QAPP amendments	Navy RPM	Joseph Rail	202.685.3105	Send scope change to Tetra Tech Program Management Office.
Fieldwork schedule changes	Tetra Tech PM	Ralph Basinski	412.921.8308	Verbally inform Navy on the day that the schedule change is known and if significant document via a schedule impact letter if fieldwork schedules will be impacted by greater than 2 weeks.

Communication Driver	Responsible Affiliation	Name	Phone Number and/or E-Mail	Procedure
Field issues that require changes in the scope or implementation of field work	Tetra Tech PM Tetra Tech FOL	Ralph Basinski Fred Ramser	412.921.8308 412.921.8838	FOL will inform Tetra Tech PM on the day that the issue is discovered, Tetra Tech PM will inform Navy RPM, Navy RPM will issue scope change, if warranted; scope change to be implemented before further work is executed.
Stop-work recommendations, for example, to protect workers from unsafe conditions or situations or to prevent a degradation in quality of work	Tetra Tech PM Tetra Tech FOL Tetra Tech Project Geophysicist Tetra Tech QAM Tetra Tech HSM Navy RPM	Ralph Basinski Fred Ramser Jim Coffman Tom Johnston Matt Soltis Joseph Rail	412.921.8308 412-921-8838 412.921.8244 412.921.8615 412.921.8912 202.685.3105	Responsible party will immediately inform subcontractors, Navy, and project team.
Field or laboratory data issues	Analytical Laboratory Chemist	Analytical Laboratory Services Inc. Scott Brunk or Anna Milliken Data Chem Laboratories Kevin Griffiths	717.944.5541 801.904.4302	The laboratory will notify Tetra Tech Project Chemist within 1 day of the time that issues related to chemical data are discovered.
Field or laboratory data issues	Tetra Tech Project Chemist	Matt Kraus	412.921.8729	Notify data validation staff and Tetra Tech PM if necessary within 1 day of the time that the issue is discovered.
Corrective action for field program	Tetra Tech QAM	Tom Johnston	412.921.8615	Notify Tetra Tech PM within 1 day that the corrective action has been completed. The PM will then notify the Navy RPM within 1 day.

NOSSA - Naval Ordnance Safety and Security Activity

SAP Worksheet #7 – Personnel Responsibilities and Qualification's Table

(UFP-QAPP Manual Section 2.4.3)

Name	Title/Role	Organizational Affiliation	Responsibilities	Education and/or Experience Qualifications (Optional)
John Trepanowski	Program Manager	Tetra Tech	Oversees CLEAN Program	M.S. Mining Engineering, B.S. Mining Engineering, 27 years of engineering experience
Ralph Basinski	Project Manager	Tetra Tech	Oversees project, financial, schedule, and technical day-to-day management of the project. • Ensures timely resolution of project-related technical, quality, and safety questions associated with Tetra Tech operations. • Functions as the primary Tetra Tech interface with the Navy RPM, NSF-IH, Tetra Tech field and office personnel, and laboratory points of contact. • Ensures that Tetra Tech health and safety issues related to this project are communicated effectively to all personnel and off-site laboratories. • Monitors and evaluates all Tetra Tech subcontractor performance. • Coordinates and oversees work performed by Tetra Tech field and office technical staff (including data validation, data interpretation, and report preparation). • Coordinates and oversees maintenance of all Tetra Tech project records. • Coordinates and oversees review of Tetra Tech project deliverables. • Prepares and issues final Tetra Tech deliverables to the Navy.	B.S. Chemistry, 30 years of environmental experience

Name	Title/Role	Organizational Affiliation	Responsibilities	Education and/or Experience Qualifications (Optional)
Ralph Brooks	UXO/MEC Manager	Tetra Tech	Oversees selection of qualified UXO personnel, establishes overall quality control program for UXO activities, addresses UXO-related issues identified by field personnel	Graduate of Navy Explosive Ordnance Disposal (EOD) School - Indian Head, 26 years of EOD experience
TBD	UXO Tech III	Tetra Tech	Provides anomaly avoidance services	Graduate, Military EOD School, 8 years of military experience
Fred Ramser	FOL, Lead Geologist, Site Safety Officer (SSO)	Tetra Tech	Supervises, coordinates, and performs field sampling activities • Ensures that all health and safety requirements unique to the SI are implemented. • Functions as the on-site communications link between field staff members, the SSO, NSF-IH, and Tetra Tech PM. • Alerts off-site analytical laboratories of any special health and safety hazards associated with environmental samples. • Oversees the mobilization and demobilization of all field equipment and subcontractors. • Coordinates and manages the field technical staff. • Adheres to the work schedules provided by the Tetra Tech PM. • Ensures the proper maintenance of site logbooks, field logbooks, and field recordkeeping. • Initiates field task modification requests (field change orders) when necessary. • Identifies and resolves problems in the field, resolves difficulties via consultation with the NSF-IH, implements and documents corrective action procedures, and provides communication between the field team and project management.	B.S. Geology, 15 years of geological experience

Name	Title/Role	Organizational Affiliation	Responsibilities	Education and/or Experience Qualifications (Optional)
Tom Johnston	QAM	Tetra Tech	Reviews QAPP, oversees preparation of lab scope, coordinates with lab, and data quality review. Ensures Quality aspects of the CLEAN program. • Develops, maintains, and monitors QA policies and procedures. • Provides training to Tetra Tech staff in QA/QC policies and procedures. • Conducts systems and performance audits to monitor compliance with environmental regulations, contractual requirements, QAPP requirements, and corporate policies and procedures. • Audits project records. • Monitors subcontractor quality controls and records. • Assists in the development of corrective action plans and ensures correction of non-conformances reported in internal or external audits. • Ensures that this SAP meets Tetra Tech, Navy, and MDE requirements. • Oversees the responsibilities of the Tetra Tech Project QA/QC Advisor. • Prepares QA reports for management.	PH.D Analytical Chemistry, 30 years environmental experience

Name	Title/Role	Organizational Affiliation	Responsibilities	Education and/or Experience Qualifications (Optional)
Matt Kraus	Project Chemist	Tetra Tech	Coordinates analyses with lab chemists, ensures the scope is followed, QA data packages, communicates with Tetra Tech staff. • Ensures that the project meets objectives from the standpoint of laboratory performance • Provides technical advice to the Tetra Tech team on matters of project chemistry. • Monitors and evaluates subcontractor laboratory performance. • Ensures timely resolution of laboratory-related technical, quality, or other issues affecting project goals. • Functions as the primary interface with the subcontracted laboratory and the tetra Tech PM. • Coordinates and oversees work performed by the subcontracted laboratory. • Oversees the completion of Tetra Tech data validation. • Coordinates and oversees review of laboratory deliverables. • Recommends appropriate laboratory corrective actions.	B.S. environmental Chemistry, 2 years environmental experience
Matt Soltis	HSM	Tetra Tech	Oversees CLEAN Program Health and Safety Program • Provides technical advice to the Tetra Tech PM on matters of health and safety. • Oversees the development and review of the Health and Safety Plan (HASP). • Conducts health and safety audits. • Prepares health and safety reports for management.	B.S. Industrial Safety Sciences, 24 years environmental experience

Name	Title/Role	Organizational Affiliation	Responsibilities	Education and/or Experience Qualifications (Optional)
Scott Brunk or Anna Milliken	Laboratory Management	Analytical Laboratory Services, Inc.	Coordinates analyses with lab chemist, ensures that scope is followed, QAs data packages, communicates with Tetra Tech staff	Can be provided upon request
Kevin W. Griffiths	Laboratory Project Manager	DataChem Laboratories, Inc.	Coordinates analyses with lab chemist, ensures that scope is followed, QAs data packages, communicates with Tetra Tech staff	Can be provided upon request
TBD	DPT/ Driller	Subcontractor	Soil boring and sampling, groundwater well installation and sampling	
TBD	Utility Location	Subcontractor	Utility location	

In some cases one person may be designated responsibilities for more than one position. For example, the FOL may also be responsible for SSO duties. This action will be performed only as credentials, experience, and availability permits.

Additional responsibilities are as follows:

Laboratory Responsibilities

The subcontracted laboratory for the SI is responsible for analyzing all samples in accordance with the analytical methods and additional requirements specified in this SAP. It will also be the analytical laboratory's responsibility to properly dispose of unused sample aliquots. Responsibilities of key laboratory personnel are outlined in the following paragraphs.

Laboratory Project Managers

The Laboratory PM will interface directly with the Tetra Tech Project Chemist, Tetra Tech PM, and Tetra Tech QA Manager and will perform the following tasks:

- Ensure that methods and project-specific requirements are properly communicated and understood by laboratory personnel.
- Ensure that all laboratory resources are available on an as-required basis.
- Ensure compliance with analytical and project QA requirements.
- Review data packages for completeness, clarity, and compliance with project requirements.
- Inform the Tetra Tech PM of project status and any sample receipt or analytical problems.
- Oversee the preparation of and approve final analytical reports before submittal to Tetra Tech.

Laboratory Operations Manager

Responsibilities of the Laboratory Operations Manager include the following:

- Supporting the QA program within the laboratory
- Providing management overview of both production- and quality-related laboratory activities
- Maintaining adequate staffing to meet project analytical and quality objectives
- Approving all laboratory SOPs and QA documents
- Supervising in-house chain-of-custody documentation

Laboratory Quality Assurance Officer

The Laboratory QA Officer (QAO) will report directly to the Laboratory Operations Manager and will be independent of laboratory production management to ensure that laboratory quality performance is assessed without schedule and cost considerations. Responsibilities of the Laboratory QAO include the following:

- Defining appropriate laboratory QA procedures and monitoring overall laboratory QA.
- Stopping work if a condition adverse to the quality of work is encountered, if QA or QC procedures are not followed, or if analytical out-of-control events are encountered that have not been corrected.
- Approving and maintaining document control of all QA documents and SOPs.
- Performing and/or implementing internal system and performance audits and verifying completion of corrective actions cited in audits.
- Directing laboratory participation in laboratory accreditation and certification programs.
- Reviewing overall data packages and case narratives for completeness according to project requirements and analytical methods.

Laboratory Sample Custodian

The Laboratory Sample Custodian will report to the Laboratory Operations Manager. Responsibilities of the Laboratory Sample Custodian include the following:

- Receiving and inspecting the incoming sample containers.
- Recording conditions of incoming sample containers.
- Signing appropriate documents.
- Verifying chain-of-custody records.
- Notifying the Laboratory PM of sample receipt and inspection.
- Assigning a unique identification number and customer number and entering each into the sample receiving log.
- With the help of the Laboratory PM, initiating transfer of the samples to appropriate laboratory sections.
- Controlling and monitoring access/storage of samples and extracts.

Laboratory Technical Staff

The laboratory technical staff will be responsible for sample analyses based on the analytical methods and requirements specified in this SAP.

Site QA/QC Advisor

The FOL (or designee) will act as the Site QA/QC Advisor and will be responsible for ensuring adherence to all QA/QC requirements as defined in this SAP. Strict adherence to these procedures is critical to the collection of acceptable and representative data. The following is a summary of the Site QA/QC Advisor's responsibilities:

- Ensuring that field QC samples are collected at the proper frequencies.
- Ensuring that additional volumes of sample are supplied to the analytical laboratory with the proper frequency to accommodate laboratory QA/QC analyses.
- Ensuring that measuring and test equipment are calibrated, used, and maintained in accordance with applicable procedures and technical standards.
- Acting as liaison between site personnel, laboratory personnel, and the QAM.
- Managing bottleware shipments and overseeing field preservation.
- Preparing a daily log of all work being performed.

Site Safety Officer (SSO). The SSO will be responsible for training and monitoring site conditions. The SSO reports to the Company Health and Safety Officer (CHSO) and indirectly to the FOL and Tetra Tech PM. Details of the SSO's responsibilities are presented in the HASP and include:

- Controlling specific health and safety-related field operations such as personnel decontamination, monitoring of worker heat or cold stress, and distribution of safety equipment.
- Conducting and documenting a daily health and safety briefing each day while on site.
- Assuring that field personnel comply with all procedures established in the HASP.
- Identifying assistant SSOs in his/her absence.
- Terminating work when an imminent safety hazard, emergency situation, or other potentially dangerous situation is encountered.
- Assuring the availability and the condition of health and safety monitoring equipment.
- Coordinating with FOL and PM to institute and document any necessary HASP modifications.
- Ensuring that facility personnel and subcontractors are adequately advised and kept clear of potentially contaminated materials.

SAP Worksheet #8 -- Special Personnel Training Requirements Table

(UFP-QAPP Manual Section 2.4.4)

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
Field Technicians	40-hour Hazardous Waste Operations (HAZWOPER) 8-hour HAZWOPER Refresher	Various	Current	UXO and field sampling personnel	All field staff/ Tetra Tech	Tetra Tech project office and field office
FOL	Same as field technician HAZWOPER requirements plus Supervisor Training	Various	Current	FOL	FOL/Tetra Tech	Tetra Tech project office and field office
Field Geophysics	Geophysical prove-outs and area-specific surveys for potential MEC	Trained personnel	Current	Geophysicist	Field Geophysicist/ Tetra Tech	Tetra Tech project office and field office
Health and Safety Officer	First Aid/Cardiopulmonary Resuscitation (CPR) Training	Red Cross	Current	Field Personnel	Tetra Tech	Tetra Tech project office and field office

All field personnel will have appropriate training to conduct the field activities to which they are assigned. Additionally, each site worker will be required to have completed a 40-hour course (and 8-hour refresher, if applicable) in health and safety training (HAZWOPER) as described under Occupational Safety and Health Administration (OSHA) 29 Code of Federal Regulations (CFR) 1910.120(b)(4).

The selected analytical laboratory will have successfully completed the laboratory evaluation process required as part of the Naval Facilities Engineering Service Center (NFESC) Quality Assurance Program and described in the DoD Quality Systems Manual (QSM), January 2006.

SAP Worksheet #9 -- Project Scoping Session Participants Sheet

(UFP-QAPP Manual Section 2.5.1)

Project Name: Stump Neck Annex SI Projected Date(s) of Sampling: May, 2009 Project Manager: Ralph Basinski	Site Name: Ten MEC MRP Sites at Stump Neck Annex SI Site Location: NSF-IH—Stump Neck Annex, Charles County, Maryland

Date of Session: November 7 to 9, 2007
Scoping Session Purpose: Develop CSM and DQOs

Name	Title	Affiliation	Phone Number	E-Mail Address	Project Role
Joseph Rail	Navy RPM	NAVFAC Washington	202. 685.3105	joseph.rail@ navy.mil	Navy NAVFAC project management
Shawn Jorgensen	NSF-IH RPM	NSF-IH	301. 744.2263	shawn.a. jorgensen@ navy.mil	NSF-IH facility project management
Ralph Basinski	Project Manager	Tetra Tech	412. 921.8308	ralph.basinski@ tetratech.com	Tetra Tech project management
Ralph Brooks	UXO Manager	Tetra Tech	706. 224.4690	ralph.brooks@ tetratech.com	UXO support
Jim Coffman	Geophysicist	Tetra Tech	412. 921.8244	jim.coffman@ tetratech.com	On-site geophysics measurements
Rick Barringer	Technical Lead	Tetra Tech	412. 921.8524	rick.barringer@ tetratech.com	Technical support
George Latulippe	Site Technical Lead	Tetra Tech	N/A	Retired from Tetra Tech	Technical/ coordination support

November 7-9, 2007 Meeting Notes

The November 7 – 9, 2007 scoping session addressed 16 sites at IH-Stump Neck Annex. Ten MEC sites (UXO-01, UXO-02, UXO-04, UXO-05, UXO-10, UXO-12, UXO-21, UXO-23, UXO-26, UXO-28) are addressed in this SAP. Information relevant to these sites is included in this worksheet. The full meeting minutes area available in the project file.

IH-Stump Neck Annex MRP Site Locations	General Notes
A. Advanced IED Area (UXO-5)	• Use UXO detector-aided survey to reconnoiter the site. Additionally, focus a UXO detector-aided survey near the concrete structure and MRP site berms with 100% coverage. • Use 100% geophysics survey coverage on the berms surrounding the cleared area (next to the concrete structure). • Need for vegetation removal (grass mowing and some limited underbrush removal in forested portions) to support geophysical survey and sample collection efforts. • Selected subsurface sampling for MECs with anomaly avoidance to supplement existing site data. • Munitions items observed at subgrade concrete structure suspected to be inert training items; however, an ESS may be required due to potential munitions hazards or scrap munitions, detonation cord, fuzes, igniters, etc. at this site. • Removal of non-MEC scrap materials? • Use of facility EOD to perform removals?
B. Basic IED Area (UXO-4)	• No recommended geophysics approach here. UXO detector-aided survey is recommended to reconnoiter the range. Focus survey with smaller transect spacing around the detonation area • Need for vegetation removal (grass mowing and some limited underbrush removal in forested portions) to support detector-aided survey actions and sample collection. • Selected subsurface sampling to supplement existing environmental data. • Uses a similar approach to that proposed for the Advanced Improvised Explosive Device (IED) Area.
C. EOD School Demolition Area (UXO-28)	• No recommended geophysics here. Use UXO detector-aided survey to focus small transect spacing around concrete structure and a coarser transect spacing to reconnoiter the rest of the site (5 acres). • Need for vegetation removal (grass mowing and limited underbrush removal-forest portions) to support surface sweep activities and soil sampling performance. • Selected subsurface sampling of munitions constituents (MCs) with anomaly avoidance to supplement existing environmental data.

IH-Stump Neck Annex MRP Site Locations	General Notes
D. Torpedo Burial Site (UXO-12)	• Use geophysics survey with 5 ft line spacing to allow coverage for large targets across the site (site grew from inventory to now being about 1.75 acres in area). • Need for vegetation (underbrush) removal to support geophysical grid performance. • Looking for shallow burial pits with metallic torpedoes at this site, so the geophysical signal should be very evident. • Selected subsurface sampling for MECs with anomaly avoidance.
E. Stump Neck Impact Area (UXO-10)	• Use geophysics survey on transects to reconnoiter the accessible land portions of the site while the ground is frozen (perhaps about 6-8 acres of survey area might be accessible). Investigation depth for individual targets is limited to about top 4 feet. • Historical records also indicate possible EOD training activities in this area. • Munitions impact penetration depths are 4 to 12 feet below ground surface (bgs). • Need for vegetation (underbrush) removal (or perhaps just stomping it down) to support geophysical grid performance. • There may be limitations on wetlands vegetation clearance within this MRP site. • Selected subsurface sampling for munitions and explosives of concern (MECs) with anomaly avoidance.
F. Air Blast Pond (UXO-1)	• Metallic debris is a problem at this site both inside and outside the Air Blast Pond. • A 57mm projectile (expended) was recovered at this site (on the berm). • Use of a geophysics survey to perform site footprint reduction will require extensive work to remove metallic interference. • Operations included testing and detonation of bulk explosives (TNT, PETN, HBX-1, HBX-2, H-6, C4, and Composition B). • Based on the materials observed outside, but adjacent to the Air Blast Pond, there may have been other training activities performed at this site. There are multiple drums, pipe sections, solid metallic training items, and other debris outside the berms of the Air Blast Pond. Items may remain on the pond bottom • Limited soil sampling during the Visual Inspection (VI) for soil (surface and subsurface) inside and outside the pond and sediment outside the Air Blast Pond confirmed no detectable explosives. • Selected surface/subsurface sampling (explosives) to supplement existing environmental data.

IH-Stump Neck Annex MRP Site Locations	General Notes
G. Area 8 (UXO-2)	• Need to supplement VI environmental data. Operations included Trinitrotoluene (TNT) blocks, detonation cord, fuzes, etc. Inert training items may remain on the pond bottom. • Perform detector-aided general surface sweep within 25 feet of inert training device locations (which were connected to shot points) to identify any remaining training materials at site. • Selected subsurface sampling for explosives with anomaly avoidance. • As a part of regular maintenance for water shot-points, the holes may have been periodically re-excavated and materials from the bottom of the hole and redeposited on the hole margins. • Three groundwater wells are located at this site. Is there a need for additional groundwater sampling points or is it adequate to use existing wells for groundwater sampling? • Groundwater samples to be evaluated for explosives/perchlorate (confirmatory sampling)? • Selected soil sampling to supplement existing environmental data (confirmatory sampling).
H. Test Area 1 (UXO-21)	• Selected subsurface sampling to supplement existing environmental data. Emphasis is to perform site footprint reduction. • Perform visual inspection of the antenna bowl. Geophysics sweep of bowl not possible due to iron mesh reinforcement in asphalt materials. • A 100-percent detector-aided surface sweep is recommended for the MRP Site area outside the bowl. • The southeastern corner of the site appears to have been the site of some explosive training activities. • Proposed sampling will include sampling for explosives and lead (lead linear-shaped charges) at selected locations in soil and sediment. • Soil samples/sediment samples to be field-screened using x-ray fluorescence (XRF) instrumentation to identify lead concentrations. • Lead is the marker compound (due to linear shaped charges). Need to obtain a reference concentration–either health-based or risk-based for lead in soil to screen samples against. • Sampling points may be based on grid sampling or Multi-Increment Samples (MIS) techniques. • Sampling may include a sediment sample from the drainage grate at the base of the bowl antenna.

IH-Stump Neck Annex MRP Site Locations	General Notes
I. The Valley Impact Area (UXO-26)	• Subdivide The Valley Impact Fan Area into general categories √ Developed Areas (to be excluded) √ Undeveloped Areas √ Open Accessible Areas √ Inaccessible Areas (swamp/wetlands, also to be excluded) • Use geophysics surveys with variable transect spacings determined by the size of the survey areas (small sites – small transect spacing, larger sites – larger transect spacing) to reconnoiter the accessible undeveloped areas of the Valley Impact Area. Question raised as to whether Valley Impacts were ever discovered within the developed areas (Action Item – determine if there is a problem related to these old impacts?) • Historical records and observed munitions fragments and debris at Stump Neck Point (end of peninsula) also indicate EOD training activities (i.e., Range 6) within this area. • Munitions impact penetration depths may extend to a depth of 47 feet below ground surface for the largest munitions (16-inch projectiles). • Need for vegetation (underbrush) removal (or perhaps just stomping it down) to support geophysical grid performance. • There may be access limitations on wetlands vegetation clearance within this MRP site. • Selected subsurface sampling for MECs with anomaly avoidance.
J. Torpedo Casing Disposal Area (UXO-23)	• Use geophysics survey (10-foot line spacing) to search for disposal areas (areas with high metal content (torpedoes)). • Need for vegetation (underbrush) removal to support geophysical grid performance. • Looking for shallow burial pits with metallic torpedo casings at this site, so the geophysical signal should be very evident. • Subsurface anomalies (potential disposal pits) will be included in the selected subsurface soil sampling for munitions and explosives of concern (as residual MEC casing materials) with anomaly avoidance.

Date of Session: December 18 and 19, 2007
Scoping Session Purpose: Develop CSM and DQOs

Name	Title	Affiliation	Phone Number	E-Mail Address	Project Role
Joseph Rail	Navy RPM	NAVFAC Washington	202. 685.3105	joseph.rail@ navy.mil	Navy NAVFAC project management
Curtis DeTore	State RPM	MDE	410. 537.3791	cdetore@mde. state.md.us	Regulatory
Dennis Orenshaw	U.S. EPA Region 3 RPM	U.S. EPA Region 3	215. 814.3361	orenshaw. dennis@epa.gov	Regulatory
Ralph Basinski	PM	Tetra Tech	412. 921.8308	ralph.basinski@ tetratech.com	Tetra Tech project management
Ralph Brooks	UXO Manager	Tetra Tech	706.224. 4680	ralph.brooks@ tetratech.com	UXO support
Jim Coffman	Geophysicist	Tetra Tech	412. 921.8244	jim.coffman@ tetratech.com	Project geophysicist
Rick Barringer	Technical Lead	Tetra Tech	412. 921.8524	rick.barringer@ tetratech.com	Technical support
George Latulippe	Site Technical Lead	Tetra Tech	N/A	Retired from Tetra Tech	Technical/ coordination support

December 18 and 19, 2007 Meeting Notes

The sixteen MRP sites were toured over the period of two days. The planning team agreed that, due to the number of sites (16) and complexity of the UFP SAP, additional meetings would be necessary. The agreement was made that the small arms ranges would be addressed separately from the MEC sites and that two UFP SAPs would be prepared.

The planning team approved the general approach for the five small arms/skeet ranges, which was described in the November 7-9, 2007 meeting notes.

Preparation of a technical memorandum for No Action at Test Area 2 (UXO-22) was approved on the basis that Test Area 2 was never used.

A planning meeting was scheduled for January 28 and 29 in the MDE headquarters in Baltimore, MD for the 10 MEC sites.

Date of Session: January 28 and 29, 2008
Scoping Session Purpose: Develop CSM and DQOs

Name	Title	Affiliation	Phone #	E-mail Address	Project Role
Joseph Rail	Navy RPM	NAVFAC Washington	202. 685.3105	joseph.rail@ navy.mil	Navy NAVFAC project management
Curtis DeTore	State RPM	MDE	410. 537.3791	cdetore@mde. state.md.us	Regulatory
Dennis Orenshaw	U.S. EPA Region 3 RPM	U.S. EPA Region 3	215. 814.3361	orenshaw. dennis@epa.gov	Regulatory
Ralph Basinski	PM	Tetra Tech	412. 921.8308	ralph.basinski@ tetratech.com	Tetra Tech project management
Ralph Brooks	UXO Manager	Tetra Tech	706. 224.4680	ralph.brooks@ tetratech.com	UXO support
Jim Coffman	Geophysicist	Tetra Tech	412. 921.8244	jim.coffman@ tetratech.com	Project geophysicist
Rick Barringer	Technical Lead	Tetra Tech	412. 921.8524	rick.barringer@ tetratech.com	Technical support

January 28-29, 2008 Meeting Notes

Ten MEC MRP sites at IH-Stump Neck Annex, as listed below, were the principal focus of this scoping meeting.

- Air Blast Pond, UXO-01
- Area 8, UXO-02
- EOD School Demolition Area, UXO-28
- Basic IED Area, UXO-04
- Advanced IED Area, UXO-05
- Stump Neck Impact Area, UXO-10
- Test Area 1, UXO-21
- The Valley Impact Area, UXO-26

- Torpedo Burial Site, UXO-12
- Torpedo Casing Disposal Area, UXO-23

Ten MEC MRP sites are proposed for investigation in an SI. The goals of the SI Program for the MEC sites are:

- Evaluate if historical information supports whether site was an artillery impact range or whether explosives may have been used for training or demonstrational purposes (MEC).

- Perform area UXO surface sweep as site conditions require, and then execute geophysical survey to assess the area.

- Determine whether explosives or other contaminants MCs are present within the study area in quantities or concentrations that would require the Navy to proceed to an Remedial Investigation/Feasibility Study (RI/FS).

- Determine whether MC or other contaminants are present within the study area in quantities or concentrations that require an immediate response. If such quantities or concentration are present, then initiate an appropriate response. If no imminently hazardous MCs or other contaminants are present, then take no immediate action.

The 10 MEC MRP sites that will be investigated in the SI are addressed in this SAP. Site-specific background information was reviewed during the meeting and the general technical approach for the site investigations were developed as follows:

Air Blast Pond, UXO-01

<u>Background</u>

- Documented usage of bulk explosive testing during 1955-1975 using a circular aboveground impoundment filled with water.

- An estimated 1,500 explosive shots performed over 20 years of use.

- Air Blast Pond has been drained.

- There is evidence that other activities not related to the Air Blast Pond operations may have been conducted immediately outside the pond (based on site walks).

- Metallic debris is a problem at this site both inside and outside the Air Blast Pond.

- A 57mm projectile (expended) was recovered at this tie (on the berm).

- Based on the materials observed outside, but adjacent to the Air Blast Pond, there may have been other training activities performed at this site. There are multiple drums, pipe sections, solid metallic training items, and other debris outside the berms of the Air Blast Pond.

Technical Approach

- Use of a geophysics survey to perform site footprint reduction will require extensive work to remove metallic interference.

- Selected surface/subsurface sampling (explosives) to supplement existing environmental data.

- Determine the presence and concentrations of mujnitons constituents (MCs) in the environment (surface soils, subsurface soil, surface water, sediments).

- Limited soil sampling during the VI for soil (surface and subsurface) inside and outside the pond and sediment outside the Air Blast Pond confirmed no detectable explosives.

Area 8, UXO-02

Background

- The explosives used in Area 8 for training purposes may have included RDX, TNT, and PETN during 1957 - 1999.

- The design of the explosive shot locations (less than 0.5 pounds each) were configured to contain most of the detonation products; however the detonation shot operations may have produced a localized spray of detonated explosives (MC) in the immediate vicinity of the shot point during the training and resultant detonation activities.

Technical Approach

- Delineate suspect MEC on the surface, and qualify the amount of near surface suspect ferrous MEC across the accessible portions of selected water shot cluster areas. Locate subsurface anomalies that could possibly represent MEC at selected anomaly clusters detected by the UXO detector-aided sweep. Locate anomalies that could possibly represent MEC (if present) in the existing pond that was used for training exercises.

- The scope of geophysical activities at Area 8 is summarized as a UXO detector-aided surface sweep of the areas encompassing the water shot locations.

- Sonar survey of the pond to search for inert training devices discarded at the bottom of the pond.

- Possible geophysical survey across selected cluster anomalies detected by the UXO sweep (as deemed necessary).

- Use geophysics survey techniques (primarily transects) to reconnoiter the accessible land portions of the sites and confirm the presence of training devices to identify potential former training areas based on locations of subsurface anomalies.

- Determine the presence and concentrations of MCs in the environment (surface soils, subsurface soil, surface water, sediments) in the local environment.

EOD School Demolition Area, UXO-28

Background

- The explosives used at the EOD School Demo Area for training and demonstration purposes may have included RDX, TNT, Tetryl, and PETN during 1944 - 1949.

- After the basic demonstrations, EOD students completed exercises using cap blasters, blasting TNT blocks, shearing rails and trees, creating blow holes in the ground, and splitting live bombs by using shaped charges.

Technical Approach

- The plan for obtaining data at the EOD School Demolition Area is a UXO detector-aided surface sweep providing 100 percent coverage across a 100- by 200- foot grid surrounding the hut.

- A sweep with 50-foot spaced transects for the remainder of the 5 acres of the site (boundary as established in PA Report).

- Use geophysics survey techniques (primarily transects) to reconnoiter the accessible land portions of the sites and confirm the presence of training devices to identify potential former training areas based on locations of subsurface anomalies.

- Determine the presence and concentrations of munitions constituents (MCs) in the environment (surface soils, subsurface soil, surface water, sediments) in the local environment.

Basic IED Area, UXO-04

Background

- The Basic IED Area was used for demonstration and testing purposes on a variety of explosive devices and chemicals for a period of approximately 40 years (1957 – 1996).

- Munitions used at this location included small arms, bulk high explosives, demolition charges, primers, detonators, fuzes, and squibs.

- The 1996 VI report indicated that explosives during that period were used at a rate of about 10 pounds net explosive weight (NEW) per year.

Technical Approach

- The plan for obtaining data at the Basic IED Area is a UXO detector-aided surface sweep providing 100 percent coverage across an 80 by 150 foot grid surrounding the demolition area.

- There will be a sweep with 30-foot spaced transects for the remainder of the 3.8 acres site (boundary as established in PA Report).

- Use geophysics survey techniques (primarily transects) to reconnoiter the accessible land portions of the sites and confirm the presence of training devices to identify potential former training areas based on locations of subsurface anomalies.

- Determine the presence and concentrations of MCs in the environment (surface soils, subsurface soil, surface water, sediments) in the local environment.

Advanced IED Area, UXO-05

Background

- Advanced IED Area includes SWMU # 27, which was used by the EOD School for training and to dispose of inert ordnance items and training aids (1953 -1995).

- Advanced IED Area activities included training on dropped munitions, fuze stripping, tools/methods, explosive analysis, X-ray (baltographic) Polaroid analysis, and evaluation of accidents related to dropped munitions.

- The PA report indicated that TNT (quarter- to half-pound) charges (most likely military dynamite – 75 percent RDX, 15 percent TNT, and 10 percent desensitizers and plasticizers) with detonation cord were used as training aids.

- At this time, SWMU #27 contains a subgrade concrete bunker that contained a variety of submunitions, practice rockets, snake eye fin tubes, bomb fuzes, and random munitions debris, all believed to be inert.

Technical Approach

- Delineate the surface and near surface (ferrous) distribution of suspect MEC across the accessible portions of a 200-foot grid surrounding the concrete foundation that contains visible suspect MEC. Locate suspect MEC on the surface, and qualify the amount of near surface suspect ferrous MEC in a reconnaissance level survey across the remainder of the site (about 10 acres). Delineate the subsurface distribution and extent of detectable suspect MEC across the accessible portions of the berm and open area surrounded by it.

- Determine whether MEC are present within the study area that require an immediate response. If so, initiate the appropriate response; otherwise, take no immediate action.

- UXO detector-aided surface sweep providing 100 percent coverage across a 200-foot grid surrounding the concrete foundation (SWMU #27) and a sweep with 50-foot spaced transects for the remainder of the 10-acre site (boundary as established in PA Report).

- Geophysical survey of cleared area and surrounding berm with no greater than a planned 5-foot survey line spacing

- Use geophysics survey techniques (primarily transects) to reconnoiter the accessible portion of the sites and confirm presence of training devices to identify former training areas based on locations of subsurface anomalies.

- Determine the presence and concentrations of munitions constituents (MCs) in the environment (surface soils, subsurface soil, surface water, sediments) in the local environment.

Stump Neck Impact Area, UXO-10

Background

- The Stump Neck Impact Area was used as a long-range Naval gunnery target from the early 1890s through early 1920s and was used for similar activities sporadically through the 1930s and 1940s. Certain sources indicate that rockets may have been fired into the Impact Area through 1947, and the range has been used for a variety of other training activities including land surface demolition testing and underwater testing prior to the construction of the Area 8 pond in 1957.

- There is no physical evidence of MEC/MC observed at the site, and no MCs were observed during the visual survey. However, based on information obtained during the data collection process, MEC is suspected for the Stump Neck Impact Area.

- Munitions constituents contained in the 75mm, 37mm, and 155mm projectiles include TNT, HMX, Composition B, Composition D, and perchlorate.

Technical Approach

- Determine surface and subsurface anomaly locations that could possibly represent MEC across the accessible portions of survey transects. The purpose of this SI approach will be to provide some reconnaissance level data as to the quantity of potential MEC within about the top 2 to 6 feet depending on the target metal mass and diameter which determine its maximum detection depth (larger items can be detected deeper than shallow ones). The survey area is marshy and aquatic, and MEC are not anticipated to be very near surface (expected maximum penetration depths range from 4 to 12 feet, thereby making some potential MEC too deep to detect by the survey).

- The scope of geophysical activities at the Stump Neck Impact Area includes UXO detector-aided surface sweep of the geophysical survey area.

- Geophysical survey across accessible portions of the site using a planned 50-foot transect spacing.

- Use geophysics survey techniques (primarily transects) to reconnoiter the accessible land portions of the sites and confirm the presence of training devices to identify potential former training areas based on locations of subsurface anomalies.

- Determine the presence and concentrations of MCs in the environment (surface soils, subsurface soil, surface water, sediments).

Test Area 1, UXO-21

Background

- Test Area 1 consists of approximately 4.5 acres of land in the middle of the Stump Neck Annex peninsula. This area was used in the 1950s for the construction of a 220-foot by 263-foot “hole-in-the-ground” antenna at the range used in pioneer moon relay communication experiments. The antenna portion of Test Area 1 is now wooded and overgrown with hardwood forest vegetation.

- Test Area 1 was used in the 1960s and 1970s for the Advances, Access, and Disablement, (AA&D) trainings, (including booby traps and trip wires). Subsequent training topics in the 1980s included IED and Improvised Nuclear Device (IND). As explained for other IED training activities, the actual training item devices were inert, but were connected to working components that would set off small (quarter pound blocks of TNT) located a short distance from the training item.

Technical Approach

- The plan for obtaining data at Test Area 1 is summarized as a UXO detector-aided surface sweep providing 100 percent coverage across the accessible portions of the 4.5 acre site (boundary as established in PA report) for those areas outside of the actual antenna “bowl” area.

- Use geophysics survey techniques (primarily transects) to reconnoiter the accessible land portions of the sites and confirm the presence of training devices to identify potential former training areas based on locations of subsurface anomalies.

- Determine the presence and concentrations of MCs in the environment (surface soils, subsurface soil, surface water, sediments).

The Valley Impact Area, UXO-26

Background

- The Valley Impact Area on Stump Neck Annex was used as a long-range Naval gunnery target by the Indian Head Main Installation (between the Potomac River and Mattawoman Creek to the northeast) from the early 1890s through early 1920s. The Valley is a 21-acre site located on the Indian Head main installation that was used for developing and testing numerous ordnance items from 1891 through 1921. According to historical documentation, practically all forms of Naval ordnance used from the 1890s until the 1920s (4-inch through 16-inch) were tested and/or developed at The Valley and fired onto The Valley Impact Area.

- The shells fired onto The Valley Impact Area contained different types of explosive fillers including black powder, smokeless powder, brown prismatic powders, emmensite, joveite, wet gun cotton, randite, and other high explosives, (e.g., Thorite). The explosives used at the EOD School Demo Area for training and demonstration purposes may have included RDX, TNT, Tetryl, and PETN during 1944 - 1949.

Technical Approach

- Use geophysics survey techniques (primarily transects) to reconnoiter the accessible land portions of the sites and confirm the presence of training devices to identify potential former training areas based on locations of subsurface anomalies.

- Determine presence/concentrations of MCs in the environment (surface soils, subsurface soil, surface water, sediments).

Torpedo Burial Site, UXO-12

Background

- The Torpedo Burial Site consists of a semi-circular shaped parcel, measuring approximately 1 acre in area, in the northern portion of Stump Neck Annex facility, although it is uncertain whether 15-foot long torpedoes were actually buried at this location.

- According to available reports, the site consists of at least one unlined earthen pit used to bury waste material, including torpedoes, primers, detonators, fuzes, squibs, and other associated hardware transported from a torpedo station near Washington, D.C. in the late 1940s or early 1950s. The entire Torpedo Burial Site is considered a suspect MEC area, with the 21-inch torpedo casing discovered during the visual survey as the only known MEC area.

- Potential MC at the site (based on the possible presence of torpedoes and their components) include TNT, RDX, Composition A, Composition B, Composition C, Torpex, PETN, dynamite, nitrocellulose, cordite, perchlorate.

Technical Approach

- UXO detector-aided surface sweep of the geophysical survey area.

- Geophysical survey across accessible portions of the site using a planned 5-foot survey line spacing.

- Use geophysics survey techniques (primarily transects) to reconnoiter the accessible land portions of the sites and confirm the presence of training devices to identify potential former training areas based on locations of subsurface anomalies.

- Determine presence/concentrations of MCs in the environment (surface soils, subsurface soil, surface water, sediments).

- Torpedo parts are visible at the surface, and additional torpedoes or parts of torpedoes may be present. Determine whether additional surface or subsurface anomalies that could possibly represent large MEC items are present across the accessible portions of the site (about 1.75 acres), and if present, locate them.

Torpedo Casing Disposal Area, UXO-23

Background

- The Torpedo Casing Disposal Area consists of a rectangular-shaped parcel, measuring approximately three-quarters of an acre in area, within the northern portion of the Stump Neck Annex facility. Navy personnel indicate that the area was used as a disposal site for torpedo casings during the 1950s, although the exact dates of use are unknown. A portion of the Torpedo Casing Disposal Area is within a designated wildlife area, while the rest of the site is located within a heavily forested area that is unused and not maintained.

- The entire Torpedo Casing Disposal Area is not suspected to contain MEC, since only torpedo casings with no explosive components were reportedly buried in the area.

- MC contamination derived from the Torpedo Casing Disposal Area may potentially migrate within the soil, surface water runoff, or groundwater.

Technical Approach

- Determine subsurface anomaly locations that could possibly represent large MEC disposal areas for torpedoes or other large MEC items across the accessible portions of the site (about 3/4 acres).

- The plan for obtaining data at the Torpedo Casing Disposal Area is a UXO detector-aided surface sweep of the geophysical survey area.

- Geophysical survey across accessible portions of the site using a planned 10-foot survey line spacing.

- Use geophysics survey techniques (primarily transects) to reconnoiter the accessible land portions of the sites and confirm the presence of training devices to identify potential former training areas based on locations of subsurface anomalies.

- Determine the presence and concentrations of MCs in the environment (surface soils, subsurface soil, surface water, sediments).

Date of Session: February 11, 2008
Scoping Session Purpose: Site Walk

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February 11, 2008 Meeting Notes

A site walk, performed on February 11, 2008, was attended by the Tetra Tech Project Manager, the UXO Manager, and the FOL. The objectives of the site walk were as follows:

- Familiarize the FOL with the sites.
- Develop coordination activities between the UXO Manager and the FOL.

Participants also identified and reviewed logistical considerations of the field investigation including:

- Site access.
- Sequencing of surface clearance, geophysical investigation, and MC sampling activities.
- Navy restrictions on working.
- Vegetation clearing requirements.
- Coordination of MEC investigation and MC sampling activities.

Date of Session: May 14, 2008
Scoping Session Purpose: DQO Discussion

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May 14, 2008 Planning Meeting Minutes

The meeting started with a brief discussion of technical review comments provided by the Navy Chemist in the review of the SAP-QAPP for the small arms ranges at Indian Head-Stump Neck Annex. The rest of the meeting consisted of a general briefing and site-by-site discussion of problem statements, data quality objectives, and detailed technical approaches to collect, evaluate, and present the information necessary to support key site management decisions for individual MEC MRP sites. Tom Johnston (Tetra Tech QA Manager) also provided a brief discussion on technical approaches for UFP-QAPPs, recently received review comments, and the need to document team decisions and consensus decisions.

Comments/Decisions:

The SI is geared to provide the Navy some indication of what actions may be required for future land use at the various MRP sites. Land use controls may be required for certain MRP sites. Without a known or estimated impact to human health and the environment, there may be no compelling reason to do anything other than establish land use controls (institutional controls) for specific parcels or areas.

The term surface soil will refer to the 0- to 6-inch depth below the root zone. Subsurface soil, when collected, will be from depths of 2 to 4 feet and 4 to 6 feet, unless there are other depth-specific detected odors or visible staining that require modified soil depth sampling in the soil cores.

For groundwater samples, both total and dissolved metals will be analyzed for to determine the potential influence of suspended particulates on metals concentrations in groundwater.

Area 8—focus sampling on shot locations – surface soil from air-shot locations and sediment from about half the water-shot locations (both from the hole bottom and from the area around the hole perimeter).

Basic IED Area—consider evaluating groundwater and subsurface soil for Volatile Organic Compounds (VOCs) instead of limiting analyses to gasoline range organics. VOCs in surface soil have most likely volatilized since the site was last used.

Test Area 1—Multi-increment (MI) type surface soil sampling to be performed outside the “bowl” at the site.

Action Items:

Performance of MI sampling may use “wagon wheel” approach with a central “hub” sample and six or more “spoke” samples in a wheel-like pattern. There was some discussion on the length of the “spoke” segments from the hub, and Ralph Basinski stated that he would investigate the matter to develop a defensible and representative sampling protocol to address the size of the decision area.

Laboratory procurement must be completed to identify a laboratory that is qualified to perform SW-846 Method 8330B for explosives. Tetra Tech will sponsor a qualified laboratory to receive certification from the Navy.

Consensus Decisions:

Where appropriate, solid matrix environmental samples will be collected using a multi-increment sampling method. After drying, mixing, and sieving of the composited sample material to be analyzed, a sample aliquot will be removed for metals analysis (prior to grinding of the sample). This process will avoid the potential for biasing metals analyses with the reduced particle size and the increased total surface area that is available for leaching in metals analysis. The sample portion to be analyzed for explosives via SW-846 Method 8330B will be ground to the required size for this method.

SAP Worksheet #10 -- Problem Definition, Site History and Background

(UFP-QAPP Manual Section 2.5.2)

A detailed CSM is presented in Appendix B for each of the 10 MEC sites located at the NSF-IH - Stump Neck Annex. A CSM is a description of a site and its environment that is based on existing knowledge. It describes the sources of MEC at a site; actual, potentially complete, and incomplete exposure pathways; current and proposed reasonable future uses of the property; and potential receptors. The source-receptor interaction is a descriptive output of a CSM.

The initial CSMs were developed as part of the PA Report (Malcolm Pirnie, 2005), which is one of the initial steps in the CERCLA process. The CSMs, which were presented in the PA Report, have been reviewed and modified as necessary based on additional information obtained during the Tetra Tech site visits and scoping meetings conducted during the preparation of this UFP SAP for the SI. The CSMs for each of the sites will be updated as additional information is obtained. Updated versions of the CSMs, which incorporate data obtained in the SI field effort, will be presented in the report prepared after all SI fieldwork is completed.

This introductory section includes general information on the site background and facility history. A brief summary of the Problem Definition for each of the 10 sites addressed in this UFP SAP has been prepared and is presented here (Worksheets 10.1 through 10.10). Appendix B includes general descriptions of the geology, hydrology, endangered species, cultural settings, and natural resources on an installation-wide basis at the Stump Neck Annex as well as a detailed Problem Definition for each of the 10 MEC sites in terms of the site-specific CSM. The site–specific CSMs contain, in detail, the initial step (Step 1) of the DQO process, with site-specific maps for each site.

10-1 GENERAL INTRODUCTION FOR WORKSHEET #10

The Navy has conducted various testing, training, and disposal activities related to military munitions at the Stump Neck Annex, NSF-IH, Maryland, since it was established in 1890 as a Naval Ordnance Station. The general locations of the NSF-IH Main Installation and Stump Neck Annex are shown on Map 10-1 in Appendix B. NSF-IH is located in northwestern Charles County, Maryland, approximately 25 miles southwest of Washington, D.C. The Stump Neck Annex covers approximately 1,100 acres on the Stump Neck peninsula at the confluence of the Potomac River and Chicamuxen Creek in Charles County, Maryland. Stump Neck Annex was acquired by the Navy in 1901 to support activities at the 2,300-acre Indian Head Main Installation. These two Navy properties are not contiguous; the Indian Head Main Installation is northeast of the Stump Neck Annex across Mattawoman Creek. General Smallwood State

Park and private property parcels are located east and southeast, respectively, of Stump Neck Annex, and the Chicamuxen Wildlife Management Area (WMA) is to the south across Chicamuxen Creek.

The Valley Impact Area and Stump Neck Impact Area are both located on the Stump Neck Annex (Map 10-2 in Appendix B). These two areas received fire from the Valley Gun Proving Site located on the Main Installation of NSF-IH from 1891 through 1921. Various caliber guns (4-inch through 16-inch) were fired into these two areas. The projected firing fan from the Main Installation to the impact areas covers several of the sites discussed in this UFP SAP. In addition to fire from the gun proving site, the Stump Neck Impact Area received impacts from a firing range set up in the vicinity of Rum Point. Marine Corps Base (MCB) Quantico was also permitted to fire large artillery at the Stump Neck Annex for several years until 1934.

As a result of the Navy's explosives and munitions training activities, MEC may be present at various sties throughout the Stump Neck Annex. The term MEC includes DMM, UXO, and MC in high enough concentrations to pose an explosive hazard. This UFP SAP will cover the 10 sites presented in Table 10-1. A separate UFP SAP has been prepared to investigate five small arms ranges located on the Stump Neck Annex. The Navy is following the CERCLA process for the investigation of these sites.

The initial phase of the CERCLA process, the PA Report, was completed in September 2005 and identified 17 "other than operational range sites" or MRA/Ss at the Stump Neck Annex for further investigation (Malcolm Pirnie, 2005). Closed, transferred, and transferring military ranges and sites not located on an operational range are considered "other than operational." Two of the sites identified in the PA Report, the Old Demolition Area and Test Area 2, are considered to be currently active sites and are therefore not included in this UFP SAP.

The locations of the 10 sites presented in this UFP SAP are shown on Map 10-3 in Appendix B. The Malcolm Pirnie (2005) PA Report used five primary sources of information to support the facility data collection effort, including historical archives, personal interviews, installation data repositories [including the Administrative Record (AR)], visual surveys, and off-facility data sources and repositories such as local libraries and museums. Table 10-1 summarizes the 10 sites at the Stump Neck Annex that are further discussed in this UFP SAP.

TABLE 10-1

**SUMMARY OF OTHER THAN OPERATIONAL RANGES
NAVAL SUPPORT FACILITY INDIAN HEAD
INDIAN HEAD, MARYLAND**

Site Name	Site No.	Size (acres)(1)	Purpose	Dates of Use
Air Blast Pond	UXO 01	3.72	Testing of bulk explosives	1955-1975
Area 8	UXO 02	22.61	Training on and defusing of explosive devices	1957-1999
EOD School Demolition Area	UXO 28	4.64	Demolition area	1944-1949
Basic IED Area	UXO 04	3.79	Training and demonstration of IEDs	1957-1996
Advanced IED Area	UXO 05	10.07	Training and demonstration of IEDs	1953-1995
Stump Neck Impact Area	UXO 10	32.88	Impact area	1891-1940s
Test Area 1	UXO 21	4.52	Communication experiments, AA&D training, IED/IND training, robotics training	1950s-1980s (robotics training 1990s - present)
Valley Impact Area	UXO 26	694	Safety danger zone	1891-1921 (Quantico fired in area 1931-1934)
Torpedo Burial Site	UXO 12	0.88	Burial of torpedoes	Late 1940s-Early 1950s
Torpedo Casing Disposal Area	UXO 23	0.74	Burial of torpedo casings	1950s

(1) Size as noted in the PA (Malcolm Pirnie, 2005)
AA&D - Advances Access and Disablement
EOD - Explosive Ordnance Device
IED - Improvised Explosive Device
IND - Improvised Nuclear Device

INDIVIDUAL MRP SITE-SPECIFIC CHARACTERISTICS / PROBLEM DEFINITIONS

The following SAP worksheets (10.1 through 10.10) provide a brief summary of the Problem Definition for each of the "other than operational ranges" located on Stump Neck Annex, NSF-IH, Maryland. More detailed site specific information about each of the "other than operational ranges," including history and range description, land use, access controls and restrictions, visual survey observations and results, contaminant migration routes, and receptors is presented in Appendix B.

SAP Worksheet #10.1 – Problem Definition Summary for the Air Blast Pond (UXO 01)

The Air Blast Pond is an earthen pit previously used to test the concussive factors of bulk explosives (including Pentolite, HBX-1, HBX-2, H-6, C-4, and Composition B). The unit hosted an estimated 1,500 shots (maximum charge weights were 8 pounds per shot) over 20 years of usage (1955 to 1975). The pit area has been drained of water and is overgrown with small trees. Rusted metal piping is present on the pit floor, and piping and wires are present in the pit berms. Steel cylinders, rusted drums, concrete and wooden platforms, and other razed structure debris are present in the wooded area immediately south of the pit. During the PA, a fired 57-mm projectile was observed on the northern side of the berm, and a C-4 end cap was observed on the southwestern portion of the berm. Therefore, the Air Blast Pond is regarded as a suspected MEC site.

MC (explosives) may be present in soil as a result of concussive testing activities using bulk explosives and from other test activities that may have taken place at the site. Limited soil sampling (surface to 2 feet bgs) in and around the pit (seven locations) indicated no evidence of explosive compounds based on field test kit screening during the 1998 RI/VI. Other limited soil boring (surface and subsurface) sampling and sediment sampling (outside pit) with laboratory analysis also showed no detectable explosives.

The CSM (detailed in Appendix B) indicates that potentially complete exposure pathways exist for both human and ecological receptors under current and hypothetical future land uses. The potential presence of MC contamination is not known at this time (only limited sampling has been conducted). Unacceptable levels of human health and/or ecological risk from MC and explosive hazards from MEC may exist.

SAP Worksheet #10.2 – Problem Definition Summary for Area 8 (UXO 02)

Area 8, the Underwater Ordnance Training Area, consists of approximately 23 acres of wooded area and a small developed area (with a building and parking lot) with an explosives training pond to the south. Area 8 included 41 water shot and 30 air shot locations to train personnel to disarm inert training devices

and to test demolition charges, primers, detonators, fuzes, and squibs. The water shot locations consisted of 6-to 9-foot holes filled with surface water to a depth of 4 to 5 feet. The explosive was placed 2 to 5 feet below the water surface, and students would work on an inert training item 30 feet away. The air shot locations had explosives suspended on a wire approximately 2 feet above the ground, and students would work on an inert training item 75 feet away from the air shot location. Explosives were limited to no more than 0.5 pound of explosives at shot locations in Area 8. Explosives included TNT block, PETN, military dynamite, blasting caps, detonation cords, and similar devices.

The pond at Area 8 was used for underwater EOD training with inert mines and torpedoes placed at the pond bottom. Students dove to the pond bottom and performed reconnaissance on the 10 to 15 inert items at that location. Additional EOD training was performed at the pond edge. The pond is now stocked and used for fishing.

From 1978 to 1999, a 100-foot-long portion of Chicamuxen Creek in Area 8 was used for training students with a half-buried inert mine on the creek bottom to simulate the conditions of reconnaissance and ordnance problem-solving in muddy waters.

Limited sampling of soil, sediment, surface water, and groundwater was conducted in 1995 as part of the VI. Twenty-five water shot locations (surface water and sediment) and air shot locations (surface soil) were sampled and field-test analyzed for the presence of TNT, HMX, and RDX. TNT and RDX were detected in surface soil samples.

Limited borings and monitoring wells were located based on the soil field screening results for TNT and RDX [less than Region 3 Risk Based Concentrations (RBCs)]. No semivolatile organic compounds (SVOCs) or energetic compounds were detected in the soil samples, and no energetic compounds were detected in groundwater samples at the range.

MC at Area 8, if present, may potentially migrate within soil, groundwater, surface water, and sediment. There is the possibility for MC present in water to infiltrate to subsurface soil or surficial groundwater.

The CSM (detailed in Appendix B) indicates that potentially complete exposure pathways exist for both human and ecological receptors under current and hypothetical future land uses. The potential presence of MC contamination is not known at this time (no sampling has been conducted). Unacceptable levels of human health and/or ecological risk from MC and explosive hazards from MEC may exist.

SAP Worksheet #10.3 – Problem Definition Summary for EOD School Demolition Area (UXO 28)

The EOD School Demolition Area consists of approximately 5 acres of mostly wooded and partly open field areas within the boundaries of the Marine Rifle Range (UXO 14), and partially within the Torpedo Burial Site (UXO 12). The EOD School Demolition Area is within the estimated firing fan of the Valley Impact Area; however, no MEC was observed during the visual site survey in 2003. The EOD School Demolition Area was used from 1944 to 1949 and supported the introduction of Indian Head EOD School graduates to live explosives. The introduced materials included blocks of TNT, tetryl packs, caps, primer cord, safety fuses, and shaped charges. Students would demonstrate the use of these explosives to shear rails and trees, blow holes in the ground, and split live bombs in situ using shaped charges. As a result of the training activities, MEC and MC are suspected to be present over the entire area. The primary MCs of concern are metals, explosive residuals, TNT, and tetryl.

No past programs have sampled environmental media in the EOD School Demolition Area for energetic compounds or other relevant contaminants (i.e., metals). Potentially affected media include soil, groundwater, surface water, and sediment. Investigations for MEC have not been conducted.

MEC, if present, could present a physical hazard to human receptors. MC, if present, may potentially migrate within soil, groundwater, surface water, and sediment. There is the possibility for MC present in water to infiltrate to subsurface soil or surficial groundwater.

The CSM (detailed in Appendix B) indicates that potentially complete exposure pathways exist for both human and ecological receptors under both current and hypothetical future land uses. The potential presence of MC contamination is not known at this time. Unacceptable human health and/or ecological risk from MC and explosive hazards from MEC may exist.

SAP Worksheet #10.4 – Problem Definition Summary for Basic IED Area (UXO 04)

The Basic IED Area consists of approximately 4 acres of large wooded and open grassy fields. It was used from 1957 until approximately 1996 for the testing and demonstration of various explosive devices and chemicals. During the demonstrations, various chemicals/explosives were used including the following:

- Sulfuric acid and nitric acid.
- Potassium chloride and sodium chloride.
- Potassium permanganate and potassium nitrate.

- Gasoline.
- Red phosphorous.
- Aluminum and magnesium powders.
- Nitric acid.
- Glycerin.
- TNT, detonation cord, and black powder.
- Sodium and hydrogen peroxide.
- Bulk explosives, demolition charges, primers, detonators, fuzes, and squibs.

Limited previous groundwater and soil sampling has been conducted, and organic and inorganic constituents were detected. No energetics were detected.

The entire area has been identified as a suspected MEC site. MC and MEC, if present, could present significant risk and hazards to human and ecological receptors. The CSM (detailed in Appendix B) indicates that potentially complete exposure pathways exist for both human and ecological receptors under both current and hypothetical future land uses. Unacceptable levels of human health and/or ecological risk from MC and explosive hazards from MEC may exist.

SAP Worksheet #10.5 – Problem Definition Summary for the Advanced IED Area (UXO 05)

The Advanced IED Area was used by the EOD School for training and may have been used for the disposal of inert ordnance and training aids. An area of the site referred to as Solid Waste Management Unit (SWMU) 27 contains a concrete foundation in which a variety of submunitions and munitions debris are present. The site was reportedly active from 1953 to 1995 and is a part of the range fan of the Valley Impact Area. Currently, the site is defined as a mostly wooded 10-acre parcel. The Advanced IED Area is regarded as a suspected MEC site.

Limited previous surface soil sampling has been conducted. Elevated concentrations of common laboratory organics such as methylene chloride and toluene were detected. There were no detectable concentrations of energetics or semivolatile analytes. Concentrations of several inorganics (antimony, cadmium, calcium, copper, magnesium, tin, and zinc) were elevated with respect to background soil concentrations.

If MC sources are present in surface soil, they may migrate to surface water and sediment in the area, as well as to subsurface soil and groundwater. MEC, if present, could present a hazard to human receptors.

The CSM (detailed in Appendix B) indicates that potentially complete exposure pathways exist for both human and ecological receptors under both current and hypothetical future land uses. Unacceptable levels of human health and/or ecological risk from MC and explosive hazards from MEC may exist.

SAP Worksheet #10.6 – Problem Definition Summary for the Stump Neck Impact Area (UXO 10)

The Stump Neck Impact Area was used as a long-range naval gunnery target from the early 1890s through the early 1920s and sporadically in the 1930s and 1940s. Sources indicate that rockets may also have been fired at the impact area as late as 1947, and a variety of other training activities occurred including land surface demolition testing and underwater testing prior to the construction of the Area 8 pond in 1957. The site encompasses about 33 acres of low-elevation wetlands, tidal pools, and marsh areas surrounded by Chicamuxen Creek in the central portion of Stump Neck Annex. The estimated ordnance penetration of the munitions fired on the Stump Neck Impact Area (1-inch to 14-inch projectiles) is between 4 and 12 feet bgs. Groundwater is present immediately below the ground surface within the boundaries of the Stump Neck Impact Area. Munitions constituents include TNT, HMX, Composition B, Composition D, and perchlorate.

The Stump Neck Impact Area is regarded as a suspected MEC site. No previous environmental investigations have been conducted to determine whether MEC or MC are present. The CSM (detailed in Appendix B) indicates that potentially complete exposure pathways exist for both human and ecological receptors under current and hypothetical future land uses. Unacceptable levels of human health and/or ecological risk from MC and explosive hazards from MEC may exist.

SAP Worksheet #10.7 – Problem Definition Summary for Test Area 1 (UXO 21)

Test Area 1 is an approximately 4.5-acre wooded site. In the 1950s the Naval Research Laboratory constructed a 220-foot by 263-foot “hole-in-the-ground” antenna (the bowl) to support moon relay communication experiments. During the 1960s and 1970s, Test Area 1 was used for AA&D training (such as booby traps and trip wires). In the 1980s, Test Area 1 was used for IED and IND training. All training items were inert; however, the devices were connected to small charges (a quarter-pound block of TNT) located a short distance from the training item. The charges were sized for total consumption, although small amounts of residue may remain. During the 1990s, Test Area 1 was used primarily for robotics testing.

Based on historical use of Test Area 1 for IED and IND training, all of the area is suspect for MEC. MC (TNT and degradation products) may be present in surface soil, and if present in surface soil may migrate to subsurface soil. Environmental sampling has not been conducted. The CSM (detailed in Appendix B)

indicates that potentially complete exposure pathways exist for both human and ecological receptors under current and hypothetical future land uses. Unacceptable levels of human health and/or ecological risk from MC and explosive hazards from MEC may exist.

SAP Worksheet #10.8 – Problem Definition Summary for the Valley Impact Area (UXO 26)

The Valley Impact Area is part of the firing fan for the Indian Head Valley gun proving site firing point, which was used from 1891 to 1921. Projectiles from a wide variety of ordnance fired from the Valley gun proving site may have impacted the Valley Impact Area. In addition, the Valley Impact Area also received ordnance from a firing range set up by units from the Quantico MCB (on Stump Neck Annex near Rum Point—the exact location is unknown) for 75-mm guns and howitzers. MCB Quantico was also permitted to fire large artillery at Stump Neck Annex for several years until 1934.

The shells fired onto the Valley Impact Area contained different types of explosive fillers including black powder, smokeless powder, brown prismatic powders, emmensite, joveite, wet gun cotton, randite, and other high explosives (e.g., Thorite). Potential MC include Explosive D, black powder, TNT, magnesium, NH powder, CTNT, and other various metals and chemicals associated with pyrotechnics, such as perchlorate and propellants.

Based on historical use, the portion of the Stump Neck peninsula overlapped by the Valley Impact Area is suspect for MEC. MC (TNT, perchlorate, metals, etc.) may be present in soil as the result of releases from projectiles/shells that did not detonate or had low-order detonations. Environmental sampling specific to impacts from munitions has not been conducted at this area, although several other MRP sites are within the same impact area footprint. The CSM (detailed in Appendix B) indicates that potentially complete exposure pathways exist for both human and ecological receptors under current and hypothetical future land uses. Unacceptable levels of human health and/or ecological risk from MC and explosive hazards from MEC may exist.

SAP Worksheet #10.9 – Problem Definition Summary for the Torpedo Burial Site (UXO 12)

The 1.75-acre Torpedo Burial Site may have been used for disposal of torpedoes during the 1940s and 1950s (before becoming inactive during the early 1950s). According to available reports, the site consists of at least one unlined earthen pit used to bury waste material including torpedoes, primers, detonators, fuzes, squibs, and other associated hardware transported from a torpedo station near Washington, D.C., in the late 1940s or early 1950s. The site area was expanded following the discovery of a 21-inch torpedo casing during the visual survey.

The entire Torpedo Burial Site is considered a suspected MEC area, although the 21-inch torpedo casing discovered during the visual survey is the only known MEC area. Potential MC at the site (based on the possible presence of torpedoes and their components) include TNT, RDX, Composition A, Composition B, Composition C, Torpex, PETN, dynamite, nitrocellulose, cordite, and perchlorate.

MC, if present in subsurface soil, could potentially migrate to groundwater. The CSM (detailed in Appendix B) indicates that potentially complete exposure pathways exist for both human and ecological receptors under current and hypothetical future land uses. Unacceptable levels of human health and/or ecological risk from MC and explosive hazards from MEC may exist.

SAP Worksheet #10.10 – Problem Definition Summary for the Torpedo Casing Disposal Area (UXO 23)

The Torpedo Casing Disposal Area is described as having been used in the 1950s to dispose of inert torpedoes, which may still remain. A previous geophysical survey of the general area suggests that magnetic anomalies greater than 3 feet deep may be indicative of large-item burial locations. The torpedo casings are presumed to be inert, although there is the potential that some explosive residue (torpex consisting principally of RDX and HMX) may remain. Potential MC consists of metals from the weathering of the torpedo and explosives residues (principally RDX and HMX). MEC are not suspected to be present.

MC, if present in subsurface soil, could potentially migrate to groundwater. The CSM (detailed in Appendix B) indicates that potentially complete exposure pathways exist for both human and ecological receptors under current and hypothetical future land uses. Unacceptable levels of human health and/or ecological risk from MC may exist.

SAP Worksheet #11.1 - Data Quality Objectives for the Air Blast Pond (UXO 01)

STATE THE PROBLEM (STEP 1)

Worksheet 10.1 contains the problem definition for the Air Blast Pond.

IDENTIFY THE GOAL OF THE STUDY (STEP 2)

The primary goal of the SI for the Air Blast Pond is to obtain environmental data for use in making the following decisions:

1. Determine whether surface MEC or surface MC (explosives) are present within the study area in a condition, quantity or concentration that presents an immediate human health hazard and requires an immediate response. If such quantities are present, then initiate an appropriate remedial response. Otherwise, take no immediate action.

2. If surface MEC debris or subsurface anomalies indicate the presence of suspect MEC, then proceed with further investigation in the RI phase. If not, proceed to no further action (NFA) for MEC. In this case, MC may still be present, so continue to investigate for the presence of MC contamination in surface and subsurface soil.

3. Determine whether MC (explosives) are present in soil within the study area in quantities or concentrations above screening levels. If either of these conditions exists, then evaluate the need to proceed to an RI and FS. If not, proceed to NFA for MC.

4. Determine the extent of MEC and MC contamination for the purposes of delineation. If sufficient data have been collected for this purpose, then stop collecting data. If more data are required to delineate the extent of contamination, then conduct further investigation in the RI phase.

IDENTIFY INFORMATION INPUTS (STEP 3)

Data and information that will be required to achieve the goals include the following:

1. UXO Surface Sweeps:
   Surface: Data will be obtained from detector-aided surface sweeps conducted by UXO personnel using hand-held metal detectors, such as the Schonstedt GA-52Cx or White's Spectrum XLT or equivalent, and visual observations. UXO Technicians will use metal detectors to locate metallic

items on the surface. Items located on the surface will be visually examined to determine if they are suspect MEC, material potentially presenting an explosive hazard (MPPEH), munitions debris (MD), or non-MD. If located, suspect MEC, MPPEH, and/or MD will not be moved or disturbed during the SI.

Subsurface: Metal detector anomalies (i.e., a response from the metal detector at a location where no surface materials are found) that result from the detector-aided surface sweeps will be used to locate suspect metal objects in the shallow subsurface soil. Suspect MEC, MPPEH, MD, and subsurface metals (if metals are MEC, MPPEH, or MD) could potentially result in the release of MC.

2. Chemical Data and Physical Characteristics: Chemical data will be used to determine the presence of explosives in the surface and subsurface soil. Chemical analysis will be performed using method SW 846 8330B. Three of the soil samples shipped to the laboratory will also be analyzed for pH (SW 846 Method 9045D), total organic carbon (TOC) (Lloyd Kahn Method), and cation exchange capacity (CEC) (SW 846 Method 9081). The list of all chemical analytes is presented in Worksheet 15 and the laboratory methods are listed in Worksheet 18.

Project Action Limits

This investigation requires chemical data that can be used to further characterize the site and to begin a screening level ecological and human health risk assessment. Chemical concentrations will first be compared to conservative screening values. If any chemical concentration exceeds a screening value, human health or ecological risks may be, but are not necessarily, unacceptable. If necessary, a human health and ecological risk assessment will be conducted during an RI.

To conduct comparisons of site data to screening values, the selected laboratory must be able to achieve quantitation limits that are low enough to measure constituent concentrations below the screening values. For this investigation the screening values, which are also known as the project action limits (PALs), are listed and described below:

- U.S. EPA Regional Soil Screening Levels for Chemical Contaminants at Superfund Sites-Residential Use (July 7, 2008).
- Maryland Department of the Environment Generic Cleanup Standards (soil, August 2001).
- U.S. EPA Ecological Soil Screening Levels (ESSLs) (2005).

- U.S. EPA Region III Biology Technical Advisory Group (BTAG) criteria if U.S. EPA ESSLs are not available.

- Oak Ridge National Laboratory (ORNL) ecological screening levels if neither U.S. EPA ESSLs nor Region III BTAG criteria are available (1997).

- Background Concentrations established for soils (Appendix C).

Background values for soil have been developed. In the event that a chemical analyte exceeds a PAL, but falls below or is equal to an established background concentration, the chemical will not be retained as a chemical of potential concern (COPC). On the other hand, if the chemical analyte is measured above the established background concentration, the chemical will be retained as a COPC. Established background concentrations are provided in Appendix C.

DEFINE THE BOUNDARIES OF THE STUDY (STEP 4)

The current site investigation at the Air Blast Pond is limited to an evaluation of soil in and around the location of the former pond. An investigation of other media is beyond the scope of this investigation, but may be required based, in part, on the outcome of this investigation.

1. The initial horizontal boundary for the MEC and MC investigation will include the Air Blast Pond and the area surrounding the pond identified in the PA as the suspect MEC area. See Figure 17.1-1 (Appendix A MEC SAP) and Figure 17.1, respectively.

2. The initial vertical boundary for the MEC investigation (detector-aided surface sweep) will be 1 foot bgs. The theoretical penetration depth for the 57 mm projectiles similar to the one observed during the site walks is up to 6.5 feet bgs. However, it is unlikely that the projectile's presence was the result of the Air Blast Pond being used as an impact area. It is most likely to be present as the result of operations occurring on the surface.

3. Surface Soil Vertical Boundary for MC constituents: The surface soil interval that is of interest for ecological risk screening is the 0 to 6 inch bgs interval, while the 0 to 2 foot bgs interval is of interest for human health risk screening. Surface soil data will be collected from these intervals.

4. Subsurface Soil Boundary for MC Constituents:

   a. Suspect MEC Area: It is possible that the 0 to 2 foot bgs soil interval is contaminated. Pond waters infiltrating into the ground through the unlined pond bottom would potentially carry explosive contaminants into surface soils and then into subsurface soils. Within the area surrounding the pond, the primary contamination migration pathway would be surface deposition of low order detonations during pond testing operations.

   b. Air Blast Pond: it is possible that the 0 to 4 foot bgs soil interval is contaminated as a result of historic activities at the Air Blast pond, and so this particular interval is of interest.

DEVELOP THE ANALYTIC APPROACH (STEP 5)

The decision rules for this investigation are as follows:

MEC Approach:

1. The SI will use UXO detector-aided surface sweeps to locate surface and shallow subsurface anomalies. If the detector-aided surface sweep shows that suspect surface MEC and subsurface anomalies are not present, then proceed to NFA for MEC. In this case, MC may still be present, so continue to investigate for the presence of MC contamination in surface and subsurface soil.

2. The SI will use UXO detector-aided surface sweeps to locate surface and shallow subsurface anomalies. If suspect MEC is observed on the surface or if shallow subsurface anomalies exist, then investigate the surface and/or subsurface soil in the location of the suspect MEC or shallow subsurface anomaly in order to determine if MC contamination is present in the soil. If the collected data are sufficient to determine the presence of MC contamination associated with the suspect MEC, then stop collecting data. If the data are not sufficient to determine if MC contamination is present, then return for further investigation in the RI phase.

MC Approach:

1. If MC (explosives) are detected in surface soil or subsurface soil at concentrations less than screening levels, then proceed to NFA for MC for surface and subsurface soil. If MC are detected at concentrations above screening values, then the project team will evaluate the need to proceed to an

RI for MC. Factors considered will include the explosive(s), the magnitude of the exceedance(s), their spatial distribution and the location(s) of the exceedance(s).

Decision rules for delineation:

If MC (explosives) are detected in the soil at concentrations greater than screening values at the horizontal or vertical boundaries of sampling, then evaluate the need to collect step-out samples in the RI phase. These step-out samples may include surface soil, subsurface soil or groundwater samples. Factors considered will include the explosive(s), the magnitude of the exceedance(s), and the spatial distribution of the exceedance(s). In most cases, “step-out” samples should be collected until the perimeter sample concentrations are less than screening or background concentrations. However, professional judgment should be used to determine if such samples are needed in all cases. Professional judgment considerations include:

- The degree to which MC concentrations exceed screening or background levels. The need to collect additional data should be carefully considered when concentrations in surface or subsurface soil are within 5 percent of screening or background levels. The need to collect additional data will increase with increased number of exceedances and increased contaminant concentrations.

- The degree to which further delineation can be more efficiently and economically collected as part of follow-up RI/FS investigations (i.e., the additional sampling is unlikely to impact the decision to take or not take some type of remedial action, but may be necessary to define the limits of the action).

- Considerations of the impact of future human health and ecological risk estimations if some contaminant concentrations are not completely delineated.

    1. If suspect MEC and/or anomalies are found to be present in only a portion of the area surveyed, then consider reducing the boundaries of the suspect MEC area.

    2. If suspect MEC and/or anomalies are found to be present at the boundaries of the surveyed area, then consider extending the boundaries during the RI.

    3. Lateral and/or vertical expansion of the study area during the RI phase to include investigation of additional environmental media may be necessary if MC are present at the lateral and/or vertical extent of the initial surface or subsurface soil sampling pattern at concentrations greater than

screening levels. Factors considered will include the type of MC, the magnitude of the exceedance(s), their spatial distribution and the overall concentration data for all MC.

SPECIFY PERFORMANCE OR ACCEPTANCE CRITERIA (STEP 6)

1. The criterion for the detector-aided surface sweeps will be a go/no-go test performed by determining whether the instrument responds to metallic objects under a blanket (blanket test).

2. Because this is an SI, probability limits for false decision errors were not established for MC.

3. Performance criteria for new analytical data are normal quality assurance (NQA) limits and meeting the project action limits, which are listed in Worksheet 15 for MC.

Details of the performance criterion for the blanket test are provided in the MEC SAP (Appendix A) Worksheet 12.

DEVELOP THE PLAN FOR OBTAINING DATA (STEP 7)

The proposed SI field data collection program for the Air Blast Pond is described in detail in Worksheet 17 of this UFP SAP for MC. Appendix A contains the MEC SAP for the detector-aided surface sweeps. Worksheet 17 of the MEC SAP contains details. A brief summary of this approach is presented below.

<u>Detector-Aided Surface Sweeps</u>

1. Perform the blanket test. In this test, metal objects such as trailer hitches will be placed under a tarpaulin to verify that metal detectors are functioning.

2. Conduct detector-aided surface sweeps of the accessible area designated within the PA as suspect for MEC as shown on Figure 17.1-1 of Appendix A (MEC SAP). The sweep will be conducted by UXO technicians in 5-foot wide transects using hand-held all metals detectors (White) or magnetic locators (Schonstedt, GA-52CX). A grid (100-foot sides) will be pre-established. The grid nodes will be staked in the field using a global positioning system (GPS) instrument. Stakes will be placed at 5-foot intervals on opposite sides (north - south sides) of the grid. In clear areas (minimal tree canopy), stakes will be placed every 5-feet on the opposite intervals (east – west) and ropes will be stretched from one side to the other to establish 5-foot wide lanes. In heavily vegetated areas, where stretching of ropes is not feasible, technicians will walk side-by-side at 5–foot intervals. Locations where visual observations of suspect MEC, MPPEH, MD or subsurface anomalies are observed will

be marked with a stake. Pictures will be taken of items observed on the surface. In clear areas the locations will be recorded using a GPS. In areas where tree canopy precludes use of a GPS locations will be established using a tape measure and compass measurements from a known location(s).

3. Utilize information from detector-aided surface sweep to identify surface and subsurface soil sampling locations areas within the footprint of the surface sweep for collection of soil samples based on the presence of MD and shallow subsurface anomalies.

MC Sample Collection and Analysis

1. Surface and Subsurface Soil
   a) Forty surface soil samples will be collected at the 0- to 6-inch and 0- to 24-inch bgs levels at 20 sample locations. The 0- to 6-inch interval is of interest for ecological risk screening while the 0- to 24-inch interval is of interest for the human health risk screening. Specific locations will be selected by the planning team based on the results of the detector-aided surface sweeps. Samples will be preferentially collected at locations where suspect MEC, MPPEH, or MD were identified on the surface. If no suspect MEC, MPPEH, or MD are identified, then surface soil samples will be collected in the locations shown on Figure 17.1.

      Surface soil samples at each location sampled will be composites of seven discrete samples collected using the seven-point wheel approach. Explosives present on the surface would have resulted from low order detonations which released particles of explosives. These particles would be heterogeneously distributed in surface soil. In order to form a composite in which explosives would be evenly dispersed, the entire composite will be processed in the laboratory using the methodology described in Appendix A of SW-846 Method 8330B. This methodology consists of air drying and sieving the entire sample and conducting particle size reduction (grinding) of the entire sample.

   b) Six subsurface soil samples will be collected from 2 to 4 feet bgs. Specific locations will be determined by the project team based on the results of the detector-aided surface sweeps. Samples will be preferentially collected at locations where suspect MEC, MPPEH, or MD were located on the surface or where shallow subsurface anomalies were detected. Subsurface samples at each location will consist of one discrete sample. If no suspect MEC, MPPEH, or MD are identified, then subsurface soil samples will be collected in the evenly dispersed locations

within the Air Blast Pond shown on Figure 17.1. Subsurface soil samples will be analyzed for explosives using SW 846 Method 8330B.

c) Three soil samples shipped to the laboratory will be analyzed for pH (SW 846 Method 9045D), TOC (Lloyd Kahn Method), and CEC (SW 846 Method 9081).

d) Soil samples will be collected via hand auger.

e) Because the Air Blast Pond is a suspect MEC area and is located in the fan of the Valley Impact Area, anomaly avoidance techniques will be used for collection of samples.

SAP Worksheet #11.2 - Data Quality Objectives for Area 8 (UXO 02)

STATE THE PROBLEM (STEP 1)

Worksheet 10.2 contains the problem definition for Area 8.

IDENTIFY THE GOAL OF THE STUDY (STEP 2)

The primary goal of the SI for Area 8 is to obtain environmental data for use in making the following decisions:

1. Determine whether surface MEC or surface MC (explosives and metals) are present in a condition, quantity, or concentration that presents an immediate human health hazard and requires an immediate response. If such quantities are present, then initiate an appropriate remedial response. Otherwise, take no immediate action.

2. If surface MEC debris or subsurface anomalies indicate the presence of suspect MEC, then proceed with further investigation in the RI phase. If not, proceed to NFA for MEC. In this case, MC may still be present, so continue to investigate for the presence of MC contamination in soil, sediment, and groundwater.

3. Determine whether MC (explosives and metals) are present in the soil, sediment, and groundwater within the study area in quantities or concentrations above screening levels. If either of these conditions exists, then evaluate the need to proceed to an RI and/or FS. If not, proceed to NFA for MC.

4. Determine the extent of MEC and MC contamination for the purposes of delineation. If sufficient data have been collected for this purpose, then stop collecting data. If more data are required to delineate the extent of contamination, then conduct further investigation in the RI phase.

IDENTIFY INFORMATION INPUTS (STEP 3)

Data and information that will be required to achieve the goals include the following:

1. UXO Surface Sweeps and Geophysical Investigation:
   Surface: Data will be obtained from detector-aided surface sweeps conducted by UXO personnel using hand-held metal detectors such as the Schonstedt GA-52Cx or equivalent, and visual

observations. UXO Technicians will use metal detectors to locate metallic items on the surface. Items located on the surface will be visually examined to determine if they are suspect MEC, MPPEH, MD or non-MD. If located, suspect MEC, MPPEH, and/or MD will not be moved or disturbed during the SI.

Subsurface: Metal detector anomalies (i.e., a response from the metal detector at a location where no surface materials are found) that result from the detector-aided surface sweeps will be used, along with data from a subsurface geophysical investigation conducted by a geophysicist using an all metals detector (such as a Geometrics G858), to locate suspect metal objects in subsurface soil. Suspect MEC, MPPEH, MD and subsurface metals (if metals are MEC, MPPEH, or MD) could potentially result in the release of MC.

Water: Data from detector-aided (GPS located) sweeps will be used to locate training items, believed to be inert, that were possibly discarded in the pond.

2. Chemical Data and Physical Characteristics:

Chemical data will be used to determine the presence of MC (explosives and metals) in the surface soil, subsurface soil, sediment and groundwater. Chemical analysis will be performed using method SW 846 8330B for explosives and method SW 846 6010B/6020A for metals. Three of the soil samples shipped to the laboratory will also be analyzed for pH (SW 846 Method 9045D), TOC (Lloyd Kahn Method), and CEC (SW 846 Method 9081). The list of all chemical analytes is presented in Worksheet 15 and the laboratory methods are listed in Worksheet 18.

Project Action Limits:

This investigation requires chemical data that can be used to further characterize the site and to begin a screening level ecological and human health risk assessment. Chemical concentrations will first be compared to conservative screening values. If any chemical concentration exceeds a screening value, human health or ecological risks may be, but are not necessarily, unacceptable. If necessary, a human health and ecological risk assessment will be conducted during an RI.

To conduct comparisons of site data to screening values, the selected laboratory must be able to achieve quantitation limits that are low enough to measure constituent concentrations below the screening values. For this investigation the screening values, which are also known as the PALs, are listed and described below:

- U.S. EPA Regional Soil Screening Levels for Chemical Contaminants at Superfund Sites-Residential Use (July 7, 2008).

- Maryland Department of the Environment Generic Cleanup Standards (soil and groundwater; August 2001).

- U.S. EPA ESSLs (2005).

- U.S. EPA Region III BTAG criteria if U.S. EPA ESSLs are not available.

- ORNL ecological screening levels if neither U.S. EPA ESSLs nor Region III BTAG criteria are available (1997).

- Background Concentrations established for soils (Appendix C).

- U.S. EPA Maximum Contaminant Level, 2006 Edition of the Drinking Water Standards and Health Advisories.

Background values for soil have been developed. In the event that a chemical analyte exceeds a PAL, but falls below or is equal to an established background concentration, this chemical will not be retained as a COPC. On the other hand, if the chemical analyte is measured above the established background concentration, the chemical will be retained as a COPC. Established background concentrations are provided in Appendix C.

DEFINE BOUNDARIES OF THE STUDY (STEP 4)

The current site investigation at Area 8 is limited to an evaluation of soil, groundwater and sediment. An investigation of other media is beyond the scope of this investigation, but may be required based, in part, on the outcome of this investigation.

1. The initial horizontal boundary for the MEC and MC investigation will include the area shown on Figure 17.2-1 (Appendix A MEC SAP) and Figure 17.2, respectively.

2. The initial vertical boundary for the MEC investigation (detector-aided surface sweep and possible geophysical subsurface investigation) will be 6 feet bgs within the land area. It is reported that

explosives at Area 8 were placed at 2 to 5 feet below the water surface in the 6 to 9 foot deep water shot locations.

3. Surface Soil Vertical Boundary for MC Constituents: The surface soil interval that is of interest for ecological risk screening is the 0 to 6 inch bgs interval, while the 0 to 2 foot bgs interval is of interest for human health risk screening. Surface soil data will be collected from these intervals.

4 Subsurface Soil Vertical Boundary for MC Constituents: The initial vertical boundary will be 6 feet bgs for collection of MC (explosives and metals) data within the land area. It is reported that explosives at Area 8 were placed at 2 to 5 feet below the water in the 6 to 9-foot deep water shot locations. Subsurface soil samples will be collected from the 2 to 4 foot bgs interval and the 4 to 6 foot bgs interval.

5. The initial vertical boundary will be 6 inches bgs for collection of sediment data within the pond and Chicamuxen Creek. This interval will be of interest for the ecological and human health risk screening.

6 The initial vertical groundwater boundary will be the depth of the existing and newly installed monitoring wells.

DEVELOP THE ANALYTIC APPROACH (STEP 5)

The decision rules for this investigation are as follows:

MEC Approach:

1. If the detector-aided surface sweep or geophysical investigation shows no suspect surface MEC, subsurface MEC, or anomalies in the land or pond area, then proceed to NFA for MEC. In this case, MC may still be present, so continue to investigate for the presence of MC contamination in surface soil, subsurface soil, sediment, and groundwater.

2. If suspect MEC is observed on the surface, or if subsurface anomalies exist, then investigate the surface and/or subsurface soil in the location of the suspect MEC or subsurface anomaly in order to determine if MC contamination is present in the soil. If the collected data are sufficient to determine the presence of MC contamination associated with the suspect MEC, then stop collecting data. If the

data are not sufficient to determine the presence of MC contamination, then return for further investigation in the RI phase.

3. If anomalies are present in the pond, they will be treated as suspect MEC until visual inspection certifies the item to be free of explosives. The sediment will be investigated for the presence of MC contamination. If the collected data are sufficient to determine the presence of MC contamination in the sediment, then stop collecting data. If the data are not sufficient to determine the presence of contamination, then return for further investigation in the RI phase.

MC Approach:

1. If MC (explosives and metals) are detected in surface soil, subsurface soil, sediment, or groundwater at concentrations less than screening levels, then proceed to NFA for MC for the appropriate media. If MC (explosives and metals) are detected in surface soil, subsurface soil, sediment or groundwater at concentrations above screening values, then the project team will evaluate the need to proceed to an RI for MC. Factors considered will include the explosive(s), the metal(s), the magnitude of the exceedance(s), their spatial distribution, and the location(s) of the exceedance(s).

Decision rules for delineation:

If MC (explosives and metals) are detected in surface soil, subsurface soil, sediment or groundwater at concentrations greater than screening values at the horizontal or vertical boundaries of sampling (vertical boundary only for groundwater), then evaluate the need to collect step-out samples in the RI phase. These step-out samples may include surface soil, subsurface soil, sediment, surface water or groundwater. Factors considered will include the explosive(s), the metal(s), the magnitude of the exceedance(s), and the spatial distribution of the exceedance(s). In most cases, “step-out” samples should be collected until the perimeter sample concentrations are less than screening or background concentrations. However, professional judgment should be used to determine if such samples are needed in all cases. Professional judgment considerations include:

- The degree to which MC concentrations exceed screening or background levels. The need to collect additional data should be carefully considered when concentrations in surface soil, subsurface soil, sediment or groundwater are within 5 percent of screening or background levels. The need to collect additional data will increase with increased number of exceedances and increased contaminant concentrations.

- The degree to which further delineation can be more efficiently and economically collected as part of follow-up RI/FS investigations (i.e., the additional sampling is unlikely to impact the decision to take or not take some type of remedial action but may be necessary to define the limits of the action).

- Considerations of the impact of future human health and ecological risk estimations if some contaminant concentrations are not completely delineated.

  1. If suspect MEC and/or anomalies are found to be present in only a portion of the area surveyed, then consider reducing the boundaries of the suspect MEC area.

  2. If suspect MEC and/or anomalies are found to be present at the boundaries of the surveyed area, then consider extending the boundaries during the RI.

  3. Lateral expansion of the study area during the RI phase may be necessary if MC are present at the lateral extent of the initial sampling pattern at concentrations greater than screening levels. Factors considered will include the type of MC, the magnitude of the exceedances(s), their spatial distribution and the overall concentration data for all MC.

  4. Vertical expansion of the study area during the RI phase may be necessary if contamination is present above screening levels in the initial study area boundary. This may include further investigation of impacted environmental media such as groundwater, subsurface soil or sediment. Factors considered will include the type of MC, the magnitude of the exceedance(s), their spatial distribution and the overall concentration data for all MC.

SPECIFY PERFORMANCE OR ACCEPTANCE CRITERIA (STEP 6)

1. The criterion for the detector-aided surface sweep will be a go/no-go test performed by determining whether the instrument responds to metallic objects under a blanket (blanket test).

2. The criteria for the geophysical equipment function test will be:
   a. Detection of all seed items buried within 11x depth;
   b. Horizontal positions of seeded items within 1 meter of known locations.

3. Because this is the SI stage, probability limits for false decision errors were not established for MC.

4. Performance criteria for new analytical data are NQA limits and meeting the project action limits, which are listed on Worksheet 15 for MC.

Details of the performance criteria for the blanket test and geophysical equipment function test are provided in the MEC SAP (Appendix A) Worksheet 12.

DEVELOP THE PLAN FOR OBTAINING DATA (STEP 7)

The proposed SI field data collection program for Area 8 is described in detail in Worksheet 17 of this UFP SAP for MC. Appendix A contains the MEC SAP for the detector-aided surface sweep and the subsurface geophysical investigations. Worksheet 17 of the MEC SAP contains details. A brief summary of this approach is presented below.

Detector-Aided Surface Sweeps

1. Perform the blanket test. In this test metal objects such as trailer hitches, will be placed under a tarpaulin to verify that metal detectors are functioning.

2. Conduct detector-aided surface sweeps of the established survey areas as shown on Figure 17.2-1 in Appendix A (MEC SAP). The sweeps will be conducted by UXO Technicians, using hand held magnetic metal detectors (Schonstedt GA-52Cx), in areas where water shots were located and at the Old Shot Hole. A sweep will be conducted at 4 parallel transects spaced 15 feet apart over numerous air shot locations. A 100 percent detector-aided surface sweep will also be conducted of accessible areas within 50 feet of any anomaly clusters identified along transects during detector-aided surface sweeps, or during the subsurface geophysical investigation.. Locations where visual observations of suspect MEC, MPPEH, MD or subsurface anomalies are observed will be marked with a stake. Pictures will be taken of items observed on the surface. In clear areas the locations will be recorded using a GPS. In areas where tree canopy precludes use of a GPS, locations will be established using a tape measure and compass measurements from a known location(s).

3. An underwater magnetic locator instrument will be used to search and locate anomalies on the bottom of the pond. Data will be collected along parallel survey lines spaced no greater than 5 feet apart using ropes anchored to the land or buoys placed across the pond. Anomaly locations will be reacquired and surveyed using GPS.

4. Utilize information from detector-aided sweeps to identify surface soil, subsurface soil and sediment sampling location areas within the footprint of the surface sweeps for collection of soil and sediment samples based on the presence of MD and subsurface anomalies.

Subsurface Geophysics

1. Determine whether it is necessary to conduct a subsurface geophysical investigation based on the number, the areal extent and the location of shallow subsurface anomalies identified during the detector-aided surface sweeps. If no shallow subsurface anomalies are present, then subsurface geophysics will not be considered.

2. Perform the geophysical equipment function test. In this test, metals items will be buried at various depths. Geophysical instrumentation will then be tested to verify that the operator, instrumentation and software are functioning properly. A Geometrics G858 is planned for use at this site.

3. Conduct the subsurface geophysical investigation at anomaly clusters. The geophysical survey will be conducted at selected anomaly clusters based on the number, areal extent and location.

4. Utilize information from the subsurface geophysical investigation to identify soil sampling locations for collection of soil based on the presence of subsurface anomalies.

MC Sample Collection and Analysis

1. Surface and Subsurface Soil
   a) Eighty surface soil samples will be collected at the 0- to 6-inch and 0- to 24-inch bgs levels at 40 sample locations within the MRP area as shown on Figure 17.2. The 0- to 6-inch interval is of interest for ecological risk screening while the 0- to 24-inch interval is of interest for the human health risk screening. Specific locations will be selected by the planning team based on the results of detector-aided surface sweeps. Samples will be preferentially collected at locations where suspect MEC, MPPEH, or MD were identified on the surface or where subsurface anomalies are detected. If no suspect MEC, MPPEH, or MD or subsurface anomalies are identified, then surface soil samples will be collected in the locations shown on Figure 17.2.

   Surface soil samples at each location sampled will be composites of seven discrete samples collected using the seven-point wheel approach. Explosives present on the surface would have resulted from low order detonations which released particles of explosives. These particles would

be heterogeneously distributed in surface soil. In order to form a composite in which explosives would be evenly dispersed, the entire composite will be processed in the laboratory using the methodology described in Appendix A of SW 846 Method 8330B. This methodology consists of air drying and sieving the entire sample and conducting particle size reduction (grinding) of the entire sample. Surface soil samples will also be analyzed for metals using SW 846 Method 6010B/6020A.

b) Up to 40 subsurface soil samples will be collected from 2 to 6 feet bgs at 20 of the surface soil sample locations. Two samples will be collected within that depth interval based on visual observations of staining or other relevant indications (odors, discoloration, etc.). If these indications are not observed, samples will be collected at 2 to 4 feet and 4 to 6 feet bgs. Specific locations will be determined by the project team based on the results of detector-aided surface sweeps. Samples will be preferentially collected at locations where suspect MEC, MPPEH, or MD were located on the surface or where subsurface anomalies were detected. Subsurface samples at each location sampled will consist of one discrete sample. If no suspect MEC, MPPEH, or MD is identified, then subsurface soil samples will be collected at the soil sample locations shown on Figure 17.2. All subsurface soil samples will be analyzed for explosives (SW 846 Method 8330B) and metals (SW 846 Method 6010B/6020A).

c) Three soil samples shipped to the laboratory will be analyzed for pH (SW 846 Method 9045D), TOC (Lloyd Kahn Method), and CEC (SW 846 Method 9081).

d) Soil samples will be collected via hand auger and DPT.

e) Anomaly avoidance techniques will be followed for collection of all soil samples.

2. Sediment

a) Three sediment samples will be collected at 0- to 6-inches below the sediment surface from areas within Chicamuxen Creek adjacent to where training was conducted. Four sediment samples will be collected at 0 to 6 inches below the sediment surface from within the pond area. Specific locations will be determined by the project team based on the results of detector-aided water sweeps. Samples will be preferentially collected at locations where suspect MEC, MPPEH, or MD were located in the water or where anomalies were detected. Sediment samples at each location sampled will consist of one discrete sample. If no suspect MEC, MPPEH, or MD are identified, then sediment samples will be collected in the locations shown on Figure 17.2.

Sediment samples will be analyzed for explosives (SW 846 Method 8330B) and metals (SW 846 Method 6010B/6020A).

b) Anomaly avoidance techniques will be followed for collection of all sediment samples.

3. Groundwater

a) Six groundwater samples will be collected from three existing and three newly installed temporary wells at Area 8. The locations of the wells will be determined based on the results of the detector-aided surface sweeps and the subsurface geophysical investigation. Wells will be placed in locations where the presence of anomalies indicates the potential for release of MC. Factors considered will be the density of the anomalies, distances from existing wells, groundwater flow direction and MC data (if available). Groundwater samples will be analyzed for explosives (SW 846 Method 8330B) and metals (SW 846 Method 6010B/6020A). The groundwater samples will be filtered through a 0.45-micron filter if low-flow sample collection does not result in turbidity of less than 10 nephelometric turbidity units (NTUs) to obtain data on dissolved metals.

b) During groundwater well installation, a portion of the surface and subsurface soil samples (described above) will be collected from well borings to characterize the nature of surface and subsurface soil at the well locations. One sample will be collected at the surface and up to two samples will be collected 2 feet from the water table, based on visual observations of staining or other relevant indications (odors, discoloration, etc.). Otherwise, the subsurface samples will be collected at the water table and between the water table and surface. All soil samples will be analyzed for explosives (SW 846 Method 8330B) and metals (SW 846 Method 6010B/6020A).

SAP Worksheet #11.3 - Data Quality Objectives for EOD School Demolition Area (UXO 28)

STATE THE PROBLEM (STEP 1)

Worksheet 10.3 contains the problem definition for the EOD School Demolition Area.

IDENTIFY THE GOAL OF THE STUDY (STEP 2)

The primary goal of the SI for the EOD School Demolition Area is to obtain environmental data for use in making the following decisions:

1. Determine whether surface MEC or surface MC (explosives and metals) are present in a condition, quantity, or concentration that presents an immediate human health hazard and requires an immediate action. If such quantities are present, then initiate an appropriate remedial response. Otherwise, take no immediate action.

2. If surface MEC debris or anomalies indicate the presence of suspect MEC, then proceed with further investigation in the RI phase. If not, proceed to NFA for MEC. In this case, MC may still be present, so continue to investigate for the presence of MC contamination in surface soil.

3. Determine whether MC (explosives and metals) are present in the surface soil within the study area in quantities or concentrations above screening levels. If either of these conditions exists, then evaluate the need to proceed to an RI and FS. If not, proceed to NFA for MC.

4. Determine the extent of MEC and MC contamination for the purposes of delineation. If sufficient data have been collected for this purpose, then stop collecting data. If more data are required to delineate the extent of contamination, then conduct further investigation in the RI phase.

IDENTIFY INFORMATION INPUTS (STEP 3)

Data and information that will be required to make the decisions include the following:

1. UXO Surface Sweeps and Geophysical Investigation:
   Surface: Data will be obtained from detector-aided surface sweeps conducted by UXO personnel using hand-held metal detectors such as the Schonstedt GA-52Cx, White's Spectrum XLT or equivalent, and visual observations. UXO Technicians will use metal detectors to locate metallic items on the surface. Items located on the surface will be visually examined to determine if they are

suspect MEC, MPPEH, MD or non-MD. If located, suspect MEC, MPPEH and/or MD will not be moved or disturbed during the SI.

Subsurface: Locations of suspected metal objects in subsurface soil will be identified using metal detector anomalies (i.e., a response from the metal detector at a location where no surface materials are found) that result from the detector-aided surface sweeps will be used, along with data from a subsurface geophysical investigation conducted by a geophysicist using an all metals detector (such as Geonics EM61-MK2 or Geometrics G858 magnetometer), to locate suspect metal objects in subsurface soil. The choice of instrument will be based on the results of the ITS. Suspect MEC, MPPEH, MD and subsurface metals (if metals are MEC, MPPEH, or MD) could potentially result in the release of MC.

2. Chemical Data and Physical Characteristics:

Chemical data will be used to determine the presence of MC (explosives and metals) in the surface soil. Chemical analysis will be performed using method SW 846 8330B for explosives and method SW 846 6010B/6020A for metals. Three soil samples will also be analyzed for pH (SW 846 Method 9045D), TOC (Lloyd Kahn Method) and CEC (SW 846 Method 9081). The list of all chemical analytes is presented in Worksheet 15 and the laboratory methods are listed in Worksheet 18.

Project Action Limits:

This investigation requires chemical data that can be used to further characterize the site and to begin a screening level ecological and human health risk assessment. Chemical concentrations will first be compared to conservative screening values. If any chemical concentration exceeds a screening value, human health or ecological risks may be, but are not necessarily, unacceptable. If necessary, a human health and ecological assessment will be conducted during an RI.

To conduct comparisons of site data to screening values, the selected laboratory must be able to achieve quantitation limits that are low enough to measure constituent concentrations below the screening values. For this investigation the screening values, which are also known as the PALs, are listed and described below:

- U.S. EPA Regional Soil Screening Levels for Chemical Contaminants at Superfund Sites-Residential Use (July 7, 2008).

- Maryland Department of the Environment Generic Cleanup Standards (soil; August 2001).

- U.S. EPA ESSLs (2005).
- U.S. EPA Region III BTAG criteria if U.S. EPA ESSLs are not available.
- ORNL ecological screening levels if neither U.S. EPA ESSLs nor Region III BTAG criteria are available (1997).
- Background Concentrations established for soils (Appendix C).

Background values for soils have been developed. In the event that a chemical analyte exceeds a PAL, but falls below or is equal to an established background concentration, this chemical will not be retained as a COPC. On the other hand, if the chemical analyte is measured above the established background concentration, the chemical will be retained as a COPC. Established background concentrations are provided in Appendix C.

DEFINE THE BOUNDARIES OF THE STUDY (STEP 4)

The current site investigation at the EOD School Demolition Area is limited to an evaluation of surface soil. An investigation of other media including subsurface soil, groundwater, surface water and sediment is beyond the scope of this investigation, but may be required based, in part, on the outcome of this investigation.

1. The initial horizontal boundary for the MEC and MC investigation is the boundary of the EOD School Demolition Area as shown on Figure 17.3-1 (Appendix A MEC SAP) and Figure 17.3, respectively.

2. The initial vertical boundary for the MEC investigation (detector-aided surface sweeps and geophysical data) will be 4 feet bgs within the land area. Site activities included usage of explosive charges which created blow holes which may have been 4 feet deep. The site is overlapped by the firing fan from the Valley located on the Main Installation; therefore, there is the potential for munitions associated with the Valley to be present in the soil. Information from this investigation will also be considered in the assessment of impacts from munitions fired from the Valley.

3. Surface soil vertical boundary for MC: The surface soil interval that is of interest for ecological risk screening is the 0 to 6 inch bgs interval, while the 0 to 2 foot bgs interval is of interest for human health risk screening. Surface soil data will be collected from these intervals.

DEVELOP THE ANALYTIC APPROACH (STEP 5)

MEC Approach

1. If the detector-aided surface sweeps or geophysical investigation shows that suspect surface MEC and/or anomalies are not present, then proceed to NFA for MEC. In this case, MC may still be present, so continue to investigate for the presence of MC contamination in surface and subsurface soil.

2. If suspect MEC is observed on the surface or anomalies are present, then investigate the surface soil in the location of the suspect MEC or subsurface anomalies in order to determine if MC contamination is present in the soil. If the collected data are sufficient to determine the presence of MC contamination associated with the suspect MEC, then stop collecting data. If the data are not sufficient to determine if MC contamination is present, then return for further investigation in the RI phase.

MC Approach

1. If MC (explosives and metals) are detected in surface soil at concentrations less than screening levels, then proceed to NFA for MC for surface soil. If MC (explosives and metals) are detected in surface soil at concentrations above screening values, then the project team will evaluate the need to proceed to an RI for MC. Factors considered will include the explosive(s), the metal(s), the magnitude of the exceedance(s), their spatial distribution, and the location(s) of the exceedance(s).

Decision rules for delineation:

If MC (explosives and metals) are detected in surface soil at concentrations greater than screening values at the horizontal or vertical boundaries of sampling, then evaluate the need to collect step-out samples in the RI phase. These step-out samples may include surface soil, subsurface soil, surface water, sediment or groundwater samples. Factors considered will include the explosive(s), the metal(s), the magnitude of the exceedance(s), and the spatial distribution of the exceedance(s). In most cases, “step-out” samples should be collected until the perimeter sample concentrations are less than screening or background concentrations. However, professional judgment should be used to determine if such samples are needed in all cases. Professional judgment considerations include:

- The degree to which MC concentrations exceed screening or background levels. The need to collect additional data should be carefully considered when concentrations in surface soil are within 5 percent of screening or background levels. The need to collect additional data will increase with increased number of exceedances and increased contaminant concentrations.

- The degree to which further delineation can be more efficiently and economically collected as part of follow-up RI/FS investigations (i.e., the additional sampling is unlikely to affect the decision to take or not take some type of remedial action but may be necessary to define the limits of the action).

- Considerations of the impact of future human health and ecological risk estimations if some contaminant concentrations are not completely delineated.

    1. If suspect MEC and/or anomalies are found to be present in only a portion of the area surveyed then consider reducing the boundaries of the suspect MEC area.

    2. If suspect MEC and/or anomalies are found to be present at the boundaries of the surveyed area then consider extending the boundaries during the RI.

    3. Lateral and/or vertical expansion of the study area during the RI phase may be necessary if MC are present at the lateral and/or vertical extent of the initial surface soil sampling pattern at concentrations greater than screening levels. This may include investigation of additional environmental media. Factors considered will include the type of MC, the magnitude of the exceedance(s), their spatial distribution and the overall concentration data for all MC.

SPECIFY PERFORMANCE OR ACCEPTANCE CRITERIA (STEP 6)

1. The criterion for the detector-aided surface sweeps will be a go/no-go test performed by determining whether the instrument responds to metallic objects under a blanket (blanket test).

2. The criteria for the geophysical equipment function test will be
    a. Detection of all seed items buried within the 11x depth.
    b. Horizontal positions of seeded items within 1 meter of known locations.

3. Because this is the SI stage, probability limits for false decision errors were not established for MC.

4. Performance criteria for new analytical data are NQA limits and meeting the project action limits which are listed on Worksheet 15 for MC.

Details of the performance criteria for the blanket test and geophysical equipment function test are provided in the MEC SAP (Appendix A) Worksheet 12.

DEVELOP THE PLAN FOR OBTAINING DATA (STEP 7)

The proposed SI field data collection program for the EOD School Demolition Area is described in detail in Worksheet 17 of this UFP SAP for MC. Appendix A contains the MEC SAP for the detector-aided surface sweeps and the subsurface geophysical investigations. Worksheet 17 of the MEC SAP contains details. A brief summary of the approach is presented below.

Detector-Aided Surface Sweeps

1. Perform the blanket test. In this test metal objects such as trailer hitches, will be placed under a tarpaulin to verify that metal detectors are functioning.

2. Conduct detector-aided surface sweeps of the established survey areas as shown on Figure 17.3-1 in Appendix A (MEC SAP). A grid, 100 by 200 foot, surrounding the former ready bunker area, will be established and will receive 100% survey coverage. Sweeps, at 5-foot spaced transects will be conducted for the remainder of the area. A 100 percent detector-aided surface sweep will also be conducted of accessible areas within 50 feet of any anomaly clusters identified along transects during detector-aided surface sweeps, or during the subsurface geophysics investigation. The sweeps will be conducted by UXO technicians using hand-held metal detectors (White). Grid nodes will be staked in the field using a GPS unit. Stakes will be placed at 5-foot intervals on opposite sides (north - south sides) of the grid. In clear areas (minimal tree canopy) stakes will be placed every 5-foot on the opposite intervals (east – west) and ropes will be stretched from one side to the other to establish 5-foot wide lanes. In heavily vegetated areas, where stretching of ropes is not feasible, technicians will walk side-by-side at 5–foot intervals. Locations where visual observations of suspect MEC, MPPEH, MD or subsurface anomalies are observed will be marked with a stake. Pictures will be taken of items observed on the surface. In clear areas the locations will be recorded using a GPS unit. In areas where tree canopy precludes use of a GPS unit, locations will be established using a tape measure and compass measurements from a known location(s).

3. Utilize information from detector-aided sweeps to identify surface soil sampling location areas within the footprint of the surface sweeps for collection of soil samples based on the presence of MD and subsurface anomalies.

Subsurface Geophysics

1. Perform the geophysical equipment function test. In this test, metals items will be buried at various depths. Geophysical instrumentation will then be tested to verify that the operator, instrumentation and software are functioning properly. A Geonics EM61-MK2 or Geometrics G858 is planned for use at this site.

2. Conduct 100-percent survey of the 100- by 200-foot grid surrounding the former ready bunker area. Use survey line spacing no greater than 5 feet. Field conditions (i.e., brush) will further determine survey line spacing.

3. Conduct survey at 50-foot spaced transects for the remainder of the site.

4. Conduct 100-percent survey of accessible areas within 50 feet of any anomaly clusters identified along transects during the detector-aided surface sweeps or during the subsurface geophysical investigation.

MC Sample Collection and Analysis

1. Surface Soil
   a) Forty surface soil samples will be collected at the 0- to 6-inch bgs and 0- to 24-inch bgs levels at 20 sample locations. The 0- to 6-inch interval is of interest for ecological risk screening while the 0- to 24-inch interval is of interest for the human health risk screening. Specific locations will be selected by the planning team based on the results of detector-aided surface sweeps and geophysical investigation. Samples will be preferentially collected at locations where suspect MEC, MPPEH, or MD were identified on the surface. If no suspect MEC, MPPEH, or MD are identified, then surface soil samples will be collected in the locations shown on Figure 17.3.

      Surface soil samples at each location sampled will be composites of seven discrete samples collected using the seven-point wheel approach. Explosives present on the surface would have resulted from low order detonations releasing of particles of explosives. These particles would be

heterogeneously distributed in surface soil. In order to form a composite in which explosives would be evenly dispersed, the entire composite will be processed in the laboratory using the methodology described in Appendix A of SW 846 Method 8330B. This methodology consists of air drying and sieving the entire sample and conducting particle size reduction (grinding) of the entire sample. Surface soil samples will also be analyzed for metals using SW 846 Method 6010B/6020A.

b) Three soil samples shipped to the laboratory will be analyzed for pH (SW 846 Method 9045D), TOC (Lloyd Kahn Method), and CEC (SW 846 Method 9081).

c) Soil samples will be collected via hand auger.

d) Anomaly avoidance techniques will be followed for collection of all soil samples.

SAP Worksheet #11.4 - Data Quality Objectives for Basic IED Area (UXO 04)

STATE THE PROBLEM (STEP 1)

Worksheet 10.4 contains the problem definition for the Basic IED Area.

IDENTIFY THE GOAL OF THE STUDY (STEP 2)

The primary goal of the SI for the Basic IED Area is to obtain environmental data for use in making the following decisions:

1. Determine whether surface MEC or surface MC (explosives, metals and VOCs) are present in a condition, quantity, or concentration that presents an immediate human health hazard and requires an immediate response. If such quantities are present, then initiate an appropriate remedial response. Otherwise, take no immediate action.

2. If surface MEC debris or subsurface anomalies indicate the presence of suspect MEC, then proceed with further investigation in the RI phase. If not, proceed to NFA for MEC. In this case, MC may still be present, so continue to investigate for the presence of MC contamination in surface soil, subsurface soil, and groundwater.

3. Determine whether MC (explosives, metals and VOCs) are present in surface soil, subsurface soil or groundwater within the study area in quantities or concentrations above screening values. If either of these conditions exists, then evaluate the need to proceed to an RI and FS. If not, proceed to NFA for MC.

4. Determine the extent of MEC and MC contamination for the purposes of delineation. If sufficient data have been collected for this purpose, then stop collecting data. If more data are required to delineate the extent of contamination, then conduct further investigation in the RI phase.

IDENTIFY INFORMATION INPUTS (STEP 3)

Data and information that will be required to make the decisions include the following:

1. UXO Surface Sweeps:
   Surface: Data will be obtained from detector-aided surface sweeps conducted by UXO personnel using hand-held metal detectors, such as the Schonstedt GA-52Cx, White's Spectrum XLT, or

equivalent, and visual observations. UXO Technicians will use metal detectors to locate metallic items on the surface. Items located on the surface will be visually examined to determine if they are suspect MEC, MPPEH, MD or non-MD. If located, suspect MEC, MPPEH and/or MD will not be moved or disturbed during the SI.

Subsurface: Metal detector anomalies (i.e., a response from the metal detector at a location where no surface materials are found) that result from the detector-aided surface sweeps will be used to locate suspect metal objects in subsurface soils. Suspect MEC, MPPEH, munitions debris and subsurface metals (if metals are MEC, MPPEH, or MD) could potentially result in the release of MC.

2. Chemical Data and Physical Characteristics:

Chemical data will be used to determine the presence of MC (explosives, metals and VOCs) in the surface soil, subsurface soil and groundwater. Chemical analysis will be performed using method SW 846 8330B for explosives, method SW 846 6010B/6020A for metals, and method SW 846 8260B for VOCs. Three of the soil samples shipped to the laboratory will also be analyzed for pH (SW 846 Method 9045D), TOC (Lloyd Kahn Method), and CEC (SW 846 Method 9081). The list of all chemical analytes is presented in Worksheet 15 and the laboratory methods are listed in Worksheet 18.

Project Action Limits:

This investigation requires chemical data that can be used to further characterize the site and to begin a screening level ecological and human health risk assessment. Chemical concentrations will first be compared to conservative screening values. If any chemical concentration exceeds a screening value, human health or ecological risks may be, but are not necessarily, unacceptable. If necessary, a human health and ecological risk assessment will be conducted during an RI.

To conduct comparisons of site data to screening values, the selected laboratory must be able to achieve quantitation limits that are low enough to measure constituent concentrations below the screening values. For this investigation the screening values, which are also known as the PALs, are listed and described below:

- U.S. EPA Regional Soil Screening Levels for Chemical Contaminants at Superfund Sites-Residential Use (July 7, 2008).

- Maryland Department of the Environment Generic Cleanup Standards (soil and groundwater; August 2001).

- U.S. EPA ESSLs (2005).
- U.S. EPA Region III BTAG criteria if U.S. EPA ESSLs are not available.
- ORNL ecological screening levels if neither U.S. EPA ESSLs nor Region III BTAG criteria are available (1997).
- Background Concentrations established for soils (Appendix C).
- U.S. EPA Maximum Contaminant Level, 2006 Edition of the Drinking Water Standards and Health Advisories.

Background values for soil have been developed. In the event that a chemical analyte exceeds a PAL, but falls below or is equal to an established background concentration, this chemical will not be retained as a COPC. On the other hand, if the chemical analyte is measured above the established background concentration, the chemical will be retained as a COPC. Established background concentrations are provided in Appendix C.

DEFINE THE BOUNDARIES OF THE STUDY (STEP 4)

The current site investigation at the Basic IED Area is limited to an evaluation of soil and groundwater. An investigation of other media including surface water and sediment is beyond the scope of this investigation, but may be required based, in part, on the outcome of this investigation.

1. The initial horizontal boundary for MEC and MC investigation is defined as the Basic IED Area as presented on Figure 17.4-1 (Appendix A MEC SAP) and Figure 17.4, respectively.

2. The initial vertical boundary for the MEC investigation (detector-aided surface sweeps) will be 1 foot bgs within the land area. Explosives were used at this site only on the surface for testing and demonstration purposes. This site is overlapped by the firing fan from the Valley located on the Main Installation, therefore, there is the potential for munitions associated with the Valley to be present in the soil. Data from this investigation will also be used in the assessment of impacts from munitions fired from the Valley.

3. Surface Soil Vertical Boundary for MC Constituents: The surface soil interval that is of interest for ecological risk screening is the 0 to 6 inch bgs interval, while the 0 to 2 foot bgs interval is of interest for human health risk screening. Surface soil data will be collected from these intervals.

4. Subsurface Soil Vertical Boundary for MC Constituents: Subsurface soil data will be collected from the 2 to 4 foot bgs interval and the 4 to 6 foot bgs interval.

5. The initial vertical groundwater boundary will be the depth of the existing monitoring wells.

DEVELOP THE ANALYTIC APPROACH (STEP 5)

The decision rules for this investigation are as follows:

MEC Approach

1. The SI will use UXO detector-aided surface sweeps to locate surface and shallow subsurface anomalies. If the detector-aided surface sweeps shows that suspect surface MEC and subsurface anomalies are not present, then proceed to NFA for MEC. In this case, MC may still be present, so continue to investigate for the presence of MC contamination in surface soil, subsurface soil, and groundwater.

2. The SI will use UXO detector-aided surface sweeps to locate surface and shallow subsurface anomalies. If suspect MEC is observed on the surface or subsurface anomalies exist, then investigate the surface and/or subsurface soil in the location of the suspect MEC or subsurface anomaly in order to determine if MC contamination is present in the soils. If the collected data are sufficient to determine the presence of MC contamination associated with the suspect MEC, then stop collecting data. If the data are not sufficient to determine the presence, then return for further investigation in the RI phase.

MC Approach:

1. If MC (explosives, metals and VOCs) are detected in surface soil, subsurface soil or groundwater at concentrations less than screening levels, then proceed to NFA for MC for the appropriate media. If MC (explosives, metals or VOCs) are detected in surface soil, subsurface soil or groundwater at concentrations above screening values, then the project team will evaluate the need to proceed to an

RI for MC. Factors considered will include the explosive(s), the metal(s), the VOC(s), the magnitude of the exceedance(s), their spatial distribution, and the location(s) of the exceedance(s).

Decision rules for delineation:

If MC (explosives, metals and VOCs) are detected in surface soil, subsurface soil or groundwater at concentrations greater than screening values at the horizontal or vertical boundaries of sampling (vertical boundary only for groundwater), then evaluate the need to collect step-out samples in the RI phase. These step-out samples may include surface soil, subsurface soil, surface water, sediment or groundwater samples. Factors considered will include the explosive(s), the metal(s), the VOC(s), the magnitude of the exceedance, and the spatial distribution of the exceedance(s). In most cases, “step-out” samples should be collected until the perimeter sample concentrations are less than screening or background concentrations. However, professional judgment should be used to determine if such samples are needed in all cases. Professional judgment considerations include:

- The degree to which MC concentrations exceed screening or background levels. The need to collect additional data should be carefully considered when concentrations in surface soil, subsurface soil or groundwater are within 5 percent of screening or background levels. The need to collect additional data will increase with increased number of exceedances and increased contaminant concentrations.

- The degree to which further delineation can be more efficiently and economically collected as part of follow-up RI/FS investigations (i.e., the additional sampling is unlikely to impact the decision to take or not take some type of remedial action but may be necessary to define the limits of the action).

- Considerations of the impact of future human health and ecological risk estimations if some contaminant concentrations are not completely delineated.

1. If suspect MEC and/or anomalies are found to be present in only a portion of the area surveyed then consider reducing the boundaries of the suspect MEC area.

2. If suspect MEC and/or anomalies are found to be present at the boundaries of the surveyed area then consider extending the boundaries during the RI.

3. Vertical and/or lateral expansion of the study area during the RI phase may be necessary if contamination is present above screening levels in the initial study area boundary. This may include investigation of additional environmental media. Factors considered will include the type

of MC, the magnitude of the exceedance(s), their spatial distribution and the overall concentration data for all MC.

SPECIFY PERFORMANCE OR ACCEPTANCE CRITERIA (STEP 6)

1. The criterion for the detector-aided surface sweeps will be a go/no-go test performed by determining whether the instrument responds to metallic objects under a blanket (blanket test).

2. Because this is the SI stage, probability limits for false decision errors were not established for MC.

3. Performance criteria for new analytical data are NQA limits and meeting the project action limits which are listed on Worksheet 15 for MC.

Details of the performance criteria for the blanket test are provided in the MEC SAP (Appendix A) Worksheet 12.

DEVELOP THE PLAN FOR OBTAINING DATA (STEP 7)

The proposed SI field data collection program for the Basic IED Area is detailed in Worksheet 17 of this UFP SAP for MC. Appendix A contains the MEC SAP for the detector-aided surface sweeps. Worksheet 17 of the MEC SAP contains details. A brief summary of this approach is presented below.

Detector-Aided Surface Sweeps

1. Perform the blanket test. In this test, metal objects such as trailer hitches will be placed under a tarpaulin to verify that metal detectors are functioning.

2. Conduct detector-aided surface sweeps of the established survey areas as shown on Figure 17.4-1 in Appendix A (MEC SAP). A 90- by 150-foot grid around the former detonation area will be established and will receive 100% coverage. Sweeps, at 50-foot spaced transects will be conducted for the remainder of the area. A 100 percent detector-aided surface sweep will also be conducted of accessible areas within 50 feet of any anomaly clusters identified along transects during detector-aided surface sweeps. The sweeps will be conducted by UXO Technicians using hand held metal detectors (Schonstedt or White's). Grid nodes will be staked in the field using a GPS unit. Stakes will be placed at 5-foot intervals on opposite sides (north - south sides) of the grid. In clear areas (minimal tree canopy) stakes will be placed every 5 feet on the opposite intervals (east – west) and ropes will

be stretched from one side to the other to establish 5-foot wide lanes. In heavily vegetated areas, where stretching of ropes is not feasible, technicians will walk side-by-side at 5–foot intervals. Locations where visual observations of suspect MEC, MPPEH, MD or subsurface anomalies are observed will be marked with a stake. Pictures will be taken of items observed on the surface. In clear areas, the locations will be recorded using a GPS unit. In areas where tree canopy precludes use of a GPS unit, locations will be established using a tape measure and compass measurements from a known location(s).

3. Utilize information from detector-aided sweeps to identify soil sampling location areas within the footprint of the surface sweeps for collection of soil samples based on the presence of MD and subsurface anomalies.

MC Sample Collection and Analysis

1. Surface and Subsurface Soil
   a) Forty surface soil samples 40 will be collected at the 0- to 6-inch bgs and 0- to 24-inch bgs levels at 20 sample locations. The 0- to 6-inch interval is of interest for ecological risk screening while the 0- to 24-inch interval is of interest for the human health risk screening. Specific locations will be selected by the planning team based on the results of detector-aided surface sweeps. Samples will be preferentially collected at locations where suspect MEC, MPPEH, or MD were identified on the surface. If no suspect MEC, MPPEH, or MD are identified, then surface soil samples will be collected in the locations shown on Figure 17.4.

      Surface soil samples at each location sampled will be composites of seven discrete samples collected using the seven-point wheel approach. Explosives present on the surface would have resulted from low order detonations releasing particles of explosives. These particles would be heterogeneously distributed in surface soil. In order to form a composite in which explosives would be evenly dispersed, the entire composite will be processed in the laboratory using the methodology described in Appendix A of SW 846 Method 8330B. This methodology consists of air drying and sieving the entire sample and conducting particle size reduction (grinding) of the entire sample. Surface soil samples will also be analyzed for metals using SW 846 Method 6010B/6020A. Discrete surface soil samples will be collected for VOC analysis using SW 846 Method 8260B.

   b) Up to 40 subsurface soil samples will be collected from 2 to 6 feet bgs at all 20 locations. Two samples will be collected within that depth interval based on visual observations of staining or

other relevant indications (odors, discoloration, etc.). If these indications are not observed, samples will be collected at 2 to 4 feet bgs and 4 to 6 feet bgs. Specific locations will be determined by the project team based on the results of detector-aided surface sweeps. Samples will be preferentially collected at locations where suspect MEC, MPPEH, or MD were located on the surface or subsurface anomalies were detected. Subsurface samples at each location sampled will consist of one discrete sample. If no suspect MEC, MPPEH, or MD are identified, then subsurface soil samples will be collected at the soil sample locations shown on Figure 17.4. Subsurface soil samples will be analyzed for explosives (SW-846 Method 8330B), metals (SW-846 Method 6010B/6020A) and VOCs (SW 846 Method 8260B).

c) Three soil samples shipped to the laboratory will be analyzed for pH (SW 846 Method 9045D), TOC (Lloyd Kahn Method), and CEC (SW 846 Method 9081).

c) Soil samples will be collected by hand auger.

d) Anomaly avoidance techniques will be followed for collection of all soil samples.

2. Groundwater

a) Three groundwater samples will be collected from three existing monitoring wells after the wells are inspected and redeveloped, if necessary. Groundwater samples will be analyzed for explosives (SW-846 Method 8330B), metals (SW-846 Method 6010B/6020A) and VOCs (SW 846 Method 8260B). The groundwater samples will be filtered through a 0.45-micron filter if low-flow sample collection does not result in turbidity of less than 10 NTUs.

SAP Worksheet #11.5 - Data Quality Objectives for the Advanced IED Area (UXO 05)

STATE THE PROBLEM (STEP 1)

Worksheet 10.5 contains the problem definition for the Advanced IED Area.

IDENTIFY THE GOAL OF THE STUDY (STEP 2)

The primary goal of the SI for the Advanced IED Area is to obtain environmental data for use in making the following decisions:

1. Determine whether surface MEC or surface MC (explosives and metals) are present in a condition, quantity, or concentration that presents an immediate human health hazard and requires an immediate action. If such quantities are present, then initiate an appropriate remedial response. Otherwise, take no immediate action.

2. If surface MEC debris or subsurface anomalies indicate the presence of suspect MEC, then proceed with further investigation in the RI phase. If not, proceed to NFA for MEC. In this case, MC may still be present, so continue to investigate for the presence of MC contamination is surface and subsurface soil.

3. Determine whether MC (explosives and metals) are present in the surface or subsurface soil within the study area in quantities or concentrations above screening levels. If either of these conditions exists, then evaluate the need to proceed to an RI and FS. If not, proceed to NFA for MC.

4. Determine the extent of MEC and MC contamination for the purposes of delineation. If sufficient data have been collected for this purpose, then stop collecting data. If more data are required to delineate the extent of contamination, then conduct further investigation in the RI phase.

IDENTIFY INFORMATION INPUTS (STEP 3)

Data and information that will be required to make the decisions include the following:

1. UXO Surface Sweeps and Geophysical Investigation:
   Surface: Data will be obtained from detector-aided surface sweeps conducted by UXO personnel using hand-held metal detectors such as Schonstedt GA-52Cx, White's Spectrum XLT, or equivalent, and visual observations. UXO Technicians will use metal detectors to locate metallic items on the

surface. Items located on the surface will be visually examined to determine if they are suspect MEC, MPPEH, MD or non-MD. If located, suspect MEC, MPPEH and/or MD will not be moved or disturbed during the SI.

Subsurface: Metal detector anomalies (i.e., a response from the metal detector at locations where no surface materials are found) that result from the detector-aided surface sweeps will be used, along with data from a subsurface geophysical investigation conducted by a geophysicist using a Geonics EM61 or Geometrics G858, to locate suspect metal objects in subsurface soil. The choice of instrument will be based on the results of the ITS. Suspect MEC, MPPEH, MD and subsurface metals (if metals are MEC, MPPEH, or MD) could potentially result in the release of MC.

2. Chemical Data and Physical Characteristics:

Chemical data will be used to determine the presence of MC (explosives and metals) in the surface and subsurface soil. Chemical analysis will be performed using method SW 846 8330B for explosives and method SW 846 6010B/6020A for metals. Three soil samples will also be analyzed for pH (SW 846 Method 9045D), TOC (Lloyd Kahn Method) and CEC (SW 846 Method 9081). The list of all chemical analytes is presented in Worksheet 15 and the laboratory methods are listed in Worksheet 18.

Project Action Limits:

This investigation requires chemical data that can be used to further characterize the site and to begin a screening level ecological and human health risk assessment. Chemical concentrations will first be compared to conservative screening values. If any chemical concentration exceeds a screening value, human health or ecological risks may be, but are not necessarily, unacceptable. If necessary, a human health an ecological risk assessment will be conducted during an RI.

To conduct comparisons of site data to screening values, the selected laboratory must be able to achieve quantitation limits that are low enough to measure constituent concentrations below the screening values. For this investigation the screening values, which are also known as the PALs, are listed and described below:

- U.S. EPA Regional Soil Screening Levels for Chemical Contaminants at Superfund Sites-Residential Use (July 7, 2008).

- Maryland Department of the Environment Generic Cleanup Standards (soil; August 2001).

- U.S. EPA ESSLs (2005).
- U.S. EPA Region III BTAG criteria if U.S. EPA ESSLs are not available.
- ORNL ecological screening levels if neither U.S. EPA ESSLs nor Region III BTAG criteria are available (1997).
- Background Concentrations established for soils (Appendix C).

Background values for soil have been developed. In the event that a chemical analyte exceeds a PAL, but falls below or is equal to an established background concentration, this chemical will not be retained as a COPC. On the other hand, if the chemical analyte is measured above the established background concentration, the chemical will be retained as a COPC. Established background concentrations are provided in Appendix C.

DEFINE THE BOUNDARIES OF THE STUDY (STEP 4)

The current site investigation at the Advanced IED Area is limited to an evaluation of soil. An investigation of other media including groundwater, surface water and sediment is beyond the scope of this investigation, but may be required based, in part, on the outcome of this investigation.

1. The initial horizontal boundary for the MEC and MC investigation is the boundary of the Advanced IED Area as defined in the PA and shown on Figure 17.5-1 (Appendix A MEC SAP) and Figure 17.5, respectively.

2. The initial vertical boundary for the MEC investigation (detector-aided surface sweeps and geophysical data) will be 1 foot bgs within the land area as shown on Figure 17.5-1 of Appendix A. This area was used for training which did not involve firing projectile-type ordnance items; therefore, ordnance items are not suspected to be found below the 1 foot interval. The Advanced IED Area is overlapped by the firing fan from the Valley located at the Main Installation; therefore, there is the potential for munitions associated with the Valley to be present in this area. Data from this investigation will also be used in the assessment of impacts from munitions fired from the Valley.

3. Surface Soil Vertical Boundary for MC Constituents: The surface soil interval that is of interest for ecological risk screening is the 0 to 6 inch bgs interval, while the 0 to 2 foot bgs interval is of interest for human health risk screening. Surface soil data will be collected from these intervals.

4. Subsurface Soil Vertical Boundary for MC Constituents: Subsurface soil data will be collected from the 2 to 4 foot bgs interval and the 4 to 6 foot bgs interval.

DEVELOP THE ANALYTIC APPROACH (STEP 5)

The decision rules for this investigation are as follows:

MEC Approach

1. If the detector-aided surface sweeps or geophysical investigation shows that suspect surface MEC and subsurface anomalies are not present, then proceed to NFA for MEC. In this case, MC may still be present, so continue to investigate for the presence of MC contamination in surface and subsurface soil.

2. If suspect MEC is observed on the surface or if subsurface anomalies exist, then investigate the surface and/or subsurface soil in the location of the suspect MEC or subsurface anomalies in order to determine if MC contamination is present in the soil. If the collected data are sufficient to determine the presence of MC contamination associated with the suspect MEC, then stop collecting data. If the data are not sufficient to determine the presence, then return for further investigation in the RI phase.

MC Approach:

1. If MC (explosives and metals) are detected in surface or subsurface soil at concentrations less than screening levels, then proceed to NFA for MC for the appropriate media. If MC (explosives and metals) are detected in surface or subsurface soil at concentrations above screening values, then the project team will evaluate the need to proceed to an RI for MC. Factors considered will include the explosive(s), the metal(s), the magnitude of the exceedance(s), their spatial distribution, and the location(s) of the exceedance(s).

Decision rules for delineation:

If MC (explosives and metals) are detected in surface or subsurface soil at concentrations greater than screening values at the horizontal or vertical boundaries of sampling, then evaluate the need to collect step-out samples in the RI phase. These step-out samples may include surface soil, subsurface soil, surface water, sediment or groundwater samples. Factors considered will include the explosive(s), the metal(s), the magnitude of the exceedance, and the spatial distribution of the exceedance(s). In most cases, "step-out" samples should be collected until the perimeter sample concentrations are less than screening or background concentrations. However, professional judgment should be used to determine if such samples are needed in all cases. Professional judgment considerations include:

- The degree to which MC concentrations exceed screening or background levels. The need to collect additional data should be carefully considered when concentrations in surface or subsurface soil are within 5 percent of screening or background levels. The need to collect additional data will increase with increased number of exceedances and increased contaminant concentrations.

- The degree to which further delineation can be more efficiently and economically collected as part of follow-up RI/FS investigations (i.e., the additional sampling is unlikely to impact the decision to take or not take some type of remedial action but may be necessary to define the limits of the action).

- Considerations of the impact of future human health and ecological risk estimations if some contaminant concentrations are not completely delineated.

    1. If suspect MEC and/or anomalies are found to be present in only a portion of the area surveyed then consider reducing the boundaries of the suspect MEC area.

    2. If suspect MEC and/or anomalies are found to be present at the boundaries of the surveyed area then consider extending the boundaries during the RI.

    3. Lateral and/or vertical expansion of the study area during the RI phase may be necessary if MC are present at the lateral and/or vertical extent of the initial surface or subsurface soil sampling pattern at concentrations greater than screening levels. This may include investigation of additional environmental media. Factors considered will include the type of MC, the magnitude of the exceedance(s), their spatial distribution and the overall concentration data for all MC.

SPECIFY PERFORMANCE OR ACCEPTANCE CRITERIA (STEP 6)

1. The criterion for the detector-aided surface sweeps will be a go/no-go test performed by determining whether the instrument responds to metallic objects under a blanket (blanket test).

2. The criteria for the geophysical equipment function test will be:
   a) Detection of all seed items buried within the 11x depth.
   b) Horizontal positions of seeded items within 1 meter of known locations.

3. Because this is the SI stage, probability limits for false decision errors were not established for MC.

4. Performance criteria for new analytical data are NQA limits and meeting the project action limits which are listed on Worksheet 15 for MC.

Details of the performance criteria for the blanket test and geophysical equipment function test are provided in the MEC SAP (Appendix A) Worksheet 12.

DEVELOP THE PLAN FOR OBTAINING DATA (STEP 7)

The proposed SI field data collection program for the Advanced IED Area is described in detail in Worksheet 17 of this UFP SAP for MC. Appendix A contains the MEC SAP for the detector-aided surface sweeps and the subsurface geophysical investigations. Worksheet 17 of the MEC SAP contains details. A brief summary of this approach is presented below.

Detector-Aided Surface Sweeps

1. Perform the blanket test. In this test, metal objects such as trailer hitches will be placed under a tarpaulin to verify that metal detectors are functioning.

2. Conduct a 100 percent detector-aided surface sweep around SWMU 27 at the location as shown on Figure 17.5-1 in Appendix A (MEC SAP). Sweeps, at 50-foot spaced transects, will be conducted for the remainder of the area. A 100 percent detector-aided surface sweep will also be conducted of accessible areas within 50 feet of any anomaly clusters identified along transects during detector-aided surface sweeps, or during the subsurface geophysical investigation. The sweeps will be conducted by UXO Technicians using hand held metal detectors (Schonstedt or White's). Locations where visual observations of suspect MEC, MPPEH, MD or subsurface anomalies are observed will

be marked with a stake. Pictures will be taken of items observed on the surface. In clear areas, the locations will be recorded using a GPS unit. In areas where tree canopy precludes use of a GPS unit, locations will be established using a tape measure and compass measurements from a known location(s).

3. Utilize information from detector-aided sweeps to identify soil sampling location areas within the footprint of the surface sweeps for collection of soil samples based on the presence of MD and subsurface anomalies.

Subsurface Geophysics

1. Perform the geophysical equipment function test. In this test, metals items will be buried at various depths. Geophysical instrumentation will then be tested to verify that the operator, instrumentation and software are functioning properly. A Geonics EM61-MK2 or Geometrics G858 is planned for use at this site.

2. Test the survey equipment.

3. Conduct survey on 5-foot spaced parallel survey lines on the berm and with 2.5-foot spacing in the open (cleared) area surrounded by the berm.

4. Conduct 100-percent survey of accessible areas within 50 feet of any anomaly clusters identified along transects during the detector-aided surface sweeps or subsurface geophysical investigation.

5. Utilize information from subsurface geophysical investigation to identify soil sampling locations based on the presence of subsurface anomalies.

MC Sample Collections and Analysis

1. Surface and Subsurface Soil
   a) Forty surface soil samples will be collected at the 0- to 6-inch bgs and 0- to 24-inch bgs levels at 20 sample locations. The 0- to 6-inch interval is of interest for ecological risk screening while the 0- to 24-inch interval is of interest for the human health risk screening. Specific locations will be selected by the planning team based on the results of detector-aided surface sweeps and geophysical investigation. Samples will be preferentially collected at locations where suspect

MEC, MPPEH, or MD were identified on the surface. If no suspect MEC, MPPEH, or MD are identified, then surface soil samples will be collected in the locations shown on Figure 17.5.

Surface soil samples at each location sampled will be composites of seven discrete samples collected using the seven-point wheel approach. Explosives present on the surface would have resulted from low order detonations releasing particles of explosives. These particles would be heterogeneously distributed in surface soil. In order to form a composite in which explosives would be evenly dispersed, the entire composite will be processed in the laboratory using the methodology described in Appendix A of SW 846 Method 8330B. This methodology consists of air drying and sieving the entire sample and conducting particle size reduction (grinding) of the entire sample. Surface soil samples will also be analyzed for metals using SW 846 Method 6010B/6020A.

b) Up to 40 subsurface soil samples will be collected from 2 to 6 feet bgs at all 20 locations. Two samples will be collected within that depth interval based on visual observations of staining or other relevant indications (odors, discoloration, etc.). If these indications are not observed, samples will be collected at 2 to 4 feet bgs and 4 to 6 feet bgs. Specific locations will be determined by the project team based on the results of detector-aided surface sweeps and subsurface geophysical investigation. Samples will be preferentially collected at locations where suspect MEC, MPPEH, or MD was located on the surface or where subsurface anomalies were detected. Subsurface samples at each location sampled will consist of one discrete sample. If no suspect MEC, MPPEH, or MD is identified, then subsurface soil samples will be collected from each of the soil sample locations shown on Figure 17.5. Subsurface soil samples will be analyzed for explosives (SW-846 Method 8330B) and metals (SW-846 Method 6010B/6020A).

c) Three soil samples shipped to the laboratory will be analyzed for pH (SW 846 Method 9045D), TOC (Lloyd Kahn Method), and CEC (SW 846 Method 9081).

d) Soil samples will be collected by hand auger.

e) Anomaly avoidance techniques will be followed for collection of all soil samples.

SAP Worksheet #11.6 - Data Quality Objectives for the Stump Neck Impact Area (UXO 10)

STATE THE PROBLEM (STEP 1)

Worksheet 10.6 contains the problem definition for the Stump Neck Impact Area.

IDENTIFY THE GOAL OF THE STUDY (STEP 2)

The primary goal of the SI for the Stump Neck Impact Area is to obtain environmental data for use in making the following decisions:

1. Determine whether surface MEC or surface MC (explosives) are present in a condition, quantity, or concentration that presents an immediate human health hazard and requires an immediate action. If such quantities are present, then initiate an appropriate remedial response. Otherwise, take no immediate action.

2. If surface MEC debris or subsurface anomalies indicate the presence of suspect MEC, then proceed with further investigation in the RI phase. If not, proceed to NFA for MEC. In this case, MC may still be present, so continue to investigate for the presence of MC contamination in surface and subsurface soil.

3. Determine whether MC (explosives) are present in the soil within the study area in quantities or concentrations above screening levels. If either of these conditions exists, then evaluate the need to proceed to an RI and FS. If not, proceed to NFA for MC.

4. Determine the extent of MEC and MC contamination for the purposes of delineation. If sufficient data have been collected for this purpose, then stop collecting data. If more data are required to delineate the extent of contamination, then conduct further investigation in the RI phase.

IDENTIFY INFORMATION INPUTS (STEP 3)

1. UXO Surface Sweeps and Geophysical Investigation:
   Surface: Data will be obtained from detector-aided surface sweeps conducted by UXO personnel using hand-held metal detectors such as the Schonstedt GA-52Cx or equivalent, and visual observations. UXO Technicians will use metal detectors to locate metallic items on the surface. Items located on the surface will be visually examined to determine if they are suspect MEC, MPPEH,

MD or non-MD. If located, suspect MEC, MPPEH and/or MD will not be moved or disturbed during the SI.

Subsurface: Metal detector anomalies (i.e., a response from the metal detector at a location where no surface materials are found) that result from the detector-aided surface sweeps will be used, along with the data from a subsurface geophysical investigation conducted by a geophysicist using a Geometrics G858, to locate metals in subsurface soil. The choice of instrument may change based on the results of the ITS. Suspect MEC, MPPEH, MD and subsurface metals (if metals are MEC, MPPEH, or MD) could potentially result in the release of MC.

2. Chemical Data and Physical Characteristics:

Chemical data will be used to determine the presence of MC (explosives) in the surface and subsurface soil. Chemical analysis will be performed using method SW 846 8330B for explosives. Three soil samples will also be analyzed for pH (SW 846 Method 9045D), TOC (Lloyd Kahn Method) and CEC (SW 846 Method 9081). The list of all chemical analytes is presented in Worksheet 15 and the laboratory methods are listed in Worksheet 18.

Project Action Limits:

This investigation requires chemical data that can be used to further characterize the site and to begin a screening level ecological and human health risk assessment. Chemical concentrations will first be compared to conservative screening values. If any chemical concentration exceeds a screening value, human health or ecological risks may be, but are not necessarily, unacceptable. If necessary, a human health and ecological risk assessment will be conducted during an RI.

To conduct comparisons of site data to screening values, the selected laboratory must be able to achieve quantitation limits that are low enough to measure constituent concentrations below the screening values. For this investigation the screening values, which are also known as the PALs, are listed and described below:

- U.S. EPA Regional Soil Screening Levels for Chemical Contaminants at Superfund Sites-Residential Use (July 7, 2008).
- Maryland Department of the Environment Generic Cleanup Standards (soil; August 2001).
- U.S. EPA ESSLs (2005).

- U.S. EPA Region III BTAG criteria if U.S. EPA ESSLs are not available.

- ORNL ecological screening levels if neither U.S. EPA ESSLs nor Region III BTAG criteria are available (1997).

- Background Concentrations established for soils (Appendix C).

Background values for soil have been developed. In the event that a chemical analyte exceeds a PAL, but falls below or is equal to an established background concentration, this chemical will not be retained as a COPC. On the other hand, if the chemical analyte is measured above the established background concentration, the chemical will be retained as a COPC. Established background concentrations are provided in Appendix C.

DEFINE THE BOUNDARIES OF THE STUDY (STEP 4)

The current site investigation at the Stump Neck Impact Area is limited to an evaluation of soil. An investigation of other media including groundwater, surface water and sediment is beyond the scope of this investigation, but may be required based, in part, on the outcome of this investigation.

1. The initial horizontal boundary for the MEC and MC investigations will be the portions of the MRP boundary identified on Figure 17.6-1 (Appendix A MEC SAP) and Figure 17.6, respectively, that are accessible by foot and survey instrument. The wetland portion will not be investigated.

2. The initial vertical boundary for the MEC investigation (detector-aided surface sweeps and geophysical investigation) will be 1 foot bgs within the accessible land area. The vertical boundary for the geophysical investigation will be 0 to 5 feet bgs. The PA indicated that estimated penetration depths for munitions believed to have been fired into this area are between 4 and 12 feet bgs. The Stump Neck Impact Area is overlapped by the firing fan from the Valley located at the Main Installation; therefore, there is the potential for munitions associated with the Valley to be present in this area. Data from this investigation will also be used in the assessment of impacts from munitions fired from the Valley.

3. Surface Soil Vertical Boundary for MC Constituents: The surface soil interval that is of interest for ecological risk screening is the 0 to 6 inch bgs interval, while the 0 to 2 foot bgs interval is of interest for human health risk screening. Surface soil data will be collected from these intervals.

4. Subsurface Soil Vertical Boundary for MC Constituents: Subsurface soil data will be collected from the 2 to 4 foot bgs interval and the 4 to 6 foot bgs interval.

DEVELOP THE ANALYTIC APPROACH (STEP 5)

The decision rules for this investigation are as follows:

MEC Approach

1. If the detector-aided surface sweeps or geophysical investigation shows that suspect surface MEC and subsurface anomalies are not present, then proceed to NFA for MEC. In this case, MC may still be present, so continue to investigate for the presence of MC contamination in surface and subsurface soil.

2. If suspect MEC is observed on the surface or if subsurface anomalies exist, then investigate the surface and/or subsurface soil in the location of the suspect MEC or subsurface anomaly in order to determine if MC contamination is present in the soil. If the collected data are sufficient to determine the presence of MC contamination associated with the suspect MEC, then stop collecting data. If the data are not sufficient to determine the presence, then return for further investigation in the RI phase.

MC Approach:

1. If MC (explosives) are detected in surface or subsurface soil at concentrations less than screening levels, then proceed to NFA for MC for the appropriate media. If MC (explosives) are detected in surface or subsurface soil at concentrations above screening values, then the project team will evaluate the need to proceed to an RI for MC. Factors considered will include the explosive(s), the magnitude of the exceedance(s), their spatial distribution, and the location(s) of the exceedance(s).

Decision rules for delineation:

If MC (explosives) are detected in surface or subsurface soil at concentrations greater than screening values at the horizontal or vertical boundaries of sampling, then evaluate the need to collect step-out samples in the RI phase. These step-out samples may include surface soil, subsurface soil surface water, sediment or groundwater samples. Factors considered will include the explosive(s), the magnitude of the exceedance, and the spatial distribution of the exceedance(s). In most cases, “step-out” samples

should be collected until the perimeter sample concentrations are less than screening or background concentrations. However, professional judgment should be used to determine if such samples are needed in all cases. Professional judgment considerations include:

- The degree to which MC concentrations exceed screening or background levels. The need to collect additional data should be carefully considered when concentrations in surface or subsurface soil are within 5 percent of screening or background levels. The need to collect additional data will increase with increased number of exceedances and increased contaminant concentrations.

- The degree to which further delineation can be more efficiently and economically collected as part of follow-up RI/FS investigations (i.e., the additional sampling is unlikely to impact the decision to take or not take some type of remedial action but may be necessary to define the limits of the action).

- Considerations of the impact of future human health and ecological risk estimations if some contaminant concentrations are not completely delineated.

    1. If suspect MEC and/or anomalies are found to be present in only a portion of the area surveyed then consider reducing the boundaries of the suspect MEC area.

    2. If suspect MEC and/or anomalies are found to be present at the boundaries of the surveyed area then consider extending the boundaries during the RI.

    3. Lateral and/or vertical expansion of the study area during the RI phase may be necessary if MC are present at the lateral and/or vertical extent of the initial surface or subsurface soil sampling pattern at concentrations greater than screening levels. This may include the investigation of additional environmental media. Factors considered will include the type of MC, the magnitude of the exceedance(s), their spatial distribution and the overall concentration data for all MC.

SPECIFY PERFORMANCE OR ACCEPTANCE CRITERIA (STEP 6)

1. The criterion for the detector-aided surface sweeps will be a go/no-go test performed by determining whether the instrument responds to metallic objects under a blanket (blanket test).

2. The criteria for the geophysical equipment function test will be
    a. Detection of seed items buried within the 11x depth.
    b. Horizontal positions of seeded items within 1 meter of known locations.

3. Because this is the SI stage, probability limits for false decision errors were not established for MC.

4. Performance criteria for new analytical data are NQA limits and meeting the project action limits which are listed on Worksheet 15 for MC.

Details of the performance criteria for the blanket test and geophysical equipment function test are provided in the MEC SAP (Appendix A) Worksheet 12.

DEVELOP THE PLAN FOR OBTAINING DATA (STEP 7)

The proposed SI field data collection program for the Stump Neck Impact Area is described in detail in Worksheet 17 of this UFP SAP for MC. Appendix A contains the MEC SAP for the detector-aided surface sweeps and the subsurface geophysical investigations. Worksheet 17 of the MEC SAP contains details. A brief summary of this approach is presented below.

Detector-Aided Surface Sweeps

1. Perform the blanket test. In this test, metal objects such as trailer hitches will be placed under a tarpaulin to verify that metal detectors are functioning.

2. Conduct detector-aided surface sweeps of the established survey areas as shown on Figure 17.6-1 of Appendix A (MEC SAP). Sweeps, at 40-foot spaced transects along accessible portions of the site, will be conducted. A 100 percent detector-aided surface sweep will also be conducted of accessible areas within 50 feet of any anomaly clusters identified along transects during detector-aided surface sweeps, or during the subsurface geophysical investigation. The sweeps will be conducted by UXO Technicians using hand held metal detectors (Schonstedt). Locations where visual observations of suspect MEC, MPPEH, MD or subsurface anomalies are observed will be marked with a stake. Pictures will be taken of items observed on the surface. In clear areas the locations will be recorded using a GPS unit. In areas where tree canopy precludes use of a GPS unit, locations will be established using a tape measure and compass measurements from a known location(s).

3. Utilize information from detector-aided sweeps to identify soil sampling location areas within the footprint of the surface sweeps for collection of soil samples based on the presence of MD and subsurface anomalies.

Geophysical Survey

1. Perform the geophysical equipment function test. In this test, metals items will be buried at various depths. Geophysical instrumentation will then be tested to verify that the operator, instrumentation and software are functioning properly. A Geometrics G858 is planned for use at this site.

2. Test the survey equipment.

3. Conduct survey on 40-foot spaced parallel survey transects across accessible portions of the designated site.

4. Utilize information from subsurface geophysical investigation to identify soil sampling locations based on the presence of subsurface anomalies.

MC Sample Collection and Analysis

1. Surface and Subsurface Soil

   a) Twenty surface soil samples will be collected at the 0- to 6-inch bgs and 0- to 24-inch bgs levels at 10 sample locations. The 0- to 6-inch interval is of interest for ecological risk screening while the 0- to 24-inch interval is of interest for the human health risk screening. Specific locations will be selected by the planning team based on the results of detector-aided surface sweeps and geophysical investigation. Samples will be preferentially collected at locations where suspect MEC, MPPEH, or MD were identified on the surface. If no suspect MEC, MPPEH, or MD are identified, then surface soil samples will be collected in the locations shown on Figure 17.6.

      Surface soil samples at each location sampled will be composites of seven discrete samples collected using the seven-point wheel approach. Explosives present on the surface would have resulted from low order detonations releasing particles of explosives. These particles would be heterogeneously distributed in surface soil. In order to form a composite in which explosives would be evenly dispersed, the entire composite will be processed in the laboratory using the methodology described in Appendix A of SW 846 Method 8330B. This methodology consists of air drying and sieving the entire sample and conducting particle size reduction (grinding) of the entire sample. All surface soil samples will be analyzed for explosives (SW-846 Method 8330B).

   b) Up to twenty subsurface soil samples will be collected from 2 to 6 feet bgs at all 10 surface soil sample locations. Two samples will be collected within that depth interval based on visual

observations of staining or other relevant indications (odors, discoloration, etc.). If these indications are not observed, samples will be collected at 2 to 4 feet bgs and 4 to 6 feet bgs. Specific locations will be determined by the project team based on the results of detector-aided surface sweeps and subsurface geophysical investigations. Samples will be preferentially collected at locations where suspect MEC, MPPEH, or MD were located on the surface or where subsurface anomalies were detected. Subsurface soil samples at each location sampled will consist of one discrete sample. If no suspect MEC, MPPEH, or MD or subsurface anomalies are identified, then subsurface soil samples will be collected in the soil sample locations shown on Figure 17.6. All subsurface soil samples will be analyzed for explosives (SW-846 Method 8330B).

c) Three soil samples shipped to the laboratory will be analyzed for pH (SW 846 Method 9045D), TOC (Lloyd Kahn Method), and CEC (SW 846 Method 9081).

d) Soil samples will be collected by hand auger and DPT.

e) Anomaly avoidance techniques will be followed for collection of all soil samples.

SAP Worksheet #11.7 - Data Quality Objectives for Test Area 1 (UXO 21)

STATE THE PROBLEM (STEP 1)

Worksheet 10.7 contains the problem definition for the Test Area 1.

IDENTIFY THE GOAL OF THE STUDY (STEP 2)

The primary goal of the SI for Test Area 1 is to obtain environmental data for use in making the following decisions:

1. Determine whether surface MEC or surface MC (explosives) are present in a condition, quantity, or concentration that presents an immediate human health hazard and requires an immediate action. If such quantities are present, then initiate an appropriate remedial response. Otherwise, take no immediate action.

2. If surface MEC debris or subsurface anomalies indicate the presence of suspect MEC, then proceed with further investigation in the RI phase. If not, proceed to NFA for MEC. In this case, MC may still be present, so continue to investigate for the presence of MC contamination in surface soil.

3. Determine whether MC (explosives) are present in the surface soil within the study area in quantities or concentrations above screening levels. If either of these conditions exists, then evaluate the need to proceed to an RI and FS. If not, proceed to NFA for MC.

4. Determine the extent of MEC and MC contamination for the purposes of delineation. If sufficient data have been collected for this purpose, then stop collecting data. If more data are required to delineate the extent of contamination, then conduct further investigation in the RI phase.

IDENTIFY INFORMATION INPUTS (STEP 3)

Data and information that will be required to make the decisions include the following:

1. UXO Surface Sweeps:
   Surface: Data will be obtained from detector-aided surface sweeps conducted by UXO personnel using hand-held metal detectors such as the Schonstedt GA-52Cx, White's Spectrum XLT, or equivalent and visual observations. UXO Technicians will use metal detectors to locate metallic items on the surface. Items located on the surface will be visually examined to determine if they are

suspect MEC, MPPEH, MD or non-MD. If located, suspect MEC, MPPEH and/or MD will not be moved or disturbed during the SI.

Subsurface: Metal detector anomalies (i.e., a response from the metal detector at a location where no surface materials are found) that result from the detector-aided surface sweeps will be used to locate suspect metal objects in shallow subsurface soil. Suspect MEC, MPPEH, MD and subsurface metals (if metals are MEC, MPPEH, or MD) could potentially result in the release of MC.

2. Chemical Data and Physical Characteristics:
Chemical data will be used to determine the presence of MC (explosives) in the surface soil. Chemical analysis will be performed using method SW 846 8330B for explosives. Three soil samples will also be analyzed for pH (SW 846 Method 9045D), TOC (Lloyd Kahn Method) and CEC (SW 846 Method 9081). The list of all chemical analytes is presented in Worksheet 15 and the laboratory methods are listed in Worksheet 18.

Project Action Limits:

This investigation requires chemical data that can be used to further characterize the site and to begin a screening level ecological and human health risk assessment. Chemical concentrations will first be compared to conservative screening values. If any chemical concentration exceeds a screening value, human health or ecological risks may be, but are not necessarily, unacceptable. If necessary, a human health and ecological risk assessment will be conducted during an RI.

To conduct comparisons of site data to screening values, the selected laboratory must be able to achieve quantitation limits that are low enough to measure constituent concentrations below the screening values. For this investigation the screening values, which are also known as the PALs, are listed and described below:

- U.S. EPA Regional Soil Screening Levels for Chemical Contaminants at Superfund Sites-Residential Use (July 7, 2008).
- Maryland Department of the Environment Generic Cleanup Standards (soil; August 2001).
- U.S. EPA (ESSLs (2005).

- U.S. EPA Region III BTAG criteria if U.S. EPA ESSLs are not available.

- ORNL ecological screening levels if neither U.S. EPA ESSLs nor Region III BTAG criteria are available (1997).

- Background Concentrations established for soils (Appendix C).

Background values for soil have been developed. In the event that a chemical analyte exceeds a PAL, but falls below or is equal to an established background concentration, this chemical will not be retained as a COPC. On the other hand, if the chemical analyte is measured above the established background concentration, the chemical will be retained as a COPC. Established background concentrations are provided in Appendix C.

DEFINE THE BOUNDARIES OF THE STUDY (STEP 4)

The current site investigation at Test Area 1 is limited to an evaluation of surface soil. An investigation of other media including subsurface soil, groundwater, surface water and sediment is beyond the scope of this investigation, but may be required based, in part, on the outcome of this investigation.

1. The initial horizontal boundary for the MEC and MC investigations will be the MRP boundary identified on Figure 17.7-1 (Appendix A MEC SAP) and Figure 17.7, respectively.

2. Within the bowl, only visual observations of the surface will be conducted.

3. The initial vertical boundary for the MEC investigation (detector-aided surface sweeps) will be 1 foot bgs. The site was initially developed for moon relay communication experiments and was subsequently used for IED and IND training. Small TNT charges were used during training at this site, but are not expected to have penetrated the ground surface.

4. Surface soil vertical boundary for MC: The vertical boundary will be 0 to 6 inches bgs and 0 to 24 inches bgs in the area surrounding the bowl. The surface soil interval that is of interest for ecological risk screening is the 0 to 6 inch bgs interval, while the 0 to 2 foot bgs interval is of interest for human health risk screening.

DEVELOP THE ANALYTIC APPROACH (STEP 5)

The decision rules for this investigation are as follows:

MEC Approach

1. The SI will use UXO detector-aided surface sweeps to locate surface and shallow subsurface anomalies. If the detector-aided surface sweep shows that suspect surface MEC and anomalies are not present, then proceed to NFA for MEC. In this case, MC may still be present, so continue to investigate for the presence of MC contamination in soil.

2. The SI will use UXO detector-aided surface sweeps to locate surface and shallow subsurface anomalies. If suspect MEC is observed on the surface or if subsurface anomalies exist, then investigate the soil in the location of the suspect MEC or subsurface anomaly in order to determine if MC contamination is present in the soil. If the collected data are sufficient to determine the presence of MC contamination associated with the suspect MEC, then stop collecting data. If the data are not sufficient to determine the presence, then return for further investigation in the RI phase.

MC Approach:

1. If MC (explosives) are detected in surface soil at concentrations less than screening levels, then proceed to NFA for MC for surface soil. If MC (explosives) are detected in surface soil at concentrations above screening values, then the project team will evaluate the need to proceed to an RI for MC. Factors considered will include the explosive(s), the magnitude of the exceedance(s), their spatial distribution, and the location(s) of the exceedance(s).

Decision rules for delineation:

If MC (explosives) are detected in surface soil at concentrations greater than screening values at the horizontal or vertical boundaries of sampling, then evaluate the need to collect step-out samples in the RI phase. These step-out samples may include surface soil, subsurface soil, surface water, sediment or groundwater samples. Factors considered will include the explosive(s), the magnitude of the exceedance, and the spatial distribution of the exceedance(s). In most cases, “step-out” samples should be collected until the perimeter sample concentrations are less than screening or background concentrations. However, professional judgment should be used to determine if such samples are needed in all cases. Professional judgment considerations include:

- The degree to which MC concentrations exceed screening or background levels. The need to collect additional data should be carefully considered when concentrations in surface soil are within 5 percent of screening or background levels. The need to collect additional data will increase with increased number of exceedances and increased contaminant concentrations.

- The degree to which further delineation can be more efficiently and economically collected as part of follow-up RI/FS investigations (i.e., the additional sampling is unlikely to impact the decision to take or not take some type of remedial action but may be necessary to define the limits of the action).

- Considerations of the impact of future human health and ecological risk estimations if some contaminant concentrations are not completely delineated.

    1. If suspect MEC and/or anomalies are found to be present in only a portion of the area surveyed then consider reducing the boundaries of the suspect MEC area.

    2. If suspect MEC and/or anomalies are found to be present at the boundaries of the surveyed area then consider extending the boundaries during the RI.

    3. Lateral and/or vertical expansion of the study area during the RI phase may be necessary if MC are present at the lateral and/or vertical extent of the initial sampling surface soil pattern at concentrations greater than screening levels. This may include the investigation of additional environmental media. Factors considered will include the type of MC, the magnitude of the exceedance(s), their spatial distribution and the overall concentration data for all MC.

SPECIFY PERFORMANCE OR ACCEPTANCE CRITERIA (STEP 6)

1. The criterion for the detector-aided surface sweeps will be a go/no-go test performed by determining whether the instrument responds to metallic objects under a blanket (blanket test).

2. Because this is the SI stage, probability limits for false decision errors were not established for MC.

3. Performance criteria for new analytical data are NQA limits and meeting the project action limits which are listed on Worksheet 15 for MC.

Details of the performance criteria for the blanket test are provided in the MEC SAP (Appendix A) Worksheet 12.

DEVELOP THE PLAN FOR OBTAINING DATA (STEP 7)

The proposed SI field data collection program for Test Area 1 is detailed in Worksheet 17 of this UFP SAP for MC. Appendix A contains the MEC SAP for the detector-aided surface sweeps. Worksheet 17 of the MEC SAP contains details. A brief summary of this approach is presented below.

Visual Survey (Inside the Bowl)

1. Conduct a thorough visual inspection of the metal-reinforced bowl area for the presence of suspect MEC.

Detector-Aided Surface Sweep (Outside the Bowl)

1. Perform the blanket test. In this test, metal objects such as trailer hitches will be placed under a tarpaulin to verify that metal detectors are functioning.

2. Conduct a 100 percent detector-aided surface survey outside the bowl area as shown on Figure 17.7-1 of Appendix A (MEC SAP). The survey will be conducted by UXO technicians using hand held metal detectors (Schonstedt or White's). Locations where visual observations of suspect MEC, MPPEH, MD or subsurface anomalies are observed will be marked with a stake. Pictures will be taken of items observed on the surface. In clear areas the locations will be recorded using a GPS unit. In areas where tree canopy precludes use of a GPS unit, locations will be established using a tape measure and compass measurements from a known location(s).

3. Utilize information from detector-aided sweeps to identify surface soil sampling location areas within the footprint of the surface sweeps for collection of soil samples based on the presence of MD and subsurface anomalies.

MC Sample Collection and Analysis

1. Surface Soil
   a) Forty surface soil samples will be collected at the 0- to 6-inch bgs and 0 to 24-inch bgs levels at 20 sample locations. The 0- to 6-inch interval is of interest for ecological risk screening while the 0- to 24-inch interval is of interest for the human health risk screening. One surface soil sample

will be collected within the “bowl” of the Test Area. Specific sample locations outside of the bowl area will be selected by the planning team based on the results of detector-aided surface sweeps. Samples will be preferentially collected at locations where suspect MEC, MPPEH, or MD were identified on the surface. If no suspect MEC, MPPEH, or MD are identified, then surface soil samples will be collected in the locations shown on Figure 17.7.

Surface soil samples at each location sampled will be composites of seven discrete samples collected using the seven-point wheel approach. Explosives present on the surface would have resulted from low order detonations releasing particles of explosives. These particles would be heterogeneously distributed in surface soil. In order to form a composite in which explosives would be evenly dispersed, the entire composite will be processed in the laboratory using the methodology described in Appendix A of SW 846 Method 8330B. This methodology consists of air drying and sieving the entire sample and conducting particle size reduction (grinding) of the entire sample. All surface soil samples will be analyzed for explosives (SW-846 Method 8330B).

b) Three soil samples shipped to the laboratory will be analyzed for pH (SW 846 Method 9045D), TOC (Lloyd Kahn Method), and CEC (SW 846 Method 9081).

c) Soil samples will be collected by hand auger.

d) Anomaly avoidance techniques will be followed for collection of all soil samples.

SAP Worksheet #11.8 - Data Quality Objectives for the Valley Impact Area (UXO 26)

STATE THE PROBLEM (STEP 1)

Worksheet 10.8 contains the problem definition for the Valley Impact Area.

IDENTIFY THE GOAL OF THE STUDY (STEP 2)

The primary goal of the SI for the Valley Impact Area is to obtain environmental data for use in making the following decisions:

1. Determine whether surface MEC are present in a condition or quantity that presents an immediate human health hazard and requires an immediate action. If such quantities are present, then initiate an appropriate remedial response. Otherwise, take no immediate action.

2. If surface MEC debris or subsurface anomalies indicate the presence of suspect MEC, then proceed with further investigation in the RI phase. If not, then evaluate the need to conduct further investigation, based on a review of the data from investigations at co-located MRP sites.

3. The Valley Impact Area covers the majority of the Stump Neck peninsula and is covered under the separate areas proposed for investigation at the installation. Therefore, the presence of MC will be investigated in these areas, and no MC sampling is proposed for the Valley Impact Area as a whole.

IDENTIFY INFORMATION INPUTS (STEP 3)

Data and information that will be required to make the decisions include the following:

1. UXO Surface Sweeps and Geophysical Investigation:
   Surface: Data will be obtained from detector-aided surface sweeps conducted by UXO personnel using hand-held metal detectors such as the Schonstedt GA-52Cx or equivalent and visual observations. UXO Technicians will use metal detectors to locate metallic items on the surface. Items located on the surface will be visually examined to determine if they are suspect MEC, MPPEH, MD or non-MD. If located, suspect MEC, MPPEH and/or MD will not be moved or disturbed during the SI.

   Subsurface: Metal detector anomalies (i.e., a response from the metal detector at a location where no surface materials are found) that result from the detector-aided surface sweeps will be used, along

with data from a subsurface geophysical investigation conducted by a geophysicist using an instrument such as a Geometrics G858, to locate suspect metal objects in subsurface soil. The choice of instrument may change and will be based on the results of the ITS. Suspect MEC, MPPEH, MD and subsurface metals (if metals are MEC, MPPEH, or MD) could potentially result in the release of MC.

DEFINE THE BOUNDARIES OF THE STUDY (STEP 4)

The current site investigation at the Valley Impact Area is limited to UXO detector-aided surface sweeps and geophysical investigations. An investigation of environmental media is beyond the scope of this investigation, but may be required based, in part, on the outcome of this investigation.

1. The initial horizontal boundary for the MEC investigation will be the portions of the Valley Impact Area identified in the PA that are accessible by foot and survey instrument. The horizontal boundary does not include areas where development has occurred.

2. The initial vertical boundary for the MEC investigation (detector-aided surface sweeps and geophysical investigation) will be 5 feet bgs within the accessible land area.

DEVELOP THE ANALYTIC APPROACH (STEP 5)

MEC Approach

If the detector-aided surface sweeps or geophysical investigation shows that suspect surface MEC and subsurface anomalies are not present, then consider NFA for MEC.

1. If suspect MEC is observed on the surface or if subsurface anomalies are observed, then return for further investigation in the RI phase.

MC Approach

1. The Valley Impact Area covers the majority of the Stump Neck peninsula and is covered under separate areas proposed for investigation at the installation. Therefore, although the presence of MC will be investigated in these areas, no sampling is proposed for the Valley Impact Area as a whole.

Decision Rules for Delineation

If suspect MEC and/or anomalies are found to be present in only a portion of the area surveyed then consider reducing the boundaries of the suspect MEC area. If suspect MEC and/or anomalies are found to be present at the boundaries of the surveyed area then consider extending the boundaries during the RI.

SPECIFY PERFORMANCE OR ACCEPTANCE CRITERIA (STEP 6)

1. The criterion for the detector-aided surface sweeps will be a go/no-go test performed by determining whether the instrument responds to metallic objects under a blanket (blanket test).

2. The criteria for the geophysical equipment function test will be
   a. Detection of all seed items buried within the 11x depth.
   b. Horizontal positions of seeded items within 1 meter of known locations.

Details of the performance criteria for the blanket test and geophysical equipment function test are provided in the MEC SAP (Appendix A) Worksheet 12.

DEVELOP THE PLAN FOR OBTAINING DATA (STEP 7)

Appendix A contains the MEC SAP for the detector-aided surface sweeps and geophysical investigation. Worksheet 17 of the MEC SAP contains details. Collection of MC is not proposed for this site. A brief summary of the investigation approach is presented below.

<u>Detector-Aided Surface Sweep</u>

1. Perform the blanket test. In this test, metal objects such as trailer hitches will be placed under a tarpaulin to verify that metal detectors are functioning.

2. Conduct detector-aided surface sweeps of 19 (400-foot spaced) parallel survey transects across the accessible and non-developed portions of the site (as shown on Figure 17.8-1 of Appendix A (MEC SAP). The survey will be conducted by UXO Technicians using hand held metal detectors (Schonstedt). Locations where visual observations of suspect MEC, MPPEH, MD or subsurface anomalies are observed will be marked with a stake. Pictures will be taken of items observed on the surface. In clear areas the locations will be recorded using a GPS unit. In areas where tree canopy

precludes use of a GPS unit, locations will be established using a tape measure and compass measurements from a known location(s).

3. Utilize information from detector-aided sweeps to identify potential soil sampling location areas within the footprint of the surface sweeps for collection of soil samples based on the presence of MD and subsurface anomalies if the site proceeds to the RI phase.

Geophysical Survey

1. Perform the geophysical equipment function test. In this test, metals items will be buried at various depths. Geophysical instrumentation will then be tested to verify that the operator, instrumentation and software are functioning properly. A Geometrics G858 is planned for use at this site.

2. Test the survey equipment.

3. Conduct survey on 19 (400-foot spaced) parallel survey transects across the accessible and non-developed portions of the site where the detector-aided surface sweeps were conducted.

SAP Worksheet #11.9 - Data Quality Objectives for the Torpedo Burial Site (UXO 12)

STATE THE PROBLEM (STEP 1)

Worksheet 10.9 contains the problem definition for the Torpedo Burial Site.

IDENTIFY THE GOAL OF THE STUDY (STEP 2)

The primary goal of the SI for the Torpedo Burial Site is to obtain environmental data for use in making the following decisions:

1. Determine whether surface MEC are present in a condition or quantity that presents an immediate human health hazard and requires an immediate response. If such quantities are present, then initiate an appropriate remedial response. Otherwise, take no immediate action.

2. If surface MEC debris or subsurface anomalies indicate the presence of suspect MEC, then proceed with further investigation in the RI phase. If not, proceed to NFA for MEC. In this case, MC may still be present, so continue to investigate for the presence of MC contamination in subsurface soil, surface water and sediment.

3. Determine whether MC (explosives) are present in the subsurface soil, surface water and sediment within the study area in quantities or concentrations above screening levels. If either of these conditions exists, then evaluate the need to proceed to an RI and/or FS. If not, proceed to NFA for MC.

4. Determine the extent of MEC and MC contamination for the purposes of delineation. If sufficient data have been collected for this purpose, then stop collecting data. If more data are required to delineate the extent of contamination, then conduct further investigation in the RI phase.

IDENTIFY INFORMATION INPUTS (STEP 3)

Data and information that will be required to make the decisions include the following:

1. UXO Surface Sweeps and Geophysical Investigation:
   Surface: Data will be obtained from detector-aided surface sweeps conducted by UXO personnel using hand-held metal detectors such as the Schonstedt GA-52Cx or equivalent and visual observations. UXO Technicians will use metal detectors to locate metallic items on the surface.

Items located on the surface will be visually examined to determine if they are suspect MEC, MPPEH, MD or non-MD. If located, suspect MEC, MPPEH and/or MD will not be moved or disturbed during the SI.

Subsurface: Metal detector anomalies (i.e., a response from the metal detector at a location where no surface materials were found) that result from the detector-aided surface sweeps will be used, along with data from a subsurface geophysical investigation conducted by a geophysicist using a Geometrics G858, to locate suspect metal objects in subsurface soil. Suspect MEC, MPPEH, MD and subsurface metals (if metals are MEC, MPPEH, or MD) could potentially result in the release of MC.

2. Chemical Data and Physical Characteristics:

Chemical data will be used to determine the presence of MC (explosives) in the subsurface soil, surface water and sediment. Chemical analysis will be performed using method SW 846 8330B for explosives. Three of the soil samples shipped to the laboratory will also be analyzed for pH (SW 846 Method 9045D), TOC (Lloyd Kahn Method), and CEC (SW 846 Method 9081). The list of all chemical analytes is presented in Worksheet 15 and the laboratory methods are listed in Worksheet 18.

Project Action Limits:

This investigation requires chemical data that can be used to further characterize the site and to begin a screening level ecological and human health risk assessment. Chemical concentrations will first be compared to conservative screening values. If any chemical concentration exceeds a screening value, human health or ecological risks may be, but are not necessarily, unacceptable. If necessary, a human health and ecological risk assessment will be conducted during an RI.

To conduct comparisons of site data to screening values, the selected laboratory must be able to achieve quantitation limits that are low enough to measure constituent concentrations below the screening values. For this investigation the screening values, which are also known as the PALs, are listed and described below:

- U.S. EPA Regional Soil Screening Levels for Chemical Contaminants at Superfund Sites-Residential Use (July 7, 2008).

- Maryland Department of the Environment Generic Cleanup Standards (soil; August 2001).

- U.S. EPA ESSLs (2005).
- U.S. EPA Region III BTAG criteria if U.S. EPA ESSLs are not available.
- ORNL ecological screening levels if neither U.S. EPA ESSLs nor Region III BTAG criteria are available (1997).
- Background Concentrations established for soils (Appendix C).
- U.S. EPA Region 3 Risk-Based Concentration Table.

Background values for soil have been developed. In the event that a chemical analyte exceeds a PAL, but falls below or is equal to an established background concentration, this chemical will not be retained as a COPC. On the other hand, if the chemical analyte is measured above the established background concentration, the chemical will be retained as a COPC. Established background concentrations are provided in Appendix C.

DEFINE THE BOUNDARIES OF THE STUDY (STEP 4)

The current site investigation at the Torpedo Burial Site is limited to an evaluation of subsurface soil, surface water and sediment. An investigation of other media including surface soil and groundwater is beyond the scope of this investigation, but may be required based, in part, on the outcome of this investigation.

1. The initial horizontal boundary is defined as the suspect MEC and MC area as shown in the PA and on Figure 17.9-1 (Appendix A MEC SAP) and Figure 17.8, respectively.

2. The initial vertical boundary for the MEC investigation (detector-aided surface sweeps and geophysical investigation) will be 6 feet bgs within the land area.

3. The initial vertical boundary will be 6 feet bgs for collection of MC (explosives) data within the land area. The site is reported to have at least one burial pit of unknown dimension. This pit would have been large enough to accommodate torpedoes averaging 15 feet in length and 21 inches in diameter. Subsurface soil data will be collected from the 2 to 4 foot bgs interval and the 4 to 6 foot bgs interval.

4. The initial vertical boundary will be 6 inches bgs for collection of sediment data within the drainage channel. This interval will be of interest for the ecological and human health risk screening.

5. The initial vertical surface water boundary will be at the surface of the water running through the drainage channel.

DEVELOP THE ANALYTIC APPROACH (STEP 5)

The decision rules for this investigation are as follows:

MEC Approach:

1. If the detector-aided surface sweeps or geophysical investigation shows that suspect surface MEC and subsurface anomalies are not present, then proceed to NFA for MEC. In this case, MC may still be present, so continue to investigate for the presence of MC contamination in subsurface soil, surface water, and sediment.

2. If suspect MEC are observed on the surface or in the drainage channel, or if subsurface anomalies exist, then investigate the subsurface soil, surface water and sediment in the location of the suspect MEC or subsurface anomaly in order to determine if MC contamination is present in these media. If the collected data are sufficient to determine the presence of MC contamination associated with the suspect MEC, then stop collecting data. If the data are not sufficient to determine the presence of MC contamination, then return for further investigation in the RI phase.

MC Approach:

1. If MC (explosives) are detected in subsurface soil, surface water or sediment at concentrations less than screening levels, then proceed to NFA for MC for the appropriate media. If MC (explosives) are detected in subsurface soil, surface water or sediment at concentrations above screening values, then the project team will evaluate the need to proceed to an RI for MC. Factors considered will include the explosive(s), the magnitude of the exceedance(s), their spatial distribution, and the location(s) of the exceedance(s). Geophysical data regarding potential torpedo disposal locations will also be considered.

Decision rules for delineation:

If MC (explosives) are detected in subsurface soil, surface water or sediment at concentrations greater than screening values at the horizontal or vertical boundaries of sampling, then evaluate the need to collect step-out samples in the RI phase. These step-out samples may include surface soil, subsurface soil, groundwater, surface water or sediment samples. Factors considered will include the explosive(s), the magnitude of the exceedance, and the spatial distribution of the exceedance(s). In most cases, "step-out" samples should be collected until the perimeter sample concentrations are less than screening or background concentrations. However, professional judgment should be used to determine if such samples are needed in all cases. Professional judgment considerations include:

- The degree to which MC concentrations exceed screening or background levels. The need to collect additional data should be carefully considered when concentrations in subsurface soil, surface water or sediment are within 5 percent of screening or background levels. The need to collect additional data will increase with increased number of exceedances and increased contaminant concentrations.

- The degree to which further delineation can be more efficiently and economically collected as part of follow-up RI/FS investigations (i.e., the additional sampling is unlikely to impact the decision to take or not take some type of remedial action but may be necessary to define the limits of the action).

- Considerations of the impact of future human health and ecological risk estimations if some contaminant concentrations are not completely delineated.

    1. If suspect MEC and/or anomalies are found to be present in only a portion of the area surveyed then consider reducing the boundaries of the suspect MEC area.

    2. If suspect MEC and/or anomalies are found to be present at the boundaries of the surveyed area then consider extending the boundaries during the RI.

    3. Lateral and/or vertical expansion of the study area during the RI phase may be necessary if MC are present at the lateral and/or vertical extent of the initial subsurface soil, surface water or sediment sampling pattern at concentrations greater than screening levels. This may include investigation of additional environmental media. Factors considered will include the type of MC, the magnitude of the exceedance(s), their spatial distribution and the overall concentration data for all MC.

SPECIFY PERFORMANCE OR ACCEPTANCE CRITERIA (STEP 6)

1) The criterion for the detector-aided surface sweeps will be a go/no-go test performed by determining whether the instrument responds to metallic objects under a blanket (blanket test).

2) The criteria for the geophysical equipment function test will be
   a. Detection of all seed items buried within the 11x depth.
   b. Horizontal positions of seeded items within 1 meter of known locations.

3) Because this is the SI stage, probability limits for false decision errors were not established for MC.

4) Performance criteria for new analytical data are NQA limits and meeting the project action limits, which are listed in Worksheet 15 for MC.

Details of the performance criteria for the blanket test and geophysical equipment function test are provided in the MEC SAP (Appendix A) Worksheet 12.

DEVELOP THE PLAN FOR OBTAINING DATA (STEP 7)

The proposed SI field data collection program for the Torpedo Burial Site is presented in detail in Worksheet 17 of this UFP SAP for MC. Appendix A contains the MEC SAP for the detector-aided surface sweeps and geophysical investigation. Worksheet 17 of the MEC SAP contains details. A brief summary of this approach is presented below.

<u>Detector-Aided Surface Sweep</u>

1. Perform the blanket test. In this test, metal objects such as trailer hitches will be placed under a tarpaulin to verify that metal detectors are functioning.

2. Conduct a 100 percent detector-aided surface sweep of the site within the area shown on Figure 17.9-1 of Appendix A (MEC SAP). The sweep will be conducted by UXO technicians using hand held metal detectors (Schonstedt). Locations where visual observations of suspect MEC, MPPEH, MD or subsurface anomalies are observed will be marked with a stake. Pictures will be taken of items observed on the surface. In clear areas the locations will be recorded using a GPS unit. In areas where tree canopy precludes use of a GPS unit, locations will be established using a tape measure and compass measurements from a known location(s).

3. Utilize information from detector-aided sweeps to identify potential soil sampling location areas within the footprint of the surface sweeps for collection of soil samples based on the presence of MD and subsurface anomalies if site proceeds to RI phase.

Geophysical Survey

1. Perform the geophysical equipment function test. In this test, metals items will be buried at various depths. Geophysical instrumentation will then be tested to verify that the operator, instrumentation and software are functioning properly. A Geometrics G858 is planned for use at this site.

2. Test the survey equipment.

3. Conduct survey on 5-foot spaced parallel survey lines across the accessible portions of the site. The area is shown on Figure 17.9-1 of Appendix A (MEC SAP).

MC Sample Collection and Analysis

1. Subsurface Soil
   a) Up to twenty subsurface soil samples will be collected from 2 to 6 feet bgs at 10 locations. Two samples will be collected within that depth interval based on visual observations of staining or other relevant indications (odors, discoloration, etc.). If these indications are not observed, samples will be collected at 2 to 4 feet bgs and 4 to 6 feet bgs. Specific locations will be determined by the project team based on the results of detector-aided surface sweeps and geophysical investigation. Samples will be preferentially collected at locations where suspect MEC, MPPEH, or MD was located on the surface or subsurface anomalies were detected. Subsurface samples at each location sampled will consist of one discrete sample. If no suspect MEC, MPPEH, or MD is identified, then subsurface soil samples will be collected in the soil sample locations shown on Figure 17.8. Subsurface soil samples will be analyzed for explosives (SW 846 Method 8330B).

   b) Three soil samples shipped to the laboratory will be analyzed for pH (SW 846 Method 9045D), TOC (Lloyd Kahn Method), and CEC (SW 846 Method 9081).

   c) Soil samples will be collected by DPT.

   d) Anomaly avoidance techniques will be followed for collection of all soil samples.

2. Sediment
   a) Two sediment samples will be collected at 0 to 6 inches below the sediment surface from the drainage channel that runs through the site. Specific locations will be determined by the project team based on the results of detector-aided surface sweeps and geophysical investigation. Samples will be preferentially collected at locations where suspect MEC, MPPEH, or MD was located or anomalies were detected. Sediment samples at each location sampled will consist of one discrete sample. If no suspect MEC, MPPEH, or MD is identified, then sediment samples will be collected in the locations shown on Figure 17.8. Sediment samples will be analyzed for explosives (SW 846 Method 8330B).

   b) Anomaly avoidance techniques will be followed for collection of all sediment samples.

3. Surface Water
   a) One surface water sample will be collected from the drainage channel running through the site. Surface water samples will be analyzed for explosives (SW 846 Method 8330B).

SAP Worksheet #11.10 - Data Quality Objectives for the Torpedo Casing Disposal Area (UXO 23)

STATE THE PROBLEM (STEP 1)

Worksheet 10.10 contains the problem definition for the Torpedo Casing Disposal Area.

IDENTIFY THE GOAL OF THE STUDY (STEP 2)

The primary goal of the SI for the Torpedo Casing Disposal Area is to obtain environmental data for use in making the following decisions:

1. Determine whether surface MEC are present in a condition or quantity that presents an immediate human health hazard and requires an immediate response. If such quantities are present, then initiate an appropriate remedial response. Otherwise, take no immediate action.

2. If surface MEC debris or subsurface anomalies indicate the presence of suspect MEC, then proceed with further investigation in the RI phase. If not, proceed to NFA for MEC. In this case, MC may still be present, so continue to investigate for the presence of MC contamination in subsurface soil.

3. Determine whether MC (explosives and metals) are present in the subsurface soil within the study area in quantities or concentrations above screening levels. If either of these conditions exists, then evaluate the need to proceed to an RI and/or FS. If not, proceed to NFA for MC.

4. Determine the extent of MEC and MC contamination for the purposes of delineation. If sufficient data have been collected for this purpose, then stop collecting data. If more data are required to delineate the extent of contamination, then conduct further investigation in the RI phase.

IDENTIFY INFORMATION INPUTS (STEP 3)

Data and information that will be required to make the decisions include the following:

1. UXO Surface Sweeps and Geophysical Investigation:
   Surface: Data will be obtained from detector-aided surface sweeps conducted by UXO personnel using hand-held metal detectors such as the Schonstedt GA-52Cx or equivalent and visual observations. UXO Technicians will use metal detectors to locate metallic items on the surface.

Items located on the surface will be visually examined to determine if they are suspect MEC, MPPEH, MD or non-MD. If located, suspect MEC, MPPEH and/or MD will not be moved or disturbed during the SI.

Subsurface: Metal detector anomalies (i.e., a response from the metal detector at locations where no surface materials are found) that result from the detector-aided surface sweeps will be used, along with data from a subsurface geophysical investigation conducted by a geophysicist using a Geometrics G858, to locate suspect metal objects in subsurface soil. Suspect MEC, MPPEH, MD and subsurface metals (if metals are MEC, MPPEH, or MD) could potentially result in the release of MC.

2. Chemical Data and Physical Characteristics:

Chemical data will be used to determine the presence of MC (explosives and metals) in the subsurface soil. Chemical analysis will be performed using method SW 846 8330B for explosives and method SW 846 6010B/6020A for metals. Three of the soil samples shipped to the laboratory will also be analyzed for pH (SW 846 Method 9045D), TOC (Lloyd Kahn Method), and CEC (SW 846 Method 9081). The list of all chemical analytes is presented in Worksheet 15 and the laboratory methods are listed in Worksheet 18.

Project Action Limits:

This investigation requires chemical data that can be used to further characterize the site and to begin a screening level ecological and human health risk assessment. Chemical concentrations will first be compared to conservative screening values. If any chemical concentration exceeds a screening value, human health or ecological risks may be, but are not necessarily, unacceptable. If necessary, a human health and ecological risk assessment will be conducted during an RI.

To conduct comparisons of site data to screening values, the selected laboratory must be able to achieve quantitation limits that are low enough to measure constituent concentrations below the screening values. For this investigation the screening values, which are also known as the PALs, are listed and described below:

- U.S. EPA Regional Soil Screening Levels for Chemical Contaminants at Superfund Sites-Residential Use (July 7, 2008).

- Maryland Department of the Environment Generic Cleanup Standards (soil; August 2001).

- U.S. EPA ESSLs (2005).
- U.S. EPA Region III BTAG criteria if U.S. EPA ESSLs are not available.
- ORNL ecological screening levels if neither U.S. EPA ESSLs nor Region III BTAG criteria are available (1997).
- Background Concentrations established for soils (Appendix C).

Background values for soil have been developed. In the event that a chemical analyte exceeds a PAL, but falls below or is equal to an established background concentration, this chemical will not be retained as a COPC. On the other hand, if the chemical analyte is measured above the established background concentration, the chemical will be retained as a COPC. Established background concentrations are provided in Appendix C.

DEFINE THE BOUNDARIES OF THE STUDY (STEP 4)

The current site investigation at the Torpedo Casing Disposal Area is limited to an evaluation of subsurface soil. An investigation of other media including surface soil, surface water, sediment and groundwater is beyond the scope of this investigation, but may be required based, in part, on the outcome of this investigation.

1. The initial horizontal boundary for the MEC and MC investigation is defined as the suspect torpedo casing disposal area as shown in the PA and on Figure 17.10-1 (Appendix A MEC SAP) and Figure 17.9, respectively.

2. The initial vertical boundary for the MEC investigation (detector-aided surface sweeps and potential geophysical investigation) will be 6 feet bgs within the land area. Previous geophysical investigations suggested anomalies at greater than 3 feet bgs.

3. The initial vertical boundary will be 6 feet bgs for collection of MC (explosives and metals) data within the Torpedo Casing Disposal Area. Subsurface soil data will be collected from the 2 to 4 foot bgs interval and the 4 to 6 foot bgs interval.

DEVELOP THE ANALYTIC APPROACH (STEP 5)

The decision rules for this investigation are as follows:

MEC Approach:

1. If the detector-aided surface sweeps or geophysical investigation shows suspect surface MEC and subsurface anomalies are not present, then proceed to NFA for MEC. In this case, MC may still be present, so continue to investigate for the presence of MC contamination in subsurface soil.

2. If suspect MEC is observed on the surface or if subsurface anomalies exist, then investigate the soil in the location of the suspect MEC or subsurface anomaly in order to determine if MC contamination is present in the soil. If the collected data are sufficient to determine the presence of MC contamination associated with the suspect MEC, then stop collecting data. If the data are not sufficient to determine the presence, then return for further investigation in the RI phase.

MC Approach:

1. If MC (explosives and metals) are detected in subsurface soil at concentrations less than screening levels, then proceed to NFA for MC for subsurface soil. If MC (explosives and metals) are detected in subsurface soil at concentrations above screening values, then the project team will evaluate the need to proceed to an RI for MC. Factors considered will include the explosive(s), the metal(s), the magnitude of the exceedance(s), their spatial distribution, and the location(s) of the exceedance(s).

Decision rules for delineation:

If MC (explosives and metals) are detected in subsurface soil at concentrations greater than screening values at the horizontal or vertical boundaries of sampling, then evaluate the need to collect step-out samples in the RI phase. These step-out samples may include surface soil, subsurface soil, surface water, sediment or groundwater samples. Factors considered will include the explosive(s), the metal(s), the magnitude of the exceedance, and the spatial distribution of the exceedance(s). In most cases, “step-out” samples should be collected until the perimeter sample concentrations are less than screening or background concentrations. However, professional judgment should be used to determine if such samples are needed in all cases. Professional judgment considerations include:

- The degree to which MC concentrations exceed screening or background levels. The need to collect additional data should be carefully considered when concentrations in subsurface soil are within 5 percent of screening or background levels. The need to collect additional data will increase with increased number of exceedances and increased contaminant concentrations.

- The degree to which further delineation can be more efficiently and economically collected as part of follow-up RI/FS investigations (i.e., the additional sampling is unlikely to impact the decision to take or not take some type of remedial action but may be necessary to define the limits of the action).

- Considerations of the impact of future human health and ecological risk estimations if some contaminant concentrations are not completely delineated.

  1. If suspect MEC and/or anomalies are found to be present in only a portion of the area surveyed them consider reducing the boundaries of the suspect MEC area.

  2. If suspect MEC and/or anomalies are found to be present at the boundaries of the surveyed area then consider extending the boundaries during the RI.

  3. Lateral and/or vertical expansion of the study area during the RI phase may be necessary if MC are present at the lateral and/or vertical extent of the initial sampling pattern at concentrations greater than screening levels. This may include investigation of additional environmental media. Factors considered will include the type of MC, the magnitude of the exceedance(s), their spatial distribution and the overall concentration data for all MC.

SPECIFY PERFORMANCE OR ACCEPTANCE CRITERIA (STEP 6)

1. The criterion for the detector-aided surface sweeps will be a go/no-go test performed by determining whether the instrument responds to metallic objects under a blanket (blanket test).

2. The criteria for the geophysical equipment function test will be
   a. Detection of all seed items buried within the 11x depth.
   b. Horizontal positions of seeded items within 1 meter of known locations.

3. Because this is the SI stage, probability limits for false decision errors were not established for MC.

4. Performance criteria for new analytical data are NQA limits and meeting the project action limits, which are listed in Worksheet 15 for MC.

Details of the performance criteria for the blanket test and geophysical equipment function test are provided in the MEC SAP (Appendix A) Worksheet 12.

DEVELOP THE PLAN FOR OBTAINING DATA (STEP 7)

The proposed SI field data collection program for this location is presented in Worksheet 17 of this UFP SAP for MC. Appendix A contains the MEC SAP for the detector-aided surface sweeps and geophysical investigation. Worksheet 17 of the MEC SAP contains details. A brief summary of this approach is presented below.

Detector-Aided Surface Sweep

1. Perform the blanket test. In this test, metal objects such as trailer hitches will be placed under a tarpaulin to verify that metal detectors are functioning.

2. Conduct a 100 percent detector-aided surface sweep of the site as shown on Figure 17.10-1 of Appendix A (MEC SAP). The sweep will be conducted by UXO Technicians using hand held metal detectors (Schonstedt). Locations where visual observations of suspect MEC, MPPEH, MD or subsurface anomalies are observed will be marked with a stake. Pictures will be taken of items observed on the surface. In clear areas the locations will be recorded using a GPS unit. In areas where tree canopy precludes use of a GPS unit, locations will be established using a tape measure and compass measurements from a known location(s).

3. Utilize information from detector-aided sweeps to identify potential soil sampling location areas within the footprint of the surface sweeps for collection of soil samples based on the presence of MD and subsurface anomalies if the site proceeds to the RI phase.

Geophysical Survey

1. Perform the geophysical equipment function test. In this test, metals items will be buried at various depths. Geophysical instrumentation will then be tested to verify that the operator, instrumentation and software are functioning properly. A Geometrics G858 is planned for use at this site.

2. Perform the blanket test.

3. Conduct survey on 10-foot spaced parallel survey lines across the accessible portions of the site.

4. Utilize data regarding subsurface anomalies to determine locations for collection of subsurface soil samples.

MC Sample Collection and Analysis

1. Subsurface Soil
   a) Up to twenty subsurface soil samples 20 will be collected from 2 to 6 feet bgs at 10 locations. Two samples will be collected within that depth interval based on visual observations of staining or other relevant indications (odors, discoloration, etc.). If these indications are not observed, samples will be collected at 2 to 4 feet bgs and 4 to 6 feet bgs. Specific locations will be determined by the project team based on the results of detector-aided surface sweeps and geophysical investigation. Samples will be preferentially collected at locations where suspect MEC, MPPEH, or MD were located on the surface or where subsurface anomalies were detected. Subsurface samples at each location sampled will consist of one discrete sample. If no suspect MEC, MPPEH, or MD are identified, then subsurface soil samples will be collected in the soil sample locations shown on Figure 17.9. All soil samples will be analyzed for explosives (SW 846 Method 8330B) and metals (SW 846 Method 6010B/6020A).

   b) Three soil samples shipped to the laboratory will be analyzed for pH (SW 846 Method 9045D), TOC (Lloyd Kahn Method), and CEC (SW 846 Method 9081).

   c) Soil samples will be collected by DPT.

   d) Anomaly avoidance techniques will be followed for collection of all soil samples.

SAP Worksheet #12 -- Measurement Performance Criteria Table Field Quality Control Sample – All fractions

QC Sample	Analytical Group	Frequency	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
Field Blank	All Fractions	One per source water	Bias/Contamination	Detections ≤ QL	S&A
Equipment Rinsate Blanks	All Fractions	One per 20 field samples per matrix per sampling equipment	Bias/Contamination	Detections ≤ QL	S&A
Trip Blanks	VOCs	One per cooler containing VOC samples	Bias/Contamination	Detections ≤ QL	S&A
Field Duplicate	All Fractions	One per 10 field samples collected	Precision	Aqueous samples Relative Percent Difference (RPD) of 30; Solid samples RPD of 50	S
Cooler Temperature Blank	All Fractions	One per cooler	Accuracy / Representativeness	Between 2 and 6 ° C	S&A

Miscellaneous parameters (pH, TOC, CEC) are being collected and do not require any field quality control samples except a cooler blank.

SAP Worksheet No. 13 -- Secondary Data Criteria and Limitations Table

(UFP-QAPP Manual Section 2.7)

Secondary Data	Data Source (originating organization, report title and date)	Data Generator(s) (originating organization, data types, data generation / collection dates)	How Data Will Be Used	Limitations on Data Use
Site Histories, Initial CSM	Naval District Washington, Preliminary Assessment, Stump Neck Annex, Indian Head, Maryland, April 2006	Malcolm Pirnie, Inc	Basis for UFP SAP, Site Histories, and CSMs	The information is qualitative and no quantitative (site-specific nature and extent of contamination) information is available. The information was used to establish the field work program and identify areas most likely to be contaminated.

This is the initial phase of field investigation at the 10 sites, and no known secondary data exists.

SAP Worksheet #14 -- Summary of Project Tasks

(UFP-QAPP Manual Section 2.8.1)

The 10 MEC Site Investigation project activities consist of the following tasks:

- Field tasks, including:
  - Mobilization/demobilization and Utility Clearance
  - Drilling and soil sample collection
  - Soil, groundwater, surface water, and sediment sample collection
  - Quality control sample collection and other QC tasks
  - Field instrument calibration
  - Equipment decontamination
  - Investigation-derived waste (IDW) removal and disposal
  - Global positioning system
- Analytical tasks
- Data management
- Assessment and oversight
- Data review
- Project report

These tasks are summarized below. The SOPs and field documents referenced below and in other worksheets are included in Appendix D.

Field Tasks

- **Mobilization/Demobilization:** Mobilization/demobilization activities include: field equipment procurement and transport to the work site, subcontractor procurement and coordination, utility awareness and clearance, location and setup of areas for decontamination and waste storage, acquisition of vehicles, and establishment of an on-site staging area.

  Equipment requirements will be finalized by the FOL following the acceptance of the UFP-SAP. The FOL will review the scope of work and assemble equipment (e.g., vehicles, sampling, personal protection, and decontamination equipment) to implement and complete the field investigations.
  This list will be reviewed by the project team and the PM. The FOL will be responsible for receiving and unpacking the equipment and ensuring that all equipment is operable and calibrated.

The FOL will be responsible for tracking equipment used in the field. Analytical laboratory services have been subcontracted and the FOL will be responsible for coordinating associated field activities. The Tetra Tech QAO will be responsible for coordinating the analytical services, and the acquisition and delivery of sample containers to the site.

During mobilization, the FOL will review the roles and responsibilities of each field team member and review the requirements of the various field activities. A series of meetings will be conducted to review the sampling and analytical requirements. Upon mobilization, an on-site meeting will be conducted to review health and safety requirements. The SSO will be responsible for reviewing the HASP with the field team members and subcontractors. The field team will also be required to attend a hazard control briefing administered by the Environmental Division POC prior to commencing any field work at the Stump Neck Annex. Daily safety briefings by Tetra Tech shall occur for all field personnel.

- **Utility Clearance Tasks:** Prior to commencing any work at the Stump Neck Annex, the Comprehensive Work Approval Process (CWAP) will be followed. The CWAP will identify constraints in the work area, such as the locations of eagle's nests, archeological sites, wetlands, etc., that may affect work at the site and other requirements that must be met prior to commencing work, such as locating underground utilities, etc. Upon completion of the CWAP a Dig Permit will be issued to the utility contractor. The FOL will coordinate with facility personnel and with a Tetra Tech subcontractor for the utility clearance of all soil boring locations. Utilities that are not shown or are incorrectly located shall be marked on the permit and the marked-up permit shall be returned to the Indian Head Stump Neck POC for inclusion in the Activity Graphical Information System (GIS). Sites most likely requiring utility clearance include UXO 01, 02, 04, 05, 10, 12, and 23.

- **Drilling and Soil Sample Collection Tasks:** Soil borings will be advanced at the following sites: Air Blast Pond (UXO 01), Area 8 (UXO 02), Basic IED Area (UXO 04), Advanced IED Area (UXO 05), Stump Neck Impact Area (UXO 10), Torpedo Burial Site (UXO 12), and Torpedo Casing Disposal Area (UXO 23). Drilling will be conducted in accordance with SOP-05 (Soil Coring and Sampling using Hand Auger Techniques) and SOP-06 (Borehole Advancement and Soil Coring and Sampling Using Direct-Push Technology). All borings will be logged in accordance with SOP-10 (Borehole and Soil Sample Logging). Selected borings will be converted into temporary monitoring wells in accordance with SOP-16 (Temporary Monitoring Well Installation and Abandonment). Methods for recording data are included in each SOP.

- **Sample Collection Tasks:** Surface and subsurface soil samples will be collected in accordance with SOP-05 (Soil Coring and Sampling Using Hand Augering Techniques), SOP-06 (Borehole Advancement and Soil Coring and Sampling Using Direct-Push Technology), and SOP-19 (Composite Sampling for Soil and Sediment). Sediment samples will be collected in accordance with SOP-08 (Sediment Sampling), and surface water samples will be collected in accordance with SOP-07 (Surface Water Sampling). Groundwater samples will be collected in accordance with SOP-17 (Low-Flow Well Purging and Stabilization) and SOP-18 (Groundwater Sampling). The sample numbering scheme will be in accordance with SOP-02 (Sample Identification and Nomenclature). Methods for recording data are included in each of the above SOPs and in SOP-03 (Sample Custody and Documentation of Field Activities). Sample labeling will be in accordance with SOP-01 (Labeling), and selection of sample containers, sample preservation, packaging, and shipping will be in accordance with SOP-11 (Sample Packaging).

  The numbers and types of samples to be collected at each site along with associated analytical programs are presented in Worksheets 18.1 through 18.10.

- **Quality Control Tasks:** Equipment blanks, field duplicates, matrix spikes, and matrix spike duplicates will be collected as presented in Worksheets 20.1 through 20.10.

  Initial and continuing calibrations, tuning, reagent blanks, surrogates, duplicates, laboratory control samples, and all other applicable QC for all analytical methods is presented in Worksheet #28.

- **Field Instrument Calibration:** These procedures are described in Worksheet #22.

- **Equipment Decontamination**: All reusable sampling equipment (e.g., stainless steel trowels, etc.) will be decontaminated prior to sampling and between samples, according to the sequence established in SOP-04 (Appendix D).

- **Investigation-Derived Waste Tasks:** It is anticipated that waste materials will be generated during the field investigation. These wastes must be disposed in such a manner that does not contribute to further environmental contamination or pose a threat to public health or safety. SOP-09 located in Appendix D provides information on the handling of investigation-derived waste.

- **Global Positioning System (GPS):** A GPS survey will be used to locate all sampling points.

Analytical Tasks - Chemical analysis for explosives, metals, and VOCs will be performed by the subcontracted laboratory, Analytical Laboratory Services, Inc. (ALSI). ALSI is NFESC approved and National Environmental Laboratory Accreditation Program (NELAP) accredited. Analyses will be performed in accordance with the analytical methods identified in Worksheet #30. ALSI will meet the project quantitation limit (PQLs) specified in Worksheet #15. ALSI will perform the chemical analyses following laboratory-specific SOPs (Worksheets #19 and #23) developed based on the methods listed in Worksheets #19 and #30. Copies of the SOPs are included in Appendix E on the attached compact disk (CD).

Data Management

- Project documentation and records

  - Field sample collection and field measurement records are described in Worksheets #27 and #29.
  - Laboratory data package deliverables are described in the analytical specifications.
  - Data assessment documents and records are listed in Worksheet #29.

- Data recording formats are described in Worksheet #27.

Data Handling and Management - After the field investigation is completed, the field sampling log sheets will be organized by date and media and filed in the project files. The field logbooks for this project will be used only for these sites, and will also be categorized and maintained in the project files after the completion of the field program. Project personnel completing concurrent field sampling activities may maintain multiple field logbooks. When possible, logbooks will be segregated by sampling activity. The field logbooks will be titled based on date and activity. The data handling procedures to be followed by the laboratories will meet the requirements of the technical specification. The electronic data results will be automatically downloaded into the Tetra Tech database in accordance with proprietary Tetra Tech processes.

Data Tracking and Control. The Tetra Tech PM (or designee) is responsible for the overall tracking and control of data generated for the project.

- **Data Tracking**. Data is tracked from its generation to its archiving in the Tetra Tech project-specific files. The Tetra Tech Project Chemist (or designee) is responsible for tracking the samples collected and shipped to the contract laboratory. Upon receipt of the data packages from the analytical

laboratory, the Project Chemist will oversee the data validation effort, which includes verifying that the data packages are complete and results for all samples have been delivered by the analytical laboratory.

- **Data Storage, Archiving, and Retrieval**. The data packages received from the subcontract laboratory are tracked in the data validation log book. After the data are validated, the data packages are entered into the Tetra Tech CLEAN file system and archived in secure files. The field records including field log books, sample logs, chain-of-custody records, and field calibration logs will be submitted by the FOL to be entered into the CLEAN file system prior to archiving in secure project files. The project files are audited for accuracy and completeness. At the completion of the Navy contract the records will be stored by Tetra Tech.

- **Data Security**. The Tetra Tech project files are restricted to designated personnel only. Records can only be borrowed temporarily from the project file using a sign-out system. The Tetra Tech Data Manager maintains the electronic data files. Access to the data files is restricted to qualified personnel only. File and data backup procedures are routinely performed.

Assessment and Oversight – Refer to Worksheet #32 for assessment findings and corrective actions and Worksheet #33 for Quality Assurance (QA) management reports.

Data Review

- Data verification is described in Worksheet #34.
- Data validation is described in Worksheets #35 and #36.
- Usability assessment is described in Worksheet #37.

Project Report - Draft and Final versions of project reports will be prepared and submitted to the Navy, U.S. EPA, and MDE for review. The reports will include the following sections:

- Executive Summary – a very brief description of the work conducted and the findings.

- Introduction and Background – includes a description of the history of operations and activities at the site and a summary of any previous investigations and removal actions.

- Description of Field Investigations – includes a summary of the work performed in the approved SAP and any field modifications as documented by the FOL. This section will include maps showing the sampling locations and well installations and tables summarizing the data collected.

- Data quality – includes a summary of quantitative analytical performance indicators such as completeness, precision, bias and sensitivity, as well as qualitative indicators such as representativeness and comparability. Includes a reconciliation of project data with the DQOs and an identification of deviations from this SAP.

  A data usability assessment will be used to identify significant deviations in analytical performance that could affect the ability to meet project objectives. The elements of this review are presented in Worksheet #37.

- Nature and Extent of Contamination – includes the contamination previously found in each medium sampled in relation to the conceptual model of the site. This section will note the removals previously conducted, the contamination addressed and any additional contaminants found during this effort. Detected contaminant concentrations will be tabulated for each medium and depicted on maps.

- Contaminant Fate and Transport – includes a description of the contaminants detected and their behavior in the soil and bedrock, particularly with emphasis on the future migration of these contaminants to any possible exposure areas.

- Summary and Conclusions – includes a summary of the findings, a conclusion assessing whether delineation of contamination is adequate, and a recommendation for further sampling if needed.

Tetra Tech will respond to comments received on the draft report. Tetra Tech will submit the draft report before any additional sampling begins. The final version of the report will submitted in hardcopy and electronic format to the project stakeholders.

As a separate effort, Risk Assessment reports will be generated using this data as a separate effort after finalization of the data report.

SAP Worksheet #15 -- Reference Limits and Evaluation Table

(UFP-QAPP Manual Section 2.8.1)

Matrix: Groundwater

Analytical Group: VOC, Explosives, and Metals

Analyte	CAS Number	Project Action Limit (µg/L)	Project Action Limit Reference	Project Quantitation Limit Goal (µg/L)	Laboratory Detection Limits	
					QL (µg/L)	MDL (µg/L)
Metals						
BARIUM	7440-39-3	730	ORNL – R	11.1	11.1	2.6
CALCIUM	7440-70-2	NA	NA	111	111	22.9
CHROMIUM (III)	16065-83-1	100	U.S. EPA MCL	5.6	5.6	1.7
COBALT	7440-48-4	73	MDE Cleanup Standard	5.6	5.6	1.5
COPPER	7440-50-8	150	ORNL – R	11.1	11.1	2
IRON	7439-89-6	300	MDE Cleanup Standard	66.7	66.7	20.6
LITHIUM	7439-93-2	NA	NA	110	110	5
LEAD	7439-92-1	15	U.S. EPA MCL	6.7	6.7	2.1
MAGNESIUM	7439-95-4	NA	NA	111	111	16.6

Analyte	CAS Number	Project Action Limit (µg/L)	Project Action Limit Reference	Project Quantitation Limit Goal (µg/L)	Laboratory Detection Limits	
					QL (µg/L)	MDL (µg/L)
MANGANESE	7439-96-5	50	MDE Cleanup Standard	5.6	5.6	0.3
MERCURY	7439-97-6	1.1 (1)	ORNL – R	0.2	0.2	0.04
NICKEL	7440-02-0	73	ORNL – R	22.2	22.2	5
POTASSIUM	7440-09-7	NA	NA	560	560	100
SILVER	7440-22-4	18	ORNL – R	4.4	4.4	1
SODIUM	7440-23-5	NA	NA	560	560	40
STRONTIUM	7440-24-6	2200	ORNL – R	5.6	5.6	0.3
TIN	**7440-31-5**	**2.2**	**MDE Cleanup Standard**	**2.2(2)**	**22.2**	**4.1**
VANADIUM	7440-62-2	26	ORNL - R	5.6	5.6	1.4
ZINC	7440-66-6	1100	ORNL – R	22.2	22.2	2.6
Metals (by 6020)						
ALUMINUM	7429-90-5	50	MDE Cleanup Standard	50	50	17
ANTIMONY	7440-36-0	1.5	ORNL – R	1.5	1.5	0.5
ARSENIC	**7440-38-2**	**0.0045**	**ORNL – R**	**0.0045(3)**	**1.5**	**0.5**

Analyte	CAS Number	Project Action Limit (µg/L)	Project Action Limit Reference	Project Quantitation Limit Goal (µg/L)	Laboratory Detection Limits	
					QL (µg/L)	MDL (µg/L)
BERYLLIUM	7440-41-7	4	U.S. EPA MCL	1.5	1.5	0.4
CADMIUM	7440-43-9	1.8	ORNL – R	1.5	1.5	0.4
SELENIUM	7782-49-2	18	ORNL – R	6	6	2
Explosives						
1,3,5-TRINITROBENZENE	99-35-4	110	ORNL – R	0.2	0.2	0.03
1,3 DINITROBENZENE	99-65-0	0.37	ORNL – R	0.2	0.2	0.02
2,4-DINITROTOLUENE	121-14-2	7.3	ORNL – R	0.2	0.2	0.04
2,6-DINITROTOLUENE	606-20-2	3.7	ORNL – R	0.2.	0.2	0.04
2,4,6-TRINITROTOLUENE	118-96-7	0.22	ORNL – R	0.2	0.2	0.04
2-AMINO-4,6-DINITROTOLUENE	35572-78-2	7.3	ORNL – R	0.2	0.2	0.04
2-NITROTOLUENE	88-72-2	37	ORNL - R	0.2	0.2	0.03
3-NITROTOLUENE	99-08-1	NA	NA	0.2	0.2	0.04
4-AMINO-2,6-DINITROTOLUENE	1946-51-0	7.3	ORNL – R	0.2	0.2	0.03
4-NITROTOLUENE	99-99-0	0.42	ORNL – R	0.2	0.2	0.02

Analyte	CAS Number	Project Action Limit (µg/L)	Project Action Limit Reference	Project Quantitation Limit Goal (µg/L)	Laboratory Detection Limits	
					QL (µg/L)	MDL (µg/L)
HMX	2691-41-0	180	ORNL – R	0.2	0.2	0.02
TETRYL	479-45-8	15	ORNL – R	0.2	0.2	0.05
RDX	121-82-4	0.061	ORNL – R	0.06	0.06	0.02
NITROBENZENE	98-95-3	0.34	ORNL – R	0.2	0.2	0.02
NITROGLYCERIN	55-63-0	0.37	ORNL – R	0.37(4)	1.5	0.2
NITROGUANIDINE	556-88-7	370	ORNL - R	TBD	TBD	TBD
PERCHLORATE	014797-73-0	2.6	ORNL – R	0.2	0.2	0.0663
PETN	78-11-5	NA	NA	TBD	TBD	TBD
3,5-DINITROANILINE	618-87-1	NA	NA	TBD	TBD	TBD
Volatile Organic Compounds						
BENZENE	**71-43-2**	**0.041**	**ORNL – R**	**0.041(3)**	**1**	**0.2**
CARBON DISULFIDE	75-15-0	100	ORNL – R	1	1	0.3
CHLOROFORM	**67-66-3**	**0.019**	**ORNL – R**	**0.019(3)**	**1**	**0.2**
ETHYL ETHER	60-29-7	730	ORNL – R	1	1	0.3
METHYLENE CHLORIDE	75-09-2	0.48	ORNL – R	0.48(4)	1	0.3
TOLUENE	108-88-3	230	ORNL – R	1	1	0.2

Notes

MDE Cleanup Standard = State of Maryland, Department of the Environment, Cleanup Standards for Soil and Groundwater, August 2001, Interim Final Guidance (Update No. 1).

NA = Not Available

TBD = To Be Determined

U.S. EPA MCL = U.S. EPA Maximum Contaminant Level, 2006 Edition of the Drinking Water Standards and Health Advisories, August 2006.

ORNL-R = Oak Ridge National Laboratory Risk-Based Concentration Table. The noncarcinogenic values (denoted with a "N" flag on worksheet #15B) are the RBC divided by 10 to correspond to a target hazard quotient of 0.1. Carcinogenic values represent an incremental cancer risk of 1.0E-06 and are also divided by 10 (carcinogens denoted with a "C" flag on worksheet #15B) (ORNL, July 2008).

Footnotes

1. The value for mercuric chloride has been used as a surrogate for mercury.
2. The laboratory quantitation limit (LQL) is greater than the project action limit (MDE Cleanup Standard), but less than the ORNL-R standard. For purposes of comparison to risk screening criteria for COPC selection, one half of the laboratory PQL will be used.
3. The LQL is greater than the project action limit (ORNL-R), but less than both the Federal MCL and the MDE Cleanup Standard. For purposes of comparison to risk screening criteria for COPC selection, one half of the laboratory quantitation limit (QL) will be used.
4. The LQL is greater than the project action limit (ORNL-R). For purposes of comparison to risk screening criteria for COPC selection, one half of the laboratory QL will be used.

SAP Worksheet #15 -- Reference Limits and Evaluation Table

(UFP-QAPP Manual Section 2.8.1)

Matrix: Soil

Analytical Group: Volatile Organic Compounds, Explosives, and Metals

Analyte	CAS Number	Project Action Limit (mg/kg)	Project Action Limit Reference	Project Quantitation Limit Goal (mg/kg)	Laboratory Detection Limits	
					QL (mg/kg)	MDL (mg/kg)
Metals						
BARIUM	7440-39-3	330	U.S. EPA Eco-SSL	1.00	1.00	0.06
BERYLLIUM	7440-41-7	16	MDE Cleanup Standard - R	1.00	1.00	0.07
CADMIUM	7440-43-9	0.36	U.S. EPA Eco-SSL	0.2	0.2	0.06
CALCIUM	7440-70-2	NA	NA	10.0	10.0	4
CHROMIUM (III)	16065-83-1	23	MDE Cleanup Standard - R	1.00	1.00	0.4
COBALT	7440-48-4	160	MDE Cleanup Standard - R	1.00	1.00	0.2
COPPER	7440-50-8	310	MDE Cleanup Standard - R	2.00	2.00	0.5
IRON	7439-89-6	12[(1)]	R3BTAG	10.0	10.0	3
LEAD	7439-92-1	11	U.S. EPA Eco-SSL	2.00	2.00	0.5

Analyte	CAS Number	Project Action Limit (mg/kg)	Project Action Limit Reference	Project Quantitation Limit Goal (mg/kg)	Laboratory Detection Limits	
					QL (mg/kg)	MDL (mg/kg)
LITHIUM	7439-93-2	2	ORNL Plant	2.0	2.0	0.7
MAGNESIUM	7439-95-4	4400	R3BTAG	10.0	10.0	2
MANGANESE	7439-96-5	160	MDE Cleanup Standard - R	1.0	1.0	0.06
MERCURY	7439-97-6	0.058	R3BTAG	0.05	0.05	0.017
NICKEL	7440-02-0	38	U.S. EPA Eco-SSL	2.00	2.00	0.5
POTASSIUM	7440-09-7	NA	NA	50.0	50.0	16
SILVER	7440-22-4	4.2	U.S. EPA Eco-SSL	0.50	0.50	0.07
SODIUM	7440-23-5	NA	NA	50.0	50.0	3
STRONTIUM	7440-24-6	120	R3BTAG	1.00	1.00	0.6
TIN	**7440-31-5**	**0.89**	**R3BTAG**	**0.89(3)**	**5.00**	**2**
VANADIUM	7440-62-2	7.8	ORNL -R	1.00	1.00	0.3
ZINC	7440-66-6	46	U.S. EPA Eco-SSL	2.00	2.00	0.3
Metals (by 6020)						
ALUMINUM	7429-90-5	1.0(2)	R3BTAG	1.0	1.0	0.07

Analyte	CAS Number	Project Action Limit (mg/kg)	Project Action Limit Reference	Project Quantitation Limit Goal (mg/kg)	Laboratory Detection Limits	
					QL (mg/kg)	MDL (mg/kg)
ANTIMONY	7440-36-0	0.27	U.S. EPA Eco-SSL	0.2	0.2	0.02
ARSENIC	**7440-38-2**	**0.039**	**ORNL-R**	**0.039**[4]	**0.2**	**0.02**
SELENIUM	7782-49-2	0.52	U.S. EPA Eco-SSL	0.52[3]	1.0	0.15
Explosives						
1,3,5-TRINITROBENZENE	99-35-4	180	ORNL - R	0.15	0.15	0.05
1,3 DINITROBENZENE	99-65-0	0.61	ORNL - R	0.15	0.15	0.04
2,4-DINITROTOLUENE	121-14-2	1.7	MDE Cleanup Standard S-GW	0.15	0.15	0.04
2,6-DINIRTOTOLUENE	606-20-2	1.7	MDE Cleanup Standard S-GW	0.3	0.3	0.09
2,4,6-TRINITROTOLUENE	118-96-7	1.6	ORNL - R	0.15	0.15	0.04
2-AMINO-4,6-DINITROTOLUENE	35572-78-2	12	ORNL - R	0.15	0.15	0.05
2-NITROTOLUENE	88-72-2	78	ORNL - R	0.2	0.2	0.06
3-NITROTOLUENE	99-08-1	NA	NA	0.15	0.15	0.04
4-AMINO-2,6-DINITROTOLUENE	1946-51-0	12	ORNL - R	0.15	0.15	0.05
4-NITROTOLUENE	99-99-0	3	ORNL – R	0.2	0.2	0.06

Analyte	CAS Number	Project Action Limit (mg/kg)	Project Action Limit Reference	Project Quantitation Limit Goal (mg/kg)	Laboratory Detection Limits	
					QL (mg/kg)	MDL (mg/kg)
HMX	2691-41-0	310	ORNL - R	0.1	0.1	0.02
TETRYL	479-45-8	24	ORNL - R	0.15	0.15	0.05
RDX	121-82-4	0.44	ORNL - R	0.1	0.1	0.03
NITROBENZENE	98-95-3	3.1	ORNL - R	0.2	0.2	0.06
NITROGLYCERIN	55-63-0	6.1	ORNL - R	1.0	1.0	0.25
NITROGUANIDINE	556-88-7	610	ORNL - R	TBD	TBD	TBD
PERCHLORATE	014797-73-0	5.5	ORNL - R	2	2	0.663
PETN	78-11-5	NA	NA	1.0	1.0	0.32
3,5-DINITROANILINE	618-87-1	NA	NA	0.15	0.15	0.05
Volatile Organic Compounds						
BENZENE	71-43-2	0.005	MDE Cleanup Standard S-GW	0.002	0.002	0.0004
CARBON DISULFIDE	75-15-0	19	MDE Cleanup Standard S-GW	0.004	0.004	0.0007
CHLOROFORM	67-66-3	0.005	MDE Cleanup Standard S-GW	0.002	0.002	0.0005
ETHYL ETHER	60-29-7	1600	ORNL - R	0.002	0.002	0.0004
METHYLENE CHLORIDE	75-09-2	0.019	MDE Cleanup Standard S-GW	0.005	0.005	0.0013
TOLUENE	108-88-3	0.1	R3BTAG	0.002	0.002	0.006

Notes

MDE Cleanup Standard – R (residential) S-GW (soil to groundwater) = State of Maryland, Department of the Environment, Cleanup Standards for Soil and Groundwater, August 2001, Interim Final Guidance (Update No. 1).

NA = Not Available

ORNL = Efroymson, R.A., M.E. Will, G.W. Suter II, and A.C. Wooten. 1997. Toxicological Benchmarks for Screening Contaminants of Potential Concern for Effects on Terrestrial Plants: 1997 Revision. Oak Ridge National Laboratory. November. ES/ER/TM-85/R3.

R3BTAG = U.S. EPA Region 3, BTAG Screening Levels, January 1995.

TBD = To Be Determined

U.S. EPA Eco-Soil Screening Level (SSL) = U.S. EPA, 2005. Guidance for Developing Ecological Soil Screening Levels. Office of Solid Waste and Emergency and Response. OSWER Directive 92857-55. February. Directive 92857-55. February. Individual Eco-SSL documents available at http://www.epa.gov/ecotox/ecossl/.

ORNL-R = ORNL Risk-Based Concentration Table. The noncarcinogenic values (denoted with a "N" flag on worksheet #15B) are the RBC divided by 10 to correspond to a target hazard quotient of 0.1. Carcinogenic values represent an incremental cancer risk of 1.0E-06, which are also divided by 10 (carcinogens denoted with a "C" flag on worksheet #15B) (ORNL RBC, July 2008).

Footnotes

1. Iron is not expected to be toxic to plants when the soil pH is between 5 and 8.
2. Aluminum is considered a COPC only when the soil pH is less than 5.5.
3. The LQL exceeds the ecological screening criteria, but is below the human health screening criteria for COPC selection. For comparison to ecological screening criteria for COPC selection, one half of the laboratory QL will be used.
4. The LQL exceeds the human health screening criteria, but is below the ecological screening criteria for COPC selection. For comparison to human health screening criteria for COPC selectoin, one half of the laboratory QL will be used.

SAP Worksheet #15 -- Reference Limits and Evaluation Table

(UFP-QAPP Manual Section 2.8.1)

Matrix: Sediment

Analytical Group: Volatile Organic Compounds, Explosives, and Metals

Analyte	CAS Number	Project Action Limit (mg/kg)	Project Action Limit Reference	Project Quantitation Limit Goal (mg/kg)	Laboratory Detection Limits	
					QL (mg/kg)	MDL (mg/kg)
Metals						
ALUMINUM	7429-90-5	770000	ORNL-R	10.0	10.0	3.00
ANTIMONY	7440-36-0	2	R3BTAG	2.00	2.00	0.50
ARSENIC	7440-38-2	3.9	ORNL-R	2.00	2.00	0.40
BARIUM	7440-39-3	150000	ORNL-R	1.00	1.00	0.06
BERYLLIUM	7440-41-7	1600	ORNL-R	1.00	1.00	0.07
CADMIUM	7440-43-9	0.99	R3BTAG	0.2	0.2	0.06
CALCIUM	7440-70-2	NA	NA	10.0	10.0	4.00
CHROMIUM (total)	7440-47-3	43.4	R3BTAG	1.00	1.00	0.40
COBALT	7440-48-4	50	R3BTAG	1.00	1.00	0.20

Analyte	CAS Number	Project Action Limit (mg/kg)	Project Action Limit Reference	Project Quantitation Limit Goal (mg/kg)	Laboratory Detection Limits	
					QL (mg/kg)	MDL (mg/kg)
COPPER	7440-50-8	31.6	R3BTAG	2.00	2.00	0.50
IRON	7439-89-6	20000	R3BTAG	10.0	10.0	3.00
LEAD	7439-92-1	35.8	R3BTAG	2.00	2.00	0.50
LITHIUM	7439-93-2	NA	NA	10.0	10.0	0.70
MAGNESIUM	7439-95-4	NA	NA	10.0	10.0	2.00
MANGANESE	7439-96-5	460	R3BTAG	1.00	1.00	0.06
MERCURY	7439-97-6	0.18	R3BTAG	0.05	0.05	0.017
NICKEL	7440-02-0	22.7	R3BTAG	2.00	2.00	0.50
POTASSIUM	7440-09-7	NA	NA	50.0	50.0	16.0
SILVER	7440-22-4	1	R3BTAG	0.50	0.50	0.07
SODIUM	7440-23-5	NA	NA	50.0	50.0	3.00
STRONTIUM	7440-24-6	470000	ORNL-R	1.00	1.00	0.60
TIN	7440-31-5	470000	ORNL-R	5.00	5.00	2.00
VANADIUM	7440-62-2	520	NOAA SQUIRTS	1.00	1.00	0.30

Analyte	CAS Number	Project Action Limit (mg/kg)	Project Action Limit Reference	Project Quantitation Limit Goal (mg/kg)	Laboratory Detection Limits	
					QL (mg/kg)	MDL (mg/kg)
ZINC	7440-66-6	121	R3BTAG	2.00	2.00	0.30
Metals (by 6020)						
SELENIUM	7782-49-2	2	R3BTAG	1.0	1.0	0.15
Explosives						
1,3,5-TRINITROBENZENE	99-35-4	18000	ORNL-R	0.15	0.15	0.05
1,3 DINITROBENZENE	99-65-0	61	ORNL-R	0.15	0.15	0.04
2,4-DINITROTOLUENE	121-14-2	0.0416	R3BTAG	0.0416(1)	0.15	0.04
2,6-DINIRTOTOLUENE	606-20-2	610	ORNL-R	0.3	0.3	0.09
2,4,6-TRINITROTOLUENE	118-96-7	0.092	R3BTAG	0.092(1)	0.15	0.04
2-AMINO-4,6-DINITROTOLUENE	35572-78-2	1200	ORNL-R	0.15	0.15	0.05
2-NITROTOLUENE	88-72-2	7800	ORNL-R	0.2	0.2	0.06
3-NITROTOLUENE	99-08-1	NA	NA	0.15	0.15	0.04
4-AMINO-2,6-DINITROTOLUENE	1946-51-0	1200	ORNL-R	0.15	0.15	0.05
4-NITROTOLUENE	99-99-0	4.06	R3BTAG	0.2	0.2	0.06

Analyte	CAS Number	Project Action Limit (mg/kg)	Project Action Limit Reference	Project Quantitation Limit Goal (mg/kg)	Laboratory Detection Limits	
					QL (mg/kg)	MDL (mg/kg)
HMX	2691-41-0	31000	ORNL-R	0.1	0.1	0.02
TETRYL	479-45-8	2400	ORNL-R	0.15	0.15	0.05
RDX	121-82-4	0.013	R3BTAG	0.1	0.1	0.03
NITROBENZENE	98-95-3	301	ORNL-R	0.2	0.2	0.06
NITROGLYCERIN	55-63-0	610	ORNL-R	1.0	1.0	0.25
NITROGUANIDINE	556-88-7	61000	ORNL-R	TBD	TBD	TBD
PERCHLORATE	014797-73-0	550	ORNL-R	2	2	0.663
PETN	78-11-5	NA	NA	1.0	1.0	0.32
3,5-DINITROANILINE	618-87-1	NA	NA	0.15	0.15	0.05
Volatile Organic Compounds						
BENZENE	71-43-2	11	ORNL-R	0.002	0.002	0.0004
CARBON DISULFIDE	**75-15-0**	**0.00085**	R3BTAG	**0.00085**[(1)]	**0.004**	**0.0007**
CHLOROFORM	67-66-3	3	ORNL-R	0.002	0.002	0.0005
ETHYL ETHER	60-29-7	160000	ORNL-R	0.002	0.002	0.0004
METHYLENE CHLORIDE	75-09-2	110	ORNL-R	0.005	0.005	0.0013
TOLUENE	108-88-3	50000	ORNL-R	0.002	0.002	0.006

Notes

NA = Not Available

ORNL = Efroymson, R.A., M.E. Will, G.W. Suter II, and A.C. Wooten. 1997. Toxicological Benchmarks for Screening Contaminants of Potential Concern for Effects on Terrestrial Plants: 1997 Revision. Oak Ridge National Laboratory. November. ES/ER/TM-85/R3.

R3BTAG = U.S. EPA Region 3, Freshwater Sediment Screening Benchmarks, 2006.

TBD = To Be Determined

NOAA SQUIRTS = Buchman, M.F., 2006. NOAA Screening Quick Reference Tables, NOAA HAZMAT Report 99-1, Seattle, WA, Coastal Protection and Restoration Division, National Oceanic and Atmospheric Administration. http://response.restoration.noaa.gov/cpr/sediment/squairts.html. These values are considered only if thee are no Region 3 BTAG or TEC values available.

Footnotes

1. The LQL exceeds the ecological screening criteria, but is below the human health screening criteria for COPC selection. For comparison to ecological screening criteria for COPC selection, one half the laboratory QL will be used

SAP Worksheet #16 -- Project Schedule / Timeline Table (optional format)

(UFP-QAPP Manual Section 2.8.2)

Activities	Organization	Dates (MM/YY)	
		Anticipated Date(s) of Initiation	Anticipated Date of Completion
Prepare Rough Draft SI Work Plan & Appendices	Tetra Tech	10/07	10/08
Submit Rough Draft SI Work Plan & Appendices	Tetra Tech	10/08	10/08
Navy Review	Navy	11/08	11/08
Prepare Draft SI Work Plan & Appendices	Tetra Tech	12/08	3/09
Submit Draft SI Work Plan & Appendices	Tetra Tech	3/09	3/09
Regulator Review	U.S. EPA & MDE	4/09	8/09
Receive Comments/Comment Resolution	Tetra Tech	8/09	9/09
Prepare Final SI Work Plan & Appendices	Tetra Tech	8/09	9/09
Submit Final SI Work Plan & Appendices	Tetra Tech	9/09	9/09
Mobilization and Field Investigation	Tetra Tech	10/09	10/09
Complete Field Investigation and Demobilization	Tetra Tech	10/09	12/09
Laboratory Analysis	ALSI	12/09	1/10
Data Validation	Tetra Tech	1/10	2/10
Prepare Rough Draft SI Report	Tetra Tech	12/09	3/10
Submit Rough Draft SI Report	Tetra Tech	3/10	3/10

Activities	Organization	Dates (MM/YY)	
		Anticipated Date(s) of Initiation	Anticipated Date of Completion
Navy Review	Navy	3/10	4/10
Prepare Draft SI Report	Tetra Tech	4/10	5/10
Submit Draft SI Report	Tetra Tech	5/10	5/10
Regulator Review	U.S. EPA & MDE	5/10	7/10
Receive Comments/Comment Resolution	Tetra Tech	7/10	8/10
Prepare Final SI Report	Tetra Tech	8/10	9/10
Submit Final SI Report	Tetra Tech	9/10	9/10

SAP Worksheet #17 – Sampling Design and Rationale

(UFP-QAPP Manual Section 3.1.1)

This section describes sampling locations, methods, and rationales for the sampling activities to be conducted in support of the field investigations at the 10 munitions response sites located at the NSF in Indian Head, Maryland. All referenced field SOPs are presented in Appendix D. The soil samples will be collected via hand auger in accordance with SOP-05 or DPT in accordance with SOP-06. To determine the vertical extent of any surficial contamination, surface soil samples will be collected at both a 0- to 6-inch and 0- to 24-inch depth. Typically, subsurface soil samples will be collected from 2- to 4-feet and 4- to 6-feet bgs, unless refusal or the water table is encountered. The subsurface samples will be a composite of the entire length of the 2 foot sample core unless unusual staining or odor is observed in the core: in those instances, the sample will be collected from that specific area of the sample core.

All sediment samples will be collected from 0-to 6-inches bgs in accordance with SOP-08. Surface water samples will be collected in accordance with SOP-07, and groundwater samples will be collected in accordance with SOP-18.

Prior to any field activities, the Tetra Tech FOL will ensure that all field personnel read and understand this UFP-SAP and the associated HASP, and ensure that all non-health and safety-related equipment is available and operational. The SSO will ensure that all health and safety-related equipment is available and operational.

The sampling objective is to determine if past operations have led to any possible contamination at each respective site. As shown in sample Worksheets 18.1 through 18.10, samples will be analyzed for explosives, VOCs, and metals in soil, sediment, surface water, and groundwater. No samples are proposed for collection at the Valley Impact Area. All field visual observations will be recorded on sample log sheets. Any encounters with metallic objects or other objects that indicate a potential contaminant source or hazard will be reported to the FOL and SSO, and appropriate actions will be taken as specified in this UFP-SAP and associated HASP.

If MEC is observed in any boring sample or near any work area, work must be halted. The presence of MEC must be communicated to the FOL, and the FOL will then communicate with the NSF-IH POC so that the appropriate action may be taken. If obvious soil staining is observed in any boring, the staining will be described in the boring log, and additional samples may be collected at the discretion of the FOL or site geologist to determine the nature and possibly the extent of associated site-related contamination.

Sampling Strategy

The chosen sampling strategy for each of the nine areas to be investigated are detailed below. The sampling strategy employs a transect line sample design to target those areas that are most likely to be contaminated according to the CSMs presented in Appendix B, as well as nearby areas that will help to bound the contamination. The data collected under this conservative strategy will probably not represent the concentrations to which human or ecological receptors would actually be exposed. Instead, the measured concentrations are likely to be greater than actual exposure concentrations. The strategy, therefore, ensures that a potential environmental problem is not overlooked. The sampler will try to ensure good spatial coverage of the targeted contamination areas when selecting sampling locations to validate the sampling design and CSMs; areas outside of those which are expected to be contaminated will also be sampled. If the CSMs are correct, these additional locations will exhibit lower, and perhaps even non-detectable, concentrations of MC than those found in the targeted contamination areas. Additional sampling strategies can be found under the discussions for each individual site below. All soil borings will be logged to determine lithology. Details regarding sampling equipment and procedures are included in Worksheet 14 and SOP-05, -06, -07, -08, -18, and -19 contained in Appendix D.

The actual sample locations may vary from the proposed locations based on field conditions, but will remain in the estimated investigated areas as depicted on sample location Figures 17.1 through 17.9. The FOL will use his/her professional judgment and the results of the MEC investigation of the site to determine which areas are most likely to be contaminated and may adjust the proposed sample locations accordingly.

The total numbers of soil, sediment, surface water and groundwater analyses for each analyte group are tabulated in Worksheets 18.1 through 18.10. QA/QC samples will be collected at the frequencies listed in Worksheets 20.1 through 20.10. Worksheet 19 presents a summary of the sample analyses, container types and volumes, preservation requirements, and holding times for the samples to be collected.

All samples collected for fixed-base laboratory analyses will be prepared and analyzed according to the normal laboratory protocol as identified on Worksheet 30.

All sample locations will be marked with a wooden stake or brightly colored pin flag indicating the sample location. Coordinates will be determined by GPS (SOP-22) at each individual sample location which will allow for future repeatable investigations or guide in any remedial action. All sample location markers will be removed prior to the final demobilization.

Sampling activities at the following sites are described in this UFP-SAP:

- UXO 01 – Air Blast Pond
- UXO 02 – Area 8
- UXO 28 – EOD School Demolition Area
- UXO 04 – Basic IED Area
- UXO 05 – Advanced IED Area
- UXO 10 – Stump Neck Impact Area
- UXO 21 – Test Area 1
- UXO 12 – Torpedo Burial Site
- UXO 23 – Torpedo Casing Disposal Area

SAP Worksheet #17.1 - Sampling and Design Rationale for the Air Blast Pond (UXO 01)

The majority of the soil sample locations at the Air Blast Pond will be determined in response to the detector-aided surface sweep conducted as part of the site MEC investigation. Based on the results of the surface sweep, the soil samples will be focused in areas with observed munitions debris, suspect MEC, or anomaly clusters to determine if explosive contamination is present. A total of 46 soil samples are proposed at 20 locations at the Air Blast Pond. Forty surface soil samples will be collected from two depths (0 to 6 and 0 to 24 inches bgs) at each of the 20 sample locations. Six of the 20 sample locations will be selected for subsurface soil sampling at depths of 2 to 4 feet bgs based on the discretion of the FOL.

Figure 17.1 presents a close-up aerial view of the Air Blast Pond and the proposed sample locations where samples will be collected if no suspect MEC, MPPEH or munitions debris is observed. Soil sample locations are subject to relocation based on the detector-aided surface sweep. All soil samples will be collected via hand auger and submitted to the fixed-base laboratory for explosives analysis as shown on Worksheet 18.1. Three of the soil samples shipped to the laboratory will be identified for pH, TOC, and CEC analysis.

SAP Worksheet #17.2 - Sampling and Design Rationale for Area 8 (UXO 02)

Several of the soil sample locations at Area 8 will be determined in response to the detector-aided surface sweep conducted as part of the site MEC investigation. Based on the results of the surface sweep and possible geophysics data, the soil samples will be focused in areas with observed munitions

debris, MPPEH, suspect MEC, or subsurface anomaly clusters to determine if contamination exists. A total of 120 soil samples are proposed at 40 locations within Area 8. Eighty surface soil samples will be collected from two depths (0 to 6 and 0 to 24 inches bgs) at each of the 40 sample locations. Twenty of the 40 soil sample locations will be selected for subsurface soil sampling by the planning team based on the presence of subsurface anomaly clusters. Subsurface soil samples will be collected at depths of 2 to 4 and 4 to 6 feet bgs.

Seven sediment samples, collected at 0 to 6 inches, are proposed within Area 8. Three of these samples will be collected under surface water flow within Chicamuxen Creek in areas where training was known to occur. Four of the sediment samples will be collected within the pond at Area 8.

Six groundwater samples will also be collected within Area 8. Three of the samples will be collected from existing wells currently on site, and the remaining three will be from new temporary monitoring wells installed in soil borings.

Figure 17.2 presents a close-up aerial view of Area 8 where proposed soil sample will be collected within the MRP Area, and of three existing groundwater monitoring wells selected for sampling. All soil samples will be collected via DPT and submitted to the fixed-base laboratory for explosives and metals analysis as shown on Worksheet 18.2. Three of the soil samples shipped to the laboratory will be identified for pH, TOC, and CEC analysis. Sediment and groundwater samples submitted to the fixed-base laboratory will also be subject to explosives and metals analysis as shown on Worksheet 18.2.

SAP Worksheet #17.3 - Sampling and Design Rationale for the EOD School Demolition Area (UXO 28)

Soil sample locations at the EOD School Demolition Area will be determined in response to the detector-aided surface sweep conducted as part of the site MEC investigation. Based on the results of the surface sweep and geophysics data, the soil samples will be focused in areas with observed munitions debris, suspect MEC, or subsurface anomaly clusters to determine if contamination exists. A total of 40 soil samples are proposed at 20 locations at the EOD School Demolition Area. The surface soil samples will be collected from two depths (0 to 6 and 0 to 24 inches bgs) at each of the 20 sample locations.

Soil samples will be collected within the boundary of the MRP area based on the results of the detector-aided surface sweep. If no suspect MEC, MPPEH, or subsurface anomaly clusters are observed, the samples will be collected at the locations shown on Figure 17.3.

Figure 17.3 presents a close-up aerial view of the EOD School Demolition Area showing the proposed locations where samples will be collected and the proposed sample locations where samples will be collected if no suspect MEC, MPPEH, or munitions debris is observed. Shown soil sample locations are subject to relocation based on the detector-aided surface sweep. All soil samples will be collected via hand auger and submitted to the fixed-base laboratory for explosives and metals analysis as shown on Worksheet 18.3. Three of the soil samples shipped to the laboratory will be identified for pH, TOC, and CEC analysis.

SAP Worksheet #17.4 - Sampling and Design Rationale for the Basic IED Area (UXO 04)

Soil sample locations at the Basic IED Area will be determined in response to the detector-aided surface sweep conducted as part of the site MEC investigation. Based on the results of the surface sweep, the soil samples will be focused in areas with observed munitions debris, suspect MEC, or anomaly clusters to determine if contamination exists. A total of 80 soil samples are proposed at 20 locations at the Basic IED Area. The surface soil samples (40) will be collected from two depths (0 to 6 and 0 to 24 inches bgs) at each of the 20 sample locations. The 40 subsurface soil samples will also be collected from the 20 surface soil sample locations. Two subsurface samples will be collected at each location from depths of 2 to 4 and 4 to 6 feet bgs.

Three groundwater samples will also be collected within and adjacent to the Basic IED Area from existing groundwater monitoring wells.

Figure 17.4 presents a close-up aerial view of the Basic IED Area, showing the proposed locations where soil samples will be collected if no suspect MEC, MPPEH, or munitions debris is observed and the existing groundwater monitoring wells. Soil sample locations are subject to relocation based on the detector-aided surface sweep. All soil samples will be collected via hand auger. All samples submitted to the fixed-base laboratory will be analyzed for explosives, metals, and VOCs as shown on Worksheet 18.4. Three of the soil samples shipped to the laboratory will be identified for pH, TOC, and CEC analysis.

SAP Worksheet #17.5 - Sampling and Design Rationale for the Advanced IED Area (UXO 05)

Soil sample locations at the Advanced IED Area will be determined in response to the detector-aided surface sweep conducted as part of the site MEC investigation. Based on the results of the surface sweep and geophysics data, the soil samples will be focused in areas with observed munitions debris, suspect MEC, or anomaly clusters to determine if contamination exists. A total of 80 soil samples are

proposed at 20 locations at the Advanced IED Area. The surface soil samples (40) will be collected from two depths (0 to 6 and 0 to 24 inches bgs) at each of the 20 sample locations. The 40 subsurface soil samples will also be collected at each of the 20 surface soil sample locations. The subsurface samples will be collected from depths of 2 to 4 and 4 to 6 feet bgs.

Figure 17.5 presents a close-up aerial view of the Advanced IED Area showing the proposed locations where soil samples will be collected if no suspect MEC, MPPEH, or munitions debris is observed. Shown soil sample locations are subject to relocation based on the detector-aided surface sweep. All soil samples will be collected via hand auger and submitted to the fixed-base laboratory for explosives and metals analysis as shown on Worksheet 18.5. Three of the soil samples shipped to the laboratory will be identified for pH, TOC, and CEC analysis.

SAP Worksheet #17.6 - Sampling and Design Rationale for the Stump Neck Impact Area (UXO 10)

Soil sample locations at the Stump Neck Impact Area will be determined in response to the detector-aided surface sweep conducted as part of the site MEC investigation. Based on the results of the surface sweep and geophysics data, the soil samples will be focused in areas with observed munitions debris, suspect MEC, or anomaly clusters to determine if contamination exists. A total of 40 soil samples are proposed at 10 locations at the Stump Neck Impact Area. The surface soil samples (20) will be collected from two depths (0 to 6 and 0 to 24 inches bgs) at each of the 10 sample locations. The 20 subsurface soil samples will also be collected at each of the 10 surface soil sample locations. The subsurface samples will be collected from depths of 2 to 4 and 4 to 6 feet bgs.

Figure 17.6 presents a close-up aerial view of the Stump Neck Impact Area showing the proposed locations where soil samples will be collected if no suspect MEC, MPPEH, or munitions debris is observed. Soil sample locations are subject to relocation based on the detector-aided surface sweep. Soil samples will be collected via hand auger and DPT and submitted to the fixed-base laboratory for explosives analysis as shown on Worksheet 18.6. Three of the soil samples shipped to the laboratory will be identified for pH, TOC, and CEC analysis.

SAP Worksheet #17.7 - Sampling and Design Rationale for Test Area 1 (UXO 21)

Soil sample locations at the Test Area 1 will be determined in response to the detector-aided surface sweep conducted as part of the site MEC investigation. Based on the results of the surface sweep, the soil samples will be focused in areas with observed munitions debris, suspect MEC, or anomaly clusters to determine if contamination exists. A total of 41 soil samples are proposed at 21 locations at the Test

Area 1. One surface soil sample will be collected within the "bowl" of the Test Area. The remaining surface soil samples will be collected outside the bowl area. Samples will be composite samples from two depths (0 to 6 and 0 to 24 inches bgs) at each of these 20 sample locations. Each composite sample will be composed of eight discrete samples collected in a "wagon-wheel" pattern with the length of the radials being approximately 10 feet.

Figure 17.7 presents a close-up aerial view of Test Area 1 showing the proposed locations where soil samples will be collected if no suspect MEC, MPPEH, or munitions debris is observed. Shown soil sample locations are subject to relocation based on the detector-aided surface sweep. All soil samples will be collected via hand auger and submitted to the fixed-base laboratory for explosives analysis as shown on Worksheet 18.7. Three of the soil samples shipped to the laboratory will be identified for pH, TOC, and CEC analysis.

SAP Worksheet #17.8 - Sampling and Design Rationale for the Valley Impact Area (UXO 26)

The Valley Impact Area covers the majority of the Stump Neck peninsula and is covered under the separate areas proposed for investigation at the installation. Therefore, no sampling is specifically proposed for the Valley Impact Area as a whole.

SAP Worksheet #17.9 - Sampling and Design Rationale for the Torpedo Burial Site (UXO 12)

Soil sample locations at the Torpedo Burial Site will be determined in response to the detector-aided surface sweep conducted as part of the site MEC investigation. Based on the results of the surface sweep and the geophysics survey, the soil samples will be focused in areas where MEC is thought to be buried to determine if contamination exists. A total of 20 soil samples are proposed at 10 locations at the Torpedo Burial Site. Because there are torpedo casings being buried at this site, subsurface soil samples will be collected at depths of 2 to 4 and 4 to 6 feet bgs.

Two sediment samples, collected at 0 to 6 inches bgs, and one surface water sample are proposed at the Torpedo Burial Site. The samples will be collected from the drainage channel that runs through the center of the site to determine if explosive contamination is being carried through the site via surface water runoff.

Figure 17.8 presents a close-up aerial view of the Torpedo Burial Site showing the proposed soil, sediment, and surface water sample locations. Samples will be collected at these locations if no suspect MEC, MPPEH, or munitions debris is observed. Locations are subject to relocation based on the

detector-aided surface sweep. Subsurface soil samples will be collected via DPT. All samples submitted to the fixed-base laboratory will undergo explosives analysis as shown on Worksheet 18.9. Three of the soil samples shipped to the laboratory will be identified for pH, TOC, and CEC analysis.

SAP Worksheet #17.10 - Sampling and Design Rationale for the Torpedo Casing Disposal Area (UXO 23)

Soil sample locations at the Torpedo Casing Disposal Area will be determined in response to the detector-aided surface sweep conducted as part of the site MEC investigation. Based on the results of the surface sweep and the geophysics survey, the soil samples will be focused in areas where MEC is thought to be buried to determine if contamination exists. A total of 20 soil samples are proposed at 10 locations at the Torpedo Casing Disposal Area. Because torpedo casings are buried at this site, subsurface soil samples will be collected at depths of 2 to 4 and 4 to 6 feet bgs.

Figure 17.9 presents a close-up aerial view of the Torpedo Casing Disposal Area showing the proposed soil sample locations. Subsurface soil samples will be collected at these locations if no suspect MEC, MPPEH, or munitions debris is observed. Locations are subject to relocation based on the detector-aided surface sweep. Subsurface soil samples will be collected via DPT. All samples submitted to the fixed-base laboratory will undergo explosives and metals analysis as shown on Worksheet 18.10. Three of the soil samples shipped to the laboratory will be identified for pH, TOC, and CEC analysis.

SAP Worksheet #18.1 -- Air Blast Pond (UXO01) Sampling Locations and Methods/SOP Requirements Table

(UFP-QAPP Manual Section 3.1.1)

AIR BLAST POND (UXO 01)

Sample Location[1]	Sample ID[2]	Explosives	Miscellaneous
		SW-846 Method 8330B	SW-846 9045D (pH), SW-846 9081 (CEC), Lloyd Kahn Method (TOC)
X01SB001	X01SS0010006	1	TBD[4]
	X01SS0010024	1	TBD[4]
	X01SB0010204	TBD[3]	TBD[4]
X01SB002	X01SS0020006	1	TBD[4]
	X01SS0020024	1	TBD[4]
	X01SB0020204	TBD[3]	TBD[4]
X01SB003	X01SS0030006	1	TBD[4]
	X01SS0030024	1	TBD[4]
	X01SB0030204	TBD[3]	TBD[4]
X01SB004	X01SS0040006	1	TBD[4]
	X01SS0040024	1	TBD[4]
	X01SB0040204	TBD[3]	TBD[4]
X01SB005	X01SS0050006	1	TBD[4]
	X01SS0050024	1	TBD[4]
	X01SB0050204	TBD[3]	TBD[4]
X01SB006	X01SS0060006	1	TBD[4]
	X01SS0060024	1	TBD[4]
	X01SB0060204	TBD[3]	TBD[4]
X01SB007	X01SS0070006	1	TBD[4]
	X01SS0070024	1	TBD[4]
	X01SB0070204	TBD[3]	TBD[4]

Sample Location[1]	Sample ID[2]	Explosives	Miscellaneous
		SW-846 Method 8330B	SW-846 9045D (pH), SW-846 9081 (CEC), Lloyd Kahn Method (TOC)
X01SB008	X01SS0080006	1	TBD[4]
	X01SS0080024	1	TBD[4]
	X01SB0080204	TBD[3]	TBD[4]
X10SB009	X01SS0090006	1	TBD[4]
	X01SS0090024	1	TBD[4]
	X01SB0090204	TBD[3]	TBD[4]
X01SB010	X01SS0100006	1	TBD[4]
	X01SS0100024	1	TBD[4]
	X01SB0100204	TBD[3]	TBD[4]
X01SB011	X01SS0110006	1	TBD[4]
	X01SS0110024	1	TBD[4]
	X01SB0110204	TBD[3]	TBD[4]
X01SB012	X01SS0120006	1	TBD[4]
	X01SS0120024	1	TBD[4]
	X01SB0120204	TBD[3]	TBD[4]
X01SB013	X01SS0130006	1	TBD[4]
	X01SS0130024	1	TBD[4]
	X01SB0130204	TBD[3]	TBD[4]
X01SB014	X01SS0140006	1	TBD[4]
	X01SS0140024	1	TBD[4]
	X01SB0140204	TBD[3]	TBD[4]
X01SB015	X01SS0150006	1	TBD[4]
	X01SS0150024	1	TBD[4]
	X01SB0150204	TBD[3]	TBD[4]

Sample Location[1]	Sample ID[2]	Explosives	Miscellaneous
		SW-846 Method 8330B	SW-846 9045D (pH), SW-846 9081 (CEC), Lloyd Kahn Method (TOC)
X01SB016	X01SS0160006	1	TBD[4]
	X01SS0160024	1	TBD[4]
	X01SB0160204	TBD[3]	TBD[4]
X01SB017	X01SS0170006	1	TBD[4]
	X01SS0170024	1	TBD[4]
	X01SB0170204	TBD[3]	TBD[4]
X01SB018	X01SS0180006	1	TBD[4]
	X01SS0180024	1	TBD[4]
	X01SB0180204	TBD[3]	TBD[4]
X01SB019	X01SS0190006	1	TBD[4]
	X01SS0190024	1	TBD[4]
	X01SB0190204	TBD[3]	TBD[4]
X01SB020	X01SS0200006	1	TBD[4]
	X01SS0200024	1	TBD[4]
	X01SB0200204	TBD[3]	TBD[4]
Total Soil Samples - Air Blast Pond		**46**	**3**

bgs – Below ground surface.
CEC – Cation exchange capacity.
SOP – Standard Operating Procedure.
TBD - To be determined.
TOC – Total organic carbon.

1 X = UXO.
2 Surface soil (SS) sample depths include 0 to 6 inches bgs and 0 to 24 inches bgs. Subsurface soil (SB) samples to be collected from 2 to 4 feet bgs.
3 Up to six of the sample locations will be selected for collection of a subsurface soil sample. Locations TBD in the field.
4 Up to 3 of the samples submitted to the fixed-base laboratory will be marked for pH, TOC, and CEC analysis.

Soil samples will be collected in accordance with SOP-05.

Note: Field duplicate and matrix spike/matrix spike duplicate (MS/MSD) samples will be collected at a frequency of 1 per 20 samples for fixed-base laboratory samples.

SAP Worksheet #18.2 -- Area 8 (UXO02) Sampling Locations and Methods/SOP Requirements Table

(UFP-QAPP Manual Section 3.1.1)

AREA 8 (UXO 02)

Sample Location[1]	Sample ID[2]	Explosives	Metals	Miscellaneous
		SW-846 Method 8330B	SW-846 Method 6010B/6020A	SW-846 9045D (pH), SW-846 9081 (CEC), Lloyd Kahn Method (TOC)
SOIL				
X02SB001	X02SS0010006	1	1	TBD[4]
	X02SS0010024	1	1	TBD[4]
	X02SB0010204	TBD[3]	TBD[3]	TBD[4]
	X02SB0010406	TBD[3]	TBD[3]	TBD[4]
X02SB002	X02SS0020006	1	1	TBD[4]
	X02SS0020024	1	1	TBD[4]
	X02SB0020204	TBD[3]	TBD[3]	TBD[4]
	X02SB0020406	TBD[3]	TBD[3]	TBD[4]
X02SB003	X02SS0030006	1	1	TBD[4]
	X02SS0030024	1	1	TBD[4]
	X02SB0030204	TBD[3]	TBD[3]	TBD[4]
	X02SB0030406	TBD[3]	TBD[3]	TBD[4]
X02SB004	X02SS0040006	1	1	TBD[4]
	X02SS0040024	1	1	TBD[4]
	X02SB0040204	TBD[3]	TBD[3]	TBD[4]
	X02SB0040406	TBD[3]	TBD[3]	TBD[4]
X02SB005	X02SS0050006	1	1	TBD[4]
	X02SS0050024	1	1	TBD[4]
	X02SB0050204	TBD[3]	TBD[3]	TBD[4]
	X02SB0050406	TBD[3]	TBD[3]	TBD[4]

Sample Location[1]	Sample ID[2]	Explosives	Metals	Miscellaneous
		SW-846 Method 8330B	SW-846 Method 6010B/6020A	SW-846 9045D (pH), SW-846 9081 (CEC), Lloyd Kahn Method (TOC)
X02SB006	X02SS0060006	1	1	TBD[4]
	X02SS0060024	1	1	TBD[4]
	X02SB0060204	TBD[3]	TBD[3]	TBD[4]
	X02SB0060406	TBD[3]	TBD[3]	TBD[4]
X02SB007	X02SS0070006	1	1	TBD[4]
	X02SS0070024	1	1	TBD[4]
	X02SB0070204	TBD[3]	TBD[3]	TBD[4]
	X02SB0070406	TBD[3]	TBD[3]	TBD[4]
X02SB008	X02SS0080006	1	1	TBD[4]
	X02SS0080024	1	1	TBD[4]
	X02SB0080204	TBD[3]	TBD[3]	TBD[4]
	X02SB0080406	TBD[3]	TBD[3]	TBD[4]
X10SB009	X02SS0090006	1	1	TBD[4]
	X02SS0090024	1	1	TBD[4]
	X02SB0090204	TBD[3]	TBD[3]	TBD[4]
	X02SB0090406	TBD[3]	TBD[3]	TBD[4]
X02SB010	X02SS0100006	1	1	TBD[4]
	X02SS0100024	1	1	TBD[4]
	X02SB0100204	TBD[3]	TBD[3]	TBD[4]
	X02SB0100406	TBD[3]	TBD[3]	TBD[4]
X02SB011	X02SS0110006	1	1	TBD[4]
	X02SS0110024	1	1	TBD[4]
	X02SB0110204	TBD[3]	TBD[3]	TBD[4]
	X02SB0110406	TBD[3]	TBD[3]	TBD[4]
X02SB012	X02SS0120006	1	1	TBD[4]
	X02SS0120024	1	1	TBD[4]
	X02SB0120204	TBD[3]	TBD[3]	TBD[4]
	X02SB0120406	TBD[3]	TBD[3]	TBD[4]

Sample Location[1]	Sample ID[2]	Explosives	Metals	Miscellaneous
		SW-846 Method 8330B	SW-846 Method 6010B/6020A	SW-846 9045D (pH), SW-846 9081 (CEC), Lloyd Kahn Method (TOC)
X02SB013	X02SS0130006	1	1	TBD[4]
	X02SS0130024	1	1	TBD[4]
	X02SB0130204	TBD[3]	TBD[3]	TBD[4]
	X02SB0130406	TBD[3]	TBD[3]	TBD[4]
X02SB014	X02SS0140006	1	1	TBD[4]
	X02SS0140024	1	1	TBD[4]
	X02SB0140204	TBD[3]	TBD[3]	TBD[4]
	X02SB0140406	TBD[3]	TBD[3]	TBD[4]
X02SB015	X02SS0150006	1	1	TBD[4]
	X02SS0150024	1	1	TBD[4]
	X02SB0150204	TBD[3]	TBD[3]	TBD[4]
	X02SB0150406	TBD[3]	TBD[3]	TBD[4]
X02SB016	X02SS0160006	1	1	TBD[4]
	X02SS0160024	1	1	TBD[4]
	X02SB0160204	TBD[3]	TBD[3]	TBD[4]
	X02SB0160406	TBD[3]	TBD[3]	TBD[4]
X02SB017	X02SS0170006	1	1	TBD[4]
	X02SS0170024	1	1	TBD[4]
	X02SB0170204	TBD[3]	TBD[3]	TBD[4]
	X02SB0170406	TBD[3]	TBD[3]	TBD[4]
X02SB018	X02SS0180006	1	1	TBD[4]
	X02SS0180024	1	1	TBD[4]
	X02SB0180204	TBD[3]	TBD[3]	TBD[4]
	X02SB0180406	TBD[3]	TBD[3]	TBD[4]
X02SB019	X02SS0190006	1	1	TBD[4]
	X02SS0190024	1	1	TBD[4]
	X02SB0190204	TBD[3]	TBD[3]	TBD[4]
	X02SB0190406	TBD[3]	TBD[3]	TBD[4]

Sample Location[1]	Sample ID[2]	Explosives	Metals	Miscellaneous
		SW-846 Method 8330B	SW-846 Method 6010B/6020A	SW-846 9045D (pH), SW-846 9081 (CEC), Lloyd Kahn Method (TOC)
X02SB020	X02SS0200006	1	1	TBD[4]
	X02SS0200024	1	1	TBD[4]
	X02SB0200204	TBD[3]	TBD[3]	TBD[4]
	X02SB0200406	TBD[3]	TBD[3]	TBD[4]
X02SB021	X02SS0210006	1	1	TBD[4]
	X02SS0210024	1	1	TBD[4]
	X02SB0210204	TBD[3]	TBD[3]	TBD[4]
	X02SB0210406	TBD[3]	TBD[3]	TBD[4]
X02SB022	X02SS0220006	1	1	TBD[4]
	X02SS0220024	1	1	TBD[4]
	X02SB0220204	TBD[3]	TBD[3]	TBD[4]
	X02SB0220406	TBD[3]	TBD[3]	TBD[4]
X02SB023	X02SS0230006	1	1	TBD[4]
	X02SS0230024	1	1	TBD[4]
	X02SB0230204	TBD[3]	TBD[3]	TBD[4]
	X02SB0230406	TBD[3]	TBD[3]	TBD[4]
X02SB024	X02SS0240006	1	1	TBD[4]
	X02SS0240024	1	1	TBD[4]
	X02SB0240204	TBD[3]	TBD[3]	TBD[4]
	X02SB0240406	TBD[3]	TBD[3]	TBD[4]
X02SB025	X02SS0250006	1	1	TBD[4]
	X02SS0250024	1	1	TBD[4]
	X02SB0250204	TBD[3]	TBD[3]	TBD[4]
	X02SB0250406	TBD[3]	TBD[3]	TBD[4]
X02SB026	X02SS0260006	1	1	TBD[4]
	X02SS0260024	1	1	TBD[4]
	X02SB0260204	TBD[3]	TBD[3]	TBD[4]
	X02SB0260406	TBD[3]	TBD[3]	TBD[4]

Sample Location[1]	Sample ID[2]	Explosives	Metals	Miscellaneous
		SW-846 Method 8330B	SW-846 Method 6010B/6020A	SW-846 9045D (pH), SW-846 9081 (CEC), Lloyd Kahn Method (TOC)
X02SB027	X02SS0270006	1	1	TBD[4]
	X02SS0270024	1	1	TBD[4]
	X02SB0270204	TBD[3]	TBD[3]	TBD[4]
	X02SB0270406	TBD[3]	TBD[3]	TBD[4]
X02SB028	X02SS0280006	1	1	TBD[4]
	X02SS0280024	1	1	TBD[4]
	X02SB0280204	TBD[3]	TBD[3]	TBD[4]
	X02SB0280406	TBD[3]	TBD[3]	TBD[4]
X02SB029	X02SS0290006	1	1	TBD[4]
	X02SS0290024	1	1	TBD[4]
	X02SB0290204	TBD[3]	TBD[3]	TBD[4]
	X02SB0290406	TBD[3]	TBD[3]	TBD[4]
X02SB030	X02SS0300006	1	1	TBD[4]
	X02SS0300024	1	1	TBD[4]
	X02SB0300204	TBD[3]	TBD[3]	TBD[4]
	X02SB0300406	TBD[3]	TBD[3]	TBD[4]
X02SB031	X02SS0310006	1	1	TBD[4]
	X02SS0310024	1	1	TBD[4]
	X02SB0310204	TBD[3]	TBD[3]	TBD[4]
	X02SB0310406	TBD[3]	TBD[3]	TBD[4]
X02SB032	X02SS0320006	1	1	TBD[4]
	X02SS0320024	1	1	TBD[4]
	X02SB0320204	TBD[3]	TBD[3]	TBD[4]
	X02SB0320406	TBD[3]	TBD[3]	TBD[4]
X02SB033	X02SS0330006	1	1	TBD[4]
	X02SS0330024	1	1	TBD[4]
	X02SB0330204	TBD[3]	TBD[3]	TBD[4]
	X02SB0330406	TBD[3]	TBD[3]	TBD[4]

Sample Location[1]	Sample ID[2]	Explosives	Metals	Miscellaneous
		SW-846 Method 8330B	SW-846 Method 6010B/6020A	SW-846 9045D (pH), SW-846 9081 (CEC), Lloyd Kahn Method (TOC)
X02SB034	X02SS0340006	1	1	TBD4
	X02SS0340024	1	1	TBD4
	X02SB0340204	TBD3	TBD3	TBD4
	X02SB0340406	TBD3	TBD3	TBD4
X02SB035	X02SS0350006	1	1	TBD[4]
	X02SS0350024	1	1	TBD[4]
	X02SB0350204	TBD[3]	TBD[3]	TBD[4]
	X02SB0350406	TBD[3]	TBD[3]	TBD[4]
X02SB036	X02SS0360006	1	1	TBD[4]
	X02SS0360024	1	1	TBD[4]
	X02SB0360204	TBD[3]	TBD[3]	TBD[4]
	X02SB0360406	TBD[3]	TBD[3]	TBD[4]
X02SB037	X02SS0370006	1	1	TBD[4]
	X02SS0370024	1	1	TBD[4]
	X02SB0370204	TBD[3]	TBD[3]	TBD[4]
	X02SB0370406	TBD[3]	TBD[3]	TBD[4]
X02SB038	X02SS0380006	1	1	TBD[4]
	X02SS0380024	1	1	TBD[4]
	X02SB0380204	TBD[3]	TBD[3]	TBD[4]
	X02SB0380406	TBD[3]	TBD[3]	TBD[4]
X02SB039	X02SS0390006	1	1	TBD[4]
	X02SS0390024	1	1	TBD[4]
	X02SB0390204	TBD[3]	TBD[3]	TBD[4]
	X02SB0390406	TBD[3]	TBD[3]	TBD[4]

Sample Location[1]	Sample ID[2]	Explosives	Metals	Miscellaneous
		SW-846 Method 8330B	SW-846 Method 6010B/6020A	SW-846 9045D (pH), SW-846 9081 (CEC), Lloyd Kahn Method (TOC)
X02SB040	X02SS0400006	1	1	TBD[4]
	X02SS0400024	1	1	TBD[4]
	X02SB0400204	TBD[3]	TBD[3]	TBD[4]
	X02SB0400406	TBD[3]	TBD[3]	TBD[4]
Total Soil Samples – Area 8		**120**	**120**	**3**
SEDIMENT[5]				
X02SD001	X02SD001	1	1	NA
X02SD002	X02SD002	1	1	NA
X02SD003	X02SD003	1	1	NA
X02SD004	X02SD004	1	1	NA
X02SD005	X02SD005	1	1	NA
X02SD006	X02SD006	1	1	NA
X02SD007	X02SD007	1	1	NA
Total Sediment Samples - Area 8		**7**	**7**	**NA**
GROUNDWATER				
X02GW001	X02GW001	1	1[6]	NA
X02GW002	X02GW002	1	1[6]	NA
X02GW003	X02GW003	1	1[6]	NA
X02GW004	X02GW004	1	1[6]	NA
X02GW005	X02GW005	1	1[6]	NA
X02GW006	X02GW006	1	1[6]	NA
Total Groundwater Samples - Area 8		**6**	**6**	**NA**

bgs – Below ground surface.
CEC – Cation exchange capacity.
NA – Not applicable.
SOP – Standard Operating Procedure.
TBD - To be determined.
TOC – Total organic carbon.

1 X = UXO
2 Surface soil (SS) sample depths include 0 to 6 inches bgs and 0 to 24 inches bgs. Subsurface soil (SB) samples to be collected from 2 to 4 and 4 to 6 feet bgs.
3 Up to 20 of the sample locations will be selected for the collection of the subsurface soil samples. Locations TBD in the field.
4 Up to 3 of the soil samples submitted to the fixed-base laboratory will be marked for pH, TOC, and CEC analysis.
5 Sediment samples will be collected at 0 to 6 inches bgs.
6 Groundwater samples will be filtered through a 0.45-micron filter if low-flow sample collection does not result in turbidity of less than 10 NTUs. An F will be placed at the end of the sample ID to indicate that sample has been filtered, for example, X02GW001F.

Soil samples will be collected in accordance with SOP-05 and SOP-06.
Sediment samples will be collected in accordance with SOP-08.
Groundwater samples will be collected in accordance with SOP-18.

Note: Field duplicate and MS/MSD samples will be collected at a frequency of 1 per 20 samples per media for fixed-base laboratory samples.

SAP Worksheet #18.3 -- EOD School Demolition Area (UXO28) Sampling Locations and Methods/SOP Requirements Table

(UFP-QAPP Manual Section 3.1.1)

EOD SCHOOL DEMOLITION AREA (UXO 28)

Sample Location[1]	Sample ID[2]	Explosives	Metals	Miscellaneous
		SW-846 Method 8330B	SW-846 Method 6010B/6020A	SW-846 9045D (pH), SW-846 9081 (CEC), Lloyd Kahn Method (TOC)
SOIL				
X28SB001	X28SS0010006	1	1	TBD[3]
	X28SS0010024	1	1	TBD[3]
X28SB002	X28SS0020006	1	1	TBD[3]
	X28SS0020024	1	1	TBD[3]
X28SB003	X28SS0030006	1	1	TBD[3]
	X28SS0030024	1	1	TBD[3]
X28SB004	X28SS0040006	1	1	TBD[3]
	X28SS0040024	1	1	TBD[3]
X28SB005	X28SS0050006	1	1	TBD[3]
	X28SS0050024	1	1	TBD[3]
X28SB006	X28SS0060006	1	1	TBD[3]
	X28SS0060024	1	1	TBD[3]
X28SB007	X28SS0070006	1	1	TBD[3]
	X28SS0070024	1	1	TBD[3]
X28SB008	X28SS0080006	1	1	TBD[3]
	X28SS0080024	1	1	TBD[3]
X28SB009	X28SS0090006	1	1	TBD[3]
	X28SS0090024	1	1	TBD[3]
X28SB010	X28SS0100006	1	1	TBD[3]
	X28SS0100024	1	1	TBD[3]

Sample Location[1]	Sample ID[2]	Explosives	Metals	Miscellaneous
		SW-846 Method 8330B	SW-846 Method 6010B/6020A	SW-846 9045D (pH), SW-846 9081 (CEC), Lloyd Kahn Method (TOC)
X28SB011	X28SS0110006	1	1	TBD[3]
	X28SS0110024	1	1	TBD[3]
X28SB012	X28SS0120006	1	1	TBD[3]
	X28SS0120024	1	1	TBD[3]
X28SB013	X28SS0130006	1	1	TBD[3]
	X28SS0130024	1	1	TBD[3]
X28SB014	X28SS0140006	1	1	TBD[3]
	X28SS0140024	1	1	TBD[3]
X28SB015	X28SS0150006	1	1	TBD[3]
	X28SS0150024	1	1	TBD[3]
X28SB016	X28SS0160006	1	1	TBD[3]
	X28SS0160024	1	1	TBD[3]
X28SB017	X28SS0170006	1	1	TBD[3]
	X28SS0170024	1	1	TBD[3]
X28SB018	X28SS0180006	1	1	TBD[3]
	X28SS0180024	1	1	TBD[3]
X28SB019	X28SS0190006	1	1	TBD[3]
	X28SS0190024	1	1	TBD[3]
X28SB020	X28SS0200006	1	1	TBD[3]
	X28SS0200024	1	1	TBD[3]
Total Soil Samples – EOD School Demolition Area		**40**	**40**	**3**

bgs – Below ground surface.
CEC – Cation exchange capacity.
SOP – Standard Operating Procedure.
TBD - To be determined.
TOC – Total organic carbon.

1 X = UXO
2 Surface soil (SS) sample depths include 0 to 6 inches bgs and 0 to 24 inches bgs.
3 Up to 3 of the soil samples submitted to the fixed-base laboratory will be marked for pH, TOC, and CEC analysis.

Soil samples will be collected in accordance with SOP-05.

Note: Field duplicate and MS/MSD samples will be collected at a frequency of 1 per 20 samples for fixed-base laboratory samples.

SAP Worksheet #18.4 -- Basic IED Area (UXO04) Sampling Locations and Methods/SOP Requirements Table

(UFP-QAPP Manual Section 3.1.1)

BASIC IED AREA (UXO 04)

Sample Location[1]	Sample ID[2]	Explosives	Metals	VOCs	Miscellaneous
		SW-846 Method 8330B	SW-846 Method 6010B/6020A	SW-846 Method 8260B	SW-846 9045D (pH), SW-846 9081 (CEC), Lloyd Kahn Method (TOC)
SOIL					
X04SB001	X04SS0010006	1	1	1	TBD[4]
	X04SS0010024	1	1	1	TBD[4]
	X04SB0010204	TBD[3]	TBD[3]	TBD[3]	TBD[4]
	X04SB0010406	TBD[3]	TBD[3]	TBD[3]	TBD[4]
X04SB002	X04SS0020006	1	1	1	TBD[4]
	X04SS0020024	1	1	1	TBD[4]
	X04SB0020204	TBD[3]	TBD[3]	TBD[3]	TBD[4]
	X04SB0020406	TBD[3]	TBD[3]	TBD[3]	TBD[4]
X04SB003	X04SS0030006	1	1	1	TBD[4]
	X04SS0030024	1	1	1	TBD[4]
	X04SB0030204	TBD[3]	TBD[3]	TBD[3]	TBD[4]
	X04SB0030406	TBD[3]	TBD[3]	TBD[3]	TBD[4]
X04SB004	X04SS0040006	1	1	1	TBD[4]
	X04SS0040024	1	1	1	TBD[4]
	X04SB0040204	TBD[3]	TBD[3]	TBD[3]	TBD[4]
	X04SB0040406	TBD[3]	TBD[3]	TBD[3]	TBD[4]
X04SB005	X04SS0050006	1	1	1	TBD[4]
	X04SS0050024	1	1	1	TBD[4]
	X04SB0050204	TBD[3]	TBD[3]	TBD[3]	TBD[4]
	X04SB0050406	TBD[3]	TBD[3]	TBD[3]	TBD[4]

Sample Location[1]	Sample ID[2]	Explosives	Metals	VOCs	Miscellaneous
		SW-846 Method 8330B	SW-846 Method 6010B/6020A	SW-846 Method 8260B	SW-846 9045D (pH), SW-846 9081 (CEC), Lloyd Kahn Method (TOC)
X04SB006	X04SS0060006	1	1	1	TBD[4]
	X04SS0060024	1	1	1	TBD[4]
	X04SB0060204	TBD[3]	TBD[3]	TBD[3]	TBD[4]
	X04SB0060406	TBD[3]	TBD[3]	TBD[3]	TBD[4]
X04SB007	X04SS0070006	1	1	1	TBD[4]
	X04SS0070024	1	1	1	TBD[4]
	X04SB0070204	TBD[3]	TBD[3]	TBD[3]	TBD[4]
	X04SB0070406	TBD[3]	TBD[3]	TBD[3]	TBD[4]
X04SB008	X04SS0080006	1	1	1	TBD[4]
	X04SS0080024	1	1	1	TBD[4]
	X04SB0080204	TBD[3]	TBD[3]	TBD[3]	TBD[4]
	X04SB0080406	TBD[3]	TBD[3]	TBD[3]	TBD[4]
X10SB009	X04SS0090006	1	1	1	TBD[4]
	X04SS0090024	1	1	1	TBD[4]
	X04SB0090204	TBD[3]	TBD[3]	TBD[3]	TBD[4]
	X04SB0090406	TBD[3]	TBD[3]	TBD[3]	TBD[4]
X04SB010	X04SS0100006	1	1	1	TBD[4]
	X04SS0100024	1	1	1	TBD[4]
	X04SB0100204	TBD[3]	TBD[3]	TBD[3]	TBD[4]
	X04SB0100406	TBD[3]	TBD[3]	TBD[3]	TBD[4]
X04SB011	X04SS0110006	1	1	1	TBD[4]
	X04SS0110024	1	1	1	TBD[4]
	X04SB0110204	TBD[3]	TBD[3]	TBD[3]	TBD[4]
	X04SB0110406	TBD[3]	TBD[3]	TBD[3]	TBD[4]
X04SB012	X04SS0120006	1	1	1	TBD[4]
	X04SS0120024	1	1	1	TBD[4]
	X04SB0120204	TBD[3]	TBD[3]	TBD[3]	TBD[4]
	X04SB0120406	TBD[3]	TBD[3]	TBD[3]	TBD[4]

Sample Location[1]	Sample ID[2]	Explosives	Metals	VOCs	Miscellaneous
		SW-846 Method 8330B	SW-846 Method 6010B/6020A	SW-846 Method 8260B	SW-846 9045D (pH), SW-846 9081 (CEC), Lloyd Kahn Method (TOC)
X04SB013	X04SS0130006	1	1	1	TBD[4]
	X04SS0130024	1	1	1	TBD[4]
	X04SB0130204	TBD[3]	TBD[3]	TBD[3]	TBD[4]
	X04SB0130406	TBD[3]	TBD[3]	TBD[3]	TBD[4]
X04SB014	X04SS0140006	1	1	1	TBD[4]
	X04SS0140024	1	1	1	TBD[4]
	X04SB0140204	TBD[3]	TBD[3]	TBD[3]	TBD[4]
	X04SB0140406	TBD[3]	TBD[3]	TBD[3]	TBD[4]
X04SB015	X04SS0150006	1	1	1	TBD[4]
	X04SS0150024	1	1	1	TBD[4]
	X04SB0150204	TBD[3]	TBD[3]	TBD[3]	TBD[4]
	X04SB0150406	TBD[3]	TBD[3]	TBD[3]	TBD[4]
X04SB016	X04SS0160006	1	1	1	TBD[4]
	X04SS0160024	1	1	1	TBD[4]
	X04SB0160204	TBD[3]	TBD[3]	TBD[3]	TBD[4]
	X04SB0160406	TBD[3]	TBD[3]	TBD[3]	TBD[4]
X04SB017	X04SS0170006	1	1	1	TBD[4]
	X04SS0170024	1	1	1	TBD[4]
	X04SB0170204	TBD[3]	TBD[3]	TBD[3]	TBD[4]
	X04SB0170406	TBD[3]	TBD[3]	TBD[3]	TBD[4]
X04SB018	X04SS0180006	1	1	1	TBD[4]
	X04SS0180024	1	1	1	TBD[4]
	X04SB0180204	TBD[3]	TBD[3]	TBD[3]	TBD[4]
	X04SB0180406	TBD[3]	TBD[3]	TBD[3]	TBD[4]
X04SB019	X04SS0190006	1	1	1	TBD[4]
	X04SS0190024	1	1	1	TBD[4]
	X04SB0190204	TBD[3]	TBD[3]	TBD[3]	TBD[4]
	X04SB0190406	TBD[3]	TBD[3]	TBD[3]	TBD[4]

Sample Location[1]	Sample ID[2]	Explosives	Metals	VOCs	Miscellaneous
		SW-846 Method 8330B	SW-846 Method 6010B/6020A	SW-846 Method 8260B	SW-846 9045D (pH), SW-846 9081 (CEC), Lloyd Kahn Method (TOC)
X04SB020	X04SS0200006	1	1	1	TBD[4]
	X04SS0200024	1	1	1	TBD[4]
	X04SB0200204	TBD[3]	TBD[3]	TBD[3]	TBD[4]
	X04SB0200406	TBD[3]	TBD[3]	TBD[3]	TBD[4]
Total Soil Samples – Basic IED Area		**80**	**80**	**80**	**3**
GROUNDWATER					
X04GW001	X04GW001	1	1[5]	1	NA
X04GW002	X04GW002	1	1[5]	1	NA
X04GW003	X04GW003	1	1[5]	1	NA
Total Groundwater Samples - Basic IED Area		**3**	**3**	**3**	**NA**

bgs – Below ground surface.
CEC – Cation exchange capacity.
NA – Not applicable.
SOP – Standard Operating Procedure.
TBD - To be determined.
TOC – Total organic carbon.

1 X = UXO
2 Surface soil (SS) sample depths include 0 to 6 inches bgs and 0 to 24 inches bgs. Subsurface soil (SB) samples to be collected from 2 to 4 and 4 to 6 feet bgs.
3 Up to 20 of the sample locations will be selected for the collection of the subsurface soil samples. Locations TBD in the field.
4 Up to 3 of the samples submitted to the fixed-base laboratory will be marked for pH, TOC, and CEC analysis.
5 Groundwater samples will be filtered through a 0.45-micron filter if low-flow sample collection does not result in turbidity of less than 10 NTUs. An F will be placed at the end of the sample ID to indicate that sample has been filtered, for example, X02GW001F.

Soil Samples will be collected in accordance with SOP-05.
Groundwater samples will be collected in accordance with SOP-18.

Note: Field duplicate and MS/MSD samples will be collected at a frequency of 1 per 20 samples per media for fixed-base laboratory samples.

SAP Worksheet #18.5 -- Advanced IED Area (UXO05) Sampling Locations and Methods/SOP Requirements Table

(UFP-QAPP Manual Section 3.1.1)

ADVANCED IED AREA (UXO 05)

Sample Location[1]	Sample ID[2]	Explosives	Metals	Miscellaneous
		SW-846 Method 8330B	SW-846 Method 6010B/6020A	SW-846 9045D (pH), SW-846 9081 (CEC), Lloyd Kahn Method (TOC)
SOIL				
X05SB001	X05SS0010006	1	1	TBD[4]
	X05SS0010024	1	1	TBD[4]
	X05SB0010204	TBD[3]	TBD[3]	TBD[4]
	X05SB0010406	TBD[3]	TBD[3]	TBD[4]
X05SB002	X05SS0020006	1	1	TBD[4]
	X05SS0020024	1	1	TBD[4]
	X05SB0020204	TBD[3]	TBD[3]	TBD[4]
	X05SB0020406	TBD[3]	TBD[3]	TBD[4]
X05SB003	X05SS0030006	1	1	TBD[4]
	X05SS0030024	1	1	TBD[4]
	X05SB0030204	TBD[3]	TBD[3]	TBD[4]
	X05SB0030406	TBD[3]	TBD[3]	TBD[4]
X05SB004	X05SS0040006	1	1	TBD[4]
	X05SS0040024	1	1	TBD[4]
	X05SB0040204	TBD[3]	TBD[3]	TBD[4]
	X05SB0040406	TBD[3]	TBD[3]	TBD[4]
X05SB005	X05SS0050006	1	1	TBD[4]
	X05SS0050024	1	1	TBD[4]
	X05SB0050204	TBD[3]	TBD[3]	TBD[4]
	X05SB0050406	TBD[3]	TBD[3]	TBD[4]

Sample Location[1]	Sample ID[2]	Explosives	Metals	Miscellaneous
		SW-846 Method 8330B	SW-846 Method 6010B/6020A	SW-846 9045D (pH), SW-846 9081 (CEC), Lloyd Kahn Method (TOC)
X05SB006	X05SS0060006	1	1	TBD[4]
	X05SS0060024	1	1	TBD[4]
	X05SB0060204	TBD[3]	TBD[3]	TBD[4]
	X05SB0060406	TBD[3]	TBD[3]	TBD[4]
X05SB007	X05SS0070006	1	1	TBD[4]
	X05SS0070024	1	1	TBD[4]
	X05SB0070204	TBD[3]	TBD[3]	TBD[4]
	X05SB0070406	TBD[3]	TBD[3]	TBD[4]
X05SB008	X05SS0080006	1	1	TBD[4]
	X05SS0080024	1	1	TBD[4]
	X05SB0080204	TBD[3]	TBD[3]	TBD[4]
	X05SB0080406	TBD[3]	TBD[3]	TBD[4]
X10SB009	X05SS0090006	1	1	TBD[4]
	X05SS0090024	1	1	TBD[4]
	X05SB0090204	TBD[3]	TBD[3]	TBD[4]
	X05SB0090406	TBD[3]	TBD[3]	TBD[4]
X05SB010	X05SS0100006	1	1	TBD[4]
	X05SS0100024	1	1	TBD[4]
	X05SB0100204	TBD[3]	TBD[3]	TBD[4]
	X05SB0100406	TBD[3]	TBD[3]	TBD[4]
X05SB011	X05SS0110006	1	1	TBD[4]
	X05SS0110024	1	1	TBD[4]
	X05SB0110204	TBD[3]	TBD[3]	TBD[4]
	X05SB0110406	TBD[3]	TBD[3]	TBD[4]
X05SB012	X05SS0120006	1	1	TBD[4]
	X05SS0120024	1	1	TBD[4]
	X05SB0120204	TBD[3]	TBD[3]	TBD[4]
	X05SB0120406	TBD[3]	TBD[3]	TBD[4]

Sample Location[1]	Sample ID[2]	Explosives	Metals	Miscellaneous
		SW-846 Method 8330B	SW-846 Method 6010B/6020A	SW-846 9045D (pH), SW-846 9081 (CEC), Lloyd Kahn Method (TOC)
X05SB013	X05SS0130006	1	1	TBD[4]
	X05SS0130024	1	1	TBD[4]
	X05SB0130204	TBD[3]	TBD[3]	TBD[4]
	X05SB0130406	TBD[3]	TBD[3]	TBD[4]
X05SB014	X05SS0140006	1	1	TBD[4]
	X05SS0140024	1	1	TBD[4]
	X05SB0140204	TBD[3]	TBD[3]	TBD[4]
	X05SB0140406	TBD[3]	TBD[3]	TBD[4]
X05SB015	X05SS0150006	1	1	TBD[4]
	X05SS0150024	1	1	TBD[4]
	X05SB0150204	TBD[3]	TBD[3]	TBD[4]
	X05SB0150406	TBD[3]	TBD[3]	TBD[4]
X05SB016	X05SS0160006	1	1	TBD[4]
	X05SS0160024	1	1	TBD[4]
	X05SB0160204	TBD[3]	TBD[3]	TBD[4]
	X05SB0160406	TBD[3]	TBD[3]	TBD[4]
X05SB017	X05SS0170006	1	1	TBD[4]
	X05SS0170024	1	1	TBD[4]
	X05SB0170204	TBD[3]	TBD[3]	TBD[4]
	X05SB0170406	TBD[3]	TBD[3]	TBD[4]
X05SB018	X05SS0180006	1	1	TBD[4]
	X05SS0180024	1	1	TBD[4]
	X05SB0180204	TBD[3]	TBD[3]	TBD[4]
	X05SB0180406	TBD[3]	TBD[3]	TBD[4]
X05SB019	X05SS0190006	1	1	TBD[4]
	X05SS0190024	1	1	TBD[4]
	X05SB0190204	TBD[3]	TBD[3]	TBD[4]
	X05SB0190406	TBD[3]	TBD[3]	TBD[4]

Sample Location[1]	Sample ID[2]	Explosives	Metals	Miscellaneous
		SW-846 Method 8330B	SW-846 Method 6010B/6020A	SW-846 9045D (pH), SW-846 9081 (CEC), Lloyd Kahn Method (TOC)
X05SB020	X05SS0200006	1	1	TBD[4]
	X05SS0200024	1	1	TBD[4]
	X05SB0200204	TBD[3]	TBD[3]	TBD[4]
	X05SB0200406	TBD[3]	TBD[3]	TBD[4]
Total Soil Samples – Advanced IED Area		**80**	**80**	**3**

bgs – Below ground surface.
CEC – Cation exchange capacity.
SOP – Standard Operating Procedure.
TBD - To be determined.
TOC – Total organic carbon.

1 X = UXO
2 Surface soil (SS) sample depths include 0 to 6 inches bgs and 0 to 24 inches bgs. Subsurface soil (SB) samples to be collected from 2 to 4 and 4 to 6 feet bgs.
3 Up to 20 of the sample locations will be selected for the collection of the subsurface soil samples. Locations TBD in the field.
4 Up to 3 of the samples submitted to the fixed-base laboratory will be marked for pH, TOC, and CEC analysis.

Soil samples will be collected in accordance with SOP-05.

Note: Field duplicate and MS/MSD samples will be collected at a frequency of 1 per 20 samples for fixed-base laboratory samples.

SAP Worksheet #18.6 -- Stump Neck Impact Area (UXO10) Sampling Locations and Methods/SOP Requirements Table

(UFP-QAPP Manual Section 3.1.1)

STUMP NECK IMPACT AREA (UXO 10)

Sample Location[1]	Sample ID[2]	Explosives	Miscellaneous
		SW-846 Method 8330 B	SW-846 9045D (pH), SW-846 9081 (CEC), Lloyd Kahn Method (TOC)
SOIL			
X10SB001	X10SS0010006	1	TBD[4]
	X10SS0010024	1	TBD[4]
	X10SB0010204	TBD[3]	TBD[4]
	X10SB0010406	TBD[3]	TBD[4]
X10SB002	X10SS0020006	1	TBD[4]
	X10SS0020024	1	TBD[4]
	X10SB0020204	TBD[3]	TBD[4]
	X10SB0020406	TBD[3]	TBD[4]
X10SB003	X10SS0030006	1	TBD[4]
	X10SS0030024	1	TBD[4]
	X10SB0030204	TBD[3]	TBD[4]
	X10SB0030406	TBD[3]	TBD[4]
X10SB004	X10SS0040006	1	TBD[4]
	X10SS0040024	1	TBD[4]
	X10SB0040204	TBD[3]	TBD[4]
	X10SB0040406	TBD[3]	TBD[4]
X10SB005	X10SS0050006	1	TBD[4]
	X10SS0050024	1	TBD[4]
	X10SB0050204	TBD[3]	TBD[4]
	X10SB0050406	TBD[3]	TBD[4]

Sample Location[1]	Sample ID[2]	Explosives	Miscellaneous
		SW-846 Method 8330 B	SW-846 9045D (pH), SW-846 9081 (CEC), Lloyd Kahn Method (TOC)
X10SB006	X10SS0060006	1	TBD[4]
	X10SS0060024	1	TBD[4]
	X10SB0060204	TBD[3]	TBD[4]
	X10SB0060406	TBD[3]	TBD[4]
X10SB007	X10SS0070006	1	TBD[4]
	X10SS0070024	1	TBD[4]
	X10SB0070204	TBD[3]	TBD[4]
	X10SB0070406	TBD[3]	TBD[4]
X10SB008	X10SS0080006	1	TBD[4]
	X10SS0080024	1	TBD[4]
	X10SB0080204	TBD[3]	TBD[4]
	X10SB0080406	TBD[3]	TBD[4]
X10SB009	X10SS0090006	1	TBD[4]
	X10SS0090024	1	TBD[4]
	X10SB0090204	TBD[3]	TBD[4]
	X10SB0090406	TBD[3]	TBD[4]
X10SB010	X10SS0100006	1	TBD[4]
	X10SS0100024	1	TBD[4]
	X10SB0100204	TBD[3]	TBD[4]
	X10SB0100406	TBD[3]	TBD[4]
Total Soil Samples – Stump Neck Impact Area		**40**	**3**

bgs – Below ground surface.
CEC – Cation exchange capacity.
SOP – Standard Operating Procedure.
TBD - To be determined.
TOC – Total organic carbon.

1 X = UXO
2 Surface soil (SS) sample depths include 0 to 6 inches bgs and 0 to 24 inches bgs. Subsurface soil (SB) samples to be collected from 2 to 4 and 4 to 6 feet bgs.
3 All 20 sample locations will be selected for the collection of the subsurface soil samples.
4 Up to 3 of the samples submitted to the fixed-base laboratory will be marked for pH, TOC, and CEC analysis.

Soil samples will be collected in accordance with SOP-05 and SOP-06.

Note: Field duplicate and MS/MSD samples will be collected at a frequency of 1 per 20 samples for fixed-base laboratory samples.

SAP Worksheet #18.7 -- Test Area 1 (UXO21) Sampling Locations and Methods/SOP Requirements Table

(UFP-QAPP Manual Section 3.1.1)

TEST AREA 1 (UXO 21)

Sample Location[1]	Sample ID[2]	Explosives	Miscellaneous
		SW-846 Method 8330 B	SW-846 9045D (pH), SW-846 9081 (CEC), Lloyd Kahn Method (TOC)
SOIL			
X21SB001	X21SS0010006	1	TBD[3]
	X21SS0010024	1	TBD[3]
X21SB002	X21SS0020006	1	TBD[3]
	X21SS0020024	1	TBD[3]
X21SB003	X21SS0030006	1	TBD[3]
	X21SS0030024	1	TBD[3]
X21SB004	X21SS0040006	1	TBD[3]
	X21SS0040024	1	TBD[3]
X21SB005	X21SS0050006	1	TBD[3]
	X21SS0050024	1	TBD[3]
X21SB006	X21SS0060006	1	TBD[3]
	X21SS0060024	1	TBD[3]
X21SB007	X21SS0070006	1	TBD[3]
	X21SS0070024	1	TBD[3]
X21SB008	X21SS0080006	1	TBD[3]
	X21SS0080024	1	TBD[3]
X21SB009	X21SS0090006	1	TBD[3]
	X21SS0090024	1	TBD[3]
X21SB010	X21SS0100006	1	TBD[3]
	X21SS0100024	1	TBD[3]

Sample Location[1]	Sample ID[2]	Explosives	Miscellaneous
		SW-846 Method 8330 B	SW-846 9045D (pH), SW-846 9081 (CEC), Lloyd Kahn Method (TOC)
X21SB011	X21SS0110006	1	TBD[3]
	X21SS0110024	1	TBD[3]
X21SB012	X21SS0120006	1	TBD[3]
	X21SS0120024	1	TBD[3]
X21SB013	X21SS0130006	1	TBD[3]
	X21SS0130024	1	TBD[3]
X21SB014	X21SS0140006	1	TBD[3]
	X21SS0140024	1	TBD[3]
X21SB015	X21SS0150006	1	TBD[3]
	X21SS0150024	1	TBD[3]
X21SB016	X21SS0160006	1	TBD[3]
	X21SS0160024	1	TBD[3]
X21SB017	X21SS0170006	1	TBD[3]
	X21SS0170024	1	TBD[3]
X21SB018	X21SS0180006	1	TBD[3]
	X21SS0180024	1	TBD[3]
X21SB019	X21SS0190006	1	TBD[3]
	X21SS0190024	1	TBD[3]
X21SB020	X21SS0200006	1	TBD[3]
	X21SS0200024	1	TBD[3]
X21SB021	X21SS0210006	1	TBD[3]
Total Soil Samples – Test Area 1		**41**	**3**

bgs – Below ground surface.
CEC – Cation exchange capacity.
SOP – Standard Operating Procedure.
TBD - To be determined.
TOC – Total organic carbon.

1 X = UXO
2 Surface soil (SS) sample depths include 0 to 6 inches bgs and 0 to 24 inches bgs. Sample location X21SS021 will be a grab sample from within the bowl at the drainage point. All remaining samples will be composite samples.
3 Up to 3 of the samples submitted to the fixed-base laboratory will be marked for pH, TOC, and CEC analysis.

Soil samples will be collected in accordance with SOP-05 (grab) and SOP-19 (composite).

Note: Field duplicate and MS/MSD samples will be collected at a frequency of 1 per 20 samples for fixed-base laboratory samples.

SAP Worksheet #18.8 -- Valley Impact Area (UXO26) Sampling Locations and Methods/SOP Requirements Table

(UFP-QAPP Manual Section 3.1.1)

VALLEY IMPACT AREA (UXO 26)

No environmental samples are proposed for the Valley Impact Area.

SAP Worksheet #18.9 -- Torpedo Burial Site (UXO12) Sampling Locations and Methods/SOP Requirements Table

(UFP-QAPP Manual Section 3.1.1)

TORPEDO BURIAL SITE (UXO 12)

Sample Location[1]	Sample ID[2]	Explosives	Miscellaneous
		SW-846 Method 8330 B	SW-846 9045D (pH), SW-846 9081 (CEC), Lloyd Kahn Method (TOC)
SOIL			
X12SB001	X12SB0010204	1	TBD[3]
	X12SB0010406	1	TBD[3]
X12SB002	X12SB0020204	1	TBD[3]
	X12SB0020406	1	TBD[3]
X12SB003	X12SB0030204	1	TBD[3]
	X12SB0030406	1	TBD[3]
X12SB004	X12SB0040204	1	TBD[3]
	X12SB0040406	1	TBD[3]
X12SB005	X12SB0050204	1	TBD[3]
	X12SB0050406	1	TBD[3]
X12SB006	X12SB0060204	1	TBD[3]
	X12SB0060406	1	TBD[3]
X12SB007	X12SB0070204	1	TBD[3]
	X12SB0070406	1	TBD[3]
X12SB008	X12SB0080204	1	TBD[3]
	X12SB0080406	1	TBD[3]
X10SB009	X12SB0090204	1	TBD[3]
	X12SB0090406	1	TBD[3]
X12SB010	X12SB0100204	1	TBD[3]
	X12SB0100406	1	TBD[3]
Total Soil Samples – Torpedo Burial Site		**20**	**3**

Sample Location[1]	Sample ID[2]	Explosives	Miscellaneous
		SW-846 Method 8330 B	SW-846 9045D (pH), SW-846 9081 (CEC), Lloyd Kahn Method (TOC)
SEDIMENT[4]			
X12SD001	X12SD001	1	NA
X12SD002	X12SD002	1	NA
Total Sediment Samples – Torpedo Burial Site		**2**	**NA**
Surface Water			
X12SW001	X12SW001	1	NA
Total Surface Water Samples - Torpedo Burial Site		**1**	**NA**

bgs – Below ground surface.
CEC – Cation exchange capacity.
NA – Not applicable.
SOP – Standard Operating Procedure.
TBD - To be determined.
TOC – Total organic carbon.

1 X = UXO
2 Subsurface soil (SB) samples to be collected from 2 to 4 and 4 to 6 feet bgs.
3 Sediment samples will be collected at 0 to 6 inches bgs.
4 Up to 3 of the soil samples submitted to the fixed-base laboratory will be marked for pH, TOC, and CEC analysis.

Soil samples will be collected in accordance with SOP-06.
Sediment samples will be collected in accordance with SOP-08.
Surface water samples will be collected in accordance with SOP-07.

Note: Field duplicate and MS/MSD samples will be collected at a frequency of 1 per 20 samples per media for fixed-base laboratory samples.

SAP Worksheet #18.10 -- Torpedo Casing Disposal Area (UXO23) Sampling Locations and Methods/SOP Requirements Table

(UFP-QAPP Manual Section 3.1.1)

TORPEDO CASING DISPOSAL AREA (UXO 23)

Sample Location[1]	Sample ID[2]	Explosives	Metals	Miscellaneous
		SW-846 Method 8330B	SW-846 Method 6010B/6020A	SW-846 9045D (pH), SW-846 9081 (CEC), Lloyd Kahn Method (TOC)
SOIL				
X23SB001	X23SB0010204	1	1	TBD[3]
	X23SB0010406	1	1	TBD[3]
X23SB002	X23SB0020204	1	1	TBD[3]
	X23SB0020406	1	1	TBD[3]
X23SB003	X23SB0030204	1	1	TBD[3]
	X23SB0030406	1	1	TBD[3]
X23SB004	X23SB0040204	1	1	TBD[3]
	X23SB0040406	1	1	TBD[3]
X23SB005	X23SB0050204	1	1	TBD[3]
	X23SB0050406	1	1	TBD[3]
X23SB006	X23SB0060204	1	1	TBD[3]
	X23SB0060406	1	1	TBD[3]
X23SB007	X23SB0070204	1	1	TBD[3]
	X23SB0070406	1	1	TBD[3]
X23SB008	X23SB0080204	1	1	TBD[3]
	X23SB0080406	1	1	TBD[3]
X10SB009	X23SB0090204	1	1	TBD[3]
	X23SB0090406	1	1	TBD[3]
X23SB010	X23SB0100204	1	1	TBD[3]
	X23SB0100406	1	1	TBD[3]
Total Soil Samples – Torpedo Casing Disposal Area		**20**	**20**	**3**

bgs – Below ground surface.
CEC – Cation exchange capacity.
NA – Not applicable.
SOP – Standard Operating Procedure.
TBD - To be determined.
TOC – Total organic carbon.

1 X = UXO
2 Subsurface soil (SB) samples to be collected from 2 to 4 feet bgs and 4 to 6 feet bgs.
3 Up to 3 of the soil samples submitted to the fixed-base laboratory will also be analyzed for pH, TOC, and CEC.

Soil samples will be collected in accordance with SOP-06.

Note: Field duplicate and MS/MSD samples will be collected at a frequency of 1 per 20 samples for fixed-base laboratory samples.

SAP Worksheet #19 -- Analytical SOP Requirements Table

(UFP-QAPP Manual Section 3.1.1)

Matrix	Analytical Group	Analytical and Preparation Method / SOP Reference[1]	Containers (number, size, and type)	Sample volume[2] (units)	Preservation Requirements (chemical, temperature, light protected)	Maximum Holding Time[3] (preparation / analysis)
Aqueous	VOCs	SW-846 8260B/ Lab SOP 02-8260B	(2) 40 mL glass	40 milliliter (mL)	Hydrochloric acid to pH <2, cool 4°C	14 days to analysis
Soil	VOCs	SW-846 5035.8260B/Lab SOP 02-5035, 02-8260B	(3) 40 mL glass	5 grams (g)	5 mL of methanol in 1 vial, then 2 vials with 5 mL of water cool 4°C; freeze vial preserved with water upon receipt at lab	14 days to analysis
Aqueous	Metals	SW-846 09-3015; 03-6010B; 03-6010IRIS; 03-6020; 09-PD-HG; 03-Hg	1 – 500 mL Polypropylene bottle	500 mL	HNO3 <2, cool 6 C	6 months to analysis; Hg 28 days to analysis
Soil	Metals	SW-846 09-3051; 03-6010B; 03-6010IRIS; 03-6020; 09-PDS-HG; 03-Hg	1 – 4 oz glass jar	3 g minimum	Cool 6 C	6 months to analysis; Hg 28 days to analysis
Aqueous	Explosives	SW-846 8330B/09-8330W, 1B-8330	(2) 1000 mL amber glass	1000 mL	Cool 4°C	14 days to extraction/40 days to analysis
Soil	Explosives	SW-846 8330B/09-8330B Soil, 1B-8330B	8 ounce glass	30 g	Cool 4°C	14 days to extraction/40 days to analysis
Aqueous	Perchlorate	SW846-6850 / LC/MS-CL04	1-125 mL Polyethylene	10 mL	Cool to 4C +/-2	28 days to analysis
Soil	Perchlorate	SW-846 6850/ LC/MS-CL04	1-4 oz. amber glass	1 g	Cool to 4C +/- 2	28 days to analysis

1 Specify the appropriate reference letter or number from the Analytical SOP References table (Worksheet #23).
2 Provide the minimum sample volume or mass requirement if it differs from the container volume.
3 Maximum holding time is calculated from the time the sample is collected to the time the sample is prepared/extracted.

SAP Worksheet #20.1 -- Air Blast Pond (UXO01) Field Quality Control Sample Summary Table

AIR BLAST POND (UXO 01)

(UFP-QAPP Manual Section 3.1.1)

Fixed-Base Laboratory Analyses

Matrix	Analytical Group	Concentration Level	Samples	Field Duplicates[1]	MS/MSDs[1]	Rinsate Blanks[2]	Source Blanks[2]	Total Samples to Lab
Solid	Explosives	Low to Moderate	46	3	3	0	0	52
Solid	TOC	TBD	3	0	0	0	0	3
Solid	CEC	TBD	3	0	0	0	0	3
Solid	pH	TBD	3	0	0	0	0	3
Aqueous	Explosives	Low to Moderate	0	0	0	1	0	1

CEC = Cation exchange capacity

MS/MSD = Matrix spike/matrix spike duplicate

TBD = To Be Determined

TOC = Total Organic Carbon

1 Field duplicates and MS/MSD samples will be collected at a frequency of 1 per 20.
2 Rinsate blanks and source blanks will be collected at a frequency of 1 per equipment and 1 per water source. Explosives analysis will not be conducted for source blanks because they are not reasonably expected.

Note: Field sample IDs are provided in Worksheet No. 18.1. QC sample IDs will be in accordance with SOP-02 (Sample Identification Nomenclature).

SAP Worksheet #20.2 -- Area 8 (UXO02) Field Quality Control Sample Summary Table

AREA 8 (UXO 02)

(UFP-QAPP Manual Section 3.1.1)

Fixed-Base Laboratory Analyses

Matrix	Analytical Group	Concentration Level	Samples	Field Duplicates[1]	MS/MSDs[1]	Rinsate Blanks[2]	Source Blanks[2]	Total Samples to Lab
Solid	Explosives	Low to Moderate	127	7	7	0	0	141
Solid	Metals	Low to Moderate	127	7	7	0	0	141
Solid	TOC	TBD	3	0	0	0	0	3
Solid	CEC	TBD	3	0	0	0	0	3
Solid	pH	TBD	3	0	0	0	0	3
Aqueous	Explosives	Low to Moderate	6	1	1	2	0	10
Aqueous	Metals[3]	Low to Moderate	6	1	1	2	2	12

CEC = Cation exchange capacity
MS/MSD = Matrix spike/matrix spike duplicate
TBD = To Be Determined
TOC = Total Organic Carbon

1 Field duplicates and MS/MSD samples will be collected at a frequency of 1 per 20.
2 Rinsate blanks and source blanks will be collected at a frequency of 1 per equipment and 1 per water source. Explosives analysis will not be conducted for source blanks because they are not reasonably expected.
3 Aqueous samples will be filtered through a 0.45-micron filter if low-flow sample collection does not result in turbidity of less than 10 NTUs. An F will be placed at the end of the sample ID to indicate that sample has been filtered.

Note: Field sample IDs are provided in Worksheet No. 18.2. QC sample IDs will be in accordance with SOP-02 (Sample Identification Nomenclature).

SAP Worksheet #20.3 -- EOD School Demolition Area (UXO28) Field Quality Control Sample Summary Table

EOD SCHOOL DEMOLITION AREA (UXO 28)

(UFP-QAPP Manual Section 3.1.1)

Fixed-Base Laboratory Analyses

Matrix	Analytical Group	Concentration Level	Samples	Field Duplicates[1]	MS/MSDs[1]	Rinsate Blanks[2]	Source Blanks[2]	Total Samples to Lab
Solid	Explosives	Low to Moderate	40	2	2	0	0	44
Solid	Metals	Low to Moderate	40	2	2	0	0	44
Solid	TOC	TBD	3	0	0	0	0	3
Solid	CEC	TBD	3	0	0	0	0	3
Solid	pH	TBD	3	0	0	0	0	3
Aqueous	Explosives	Low to Moderate	0	0	0	1	0	1
Aqueous	Metals	Low to Moderate	0	0	0	1	1	2

CEC = Cation exchange capacity

MS/MSD = Matrix spike/matrix spike duplicate

TBD = To Be Determined

TOC = Total Organic Carbon

1 Field duplicates and MS/MSD samples will be collected at a frequency of 1 per 20.
2 Rinsate blanks and source blanks will be collected at a frequency of 1 per equipment and 1 per water source. Explosives analysis will not be conducted for source blanks because they are not reasonably expected.

Note: Field sample IDs are provided in Worksheet No. 18.3. QC sample IDs will be in accordance with SOP-02 (Sample Identification Nomenclature).

SAP Worksheet #20.4 -- Basic IED Area (UXO04) Field Quality Control Sample Summary Table

BASIC IED AREA (UXO 04)

(UFP-QAPP Manual Section 3.1.1)

Fixed-Base Laboratory Analyses

Matrix	Analytical Group	Concentration Level	Samples	Field Duplicates[1]	MS/MSDs[1]	Rinsate Blanks[2]	Source Blanks[2]	Total Samples to Lab
Solid	Explosives	Low to Moderate	80	4	4	0	0	88
Solid	Metals	Low to Moderate	80	4	4	0	0	88
Solid	VOCs	Low to Moderate	80	4	4	0	0	88
Solid	TOC	TBD	3	0	0	0	0	3
Solid	CEC	TBD	3	0	0	0	0	3
Solid	pH	TBD	3	0	0	0	0	3
Aqueous	Explosives	Low to Moderate	3	1	1	2	1	8
Aqueous	Metals[3]	Low to Moderate	3	1	1	2	2	9
Aqueous	VOCs	Low to Moderate	3	1	1	2	2	9

CEC = Cation exchange capacity
MS/MSD = Matrix spike/matrix spike duplicate
TBD = To Be Determined
TOC = Total Organic Carbon

1. Field duplicates and MS/MSD samples will be collected at a frequency of 1 per 20.
2. Rinsate blanks and source blanks will be collected at a frequency of 1 per equipment and 1 per water source. Explosives analysis will not be conducted for source blanks because they are not reasonably expected.
3. Aqueous samples will be filtered through a 0.45-micron filter if low-flow sample collection does not result in turbidity of less than 10 NTUs. An F will be placed at the end of the sample ID to indicate that sample has been filtered.

Note: Field sample IDs are provided in Worksheet No. 18.4. QC sample IDs will be in accordance with SOP-02 (Sample Identification Nomenclature).

SAP Worksheet #20.5 -- Advanced IED Area (UXO05) Field Quality Control Sample Summary Table

ADVANCED IED AREA (UXO 05)

(UFP-QAPP Manual Section 3.1.1)

Fixed-Base Laboratory Analyses

Matrix	Analytical Group	Concentration Level	Samples	Field Duplicates[1]	MS/MSDs[1]	Rinsate Blanks[2]	Source Blanks[2]	Total Samples to Lab
Solid	Explosives	Low to Moderate	80	4	4	0	0	88
Solid	Metals	Low to Moderate	80	4	4	0	0	88
Solid	TOC	TBD	3	0	0	0	0	3
Solid	CEC	TBD	3	0	0	0	0	3
Solid	pH	TBD	3	0	0	0	0	3
Aqueous	Explosives	Low to Moderate	0	0	0	1	0	1
Aqueous	Metals	Low to Moderate	0	0	0	1	1	2

CEC = Cation exchange capacity
MS/MSD = Matrix spike/matrix spike duplicate
TBD = To Be Determined
TOC = Total Organic Carbon

1 Field duplicates and MS/MSD samples will be collected at a frequency of 1 per 20.
2 Rinsate blanks and source blanks will be collected at a frequency of 1 per equipment and 1 per water source. Explosives analysis will not be conducted for source blanks because they are not reasonably expected.

Note: Field sample IDs are provided in Worksheet No. 18.5. QC sample IDs will be in accordance with SOP-02 (Sample Identification Nomenclature).

SAP Worksheet #20.6 -- Stump Neck Impact Area (UXO10) Field Quality Control Sample Summary Table

STUMP NECK IMPACT AREA (UXO 10)

(UFP-QAPP Manual Section 3.1.1)

Fixed-Base Laboratory Analyses

Matrix	Analytical Group	Concentration Level	Samples	Field Duplicates[1]	MS/MSDs[1]	Rinsate Blanks[2]	Source Blanks[2]	Total Samples to Lab
Solid	Explosives	Low to Moderate	40	2	2	0	0	44
Solid	TOC	TBD	3	0	0	0	0	3
Solid	CEC	TBD	3	0	0	0	0	3
Solid	pH	TBD	3	0	0	0	0	3
Aqueous	Explosives	Low to Moderate	0	0	0	1	0	1

CEC = Cation exchange capacity
MS/MSD = Matrix spike/matrix spike duplicate
TBD = To Be Determined
TOC = Total Organic Carbon

1 Field duplicates and MS/MSD samples will be collected at a frequency of 1 per 20.
2 Rinsate blanks and source blanks will be collected at a frequency of 1 per equipment and 1 per water source. Explosives analysis will not be conducted for source blanks because they are not reasonably expected.

Note: Field sample IDs are provided in Worksheet No. 18.6. QC sample IDs will be in accordance with SOP-02 (Sample Identification Nomenclature).

SAP Worksheet #20.7 -- Test Area 1 (UXO21) Field Quality Control Sample Summary Table

TEST AREA 1 (UXO 21)

(UFP-QAPP Manual Section 3.1.1)

Fixed-Base Laboratory Analyses

Matrix	Analytical Group	Concentration Level	Samples	Field Duplicates[1]	MS/MSDs[1]	Rinsate Blanks[2]	Source Blanks[2]	Total Samples to Lab
Solid	Explosives	Low to Moderate	41	2	2	0	0	45
Solid	TOC	TBD	3	0	0	0	0	3
Solid	CEC	TBD	3	0	0	0	0	3
Solid	pH	TBD	3	0	0	0	0	3
Aqueous	Explosives	Low to Moderate	0	0	0	1	0	1

CEC = Cation exchange capacity
MS/MSD = Matrix spike/matrix spike duplicate
TBD = To Be Determined
TOC = Total Organic Carbon

1 Field duplicates and MS/MSD samples will be collected at a frequency of 1 per 20.
2 Rinsate blanks and source blanks will be collected at a frequency of 1 per equipment and 1 per water source. Explosives analysis will not be conducted for source blanks because they are not reasonably expected.

Note: Field sample IDs are provided in Worksheet No. 18.7. QC sample IDs will be in accordance with SOP-02 (Sample Identification Nomenclature).

SAP Worksheet #20.8 -- Valley Impact Area (UXO26) Field Quality Control Sample Summary Table

VALLEY IMPACT AREA (UXO 26)

(UFP-QAPP Manual Section 3.1.1)

No environmental samples are proposed for the Valley impact Area.

SAP Worksheet #20.9 -- Torpedo Burial Site (UXO12) Field Quality Control Sample Summary Table

TORPEDO BURIAL SITE (UXO 12)

(UFP-QAPP Manual Section 3.1.1)

Fixed-Base Laboratory Analyses

Matrix	Analytical Group	Concentration Level	Samples	Field Duplicates[1]	MS/MSDs[1]	Rinsate Blanks[2]	Source Blanks[2]	Total Samples to Lab
Solid	Explosives	Low to Moderate	22	2	2	0	0	26
Solid	TOC	TBD	3	0	0	0	0	3
Solid	CEC	TBD	3	0	0	0	0	3
Solid	pH	TBD	3	0	0	0	0	3
Aqueous	Explosives	Low to Moderate	1	1	1	2	1	6

CEC = Cation exchange capacity
MS/MSD = Matrix spike/matrix spike duplicate
TBD = To Be Determined
TOC = Total Organic Carbon

1 Field duplicates and MS/MSD samples will be collected at a frequency of 1 per 20.
2 Rinsate blanks and source blanks will be collected at a frequency of 1 per equipment and 1 per water source. Explosives analysis will not be conducted for source blanks because they are not reasonably expected.

Note: Field sample IDs are provided in Worksheet No. 18.9. QC sample IDs will be in accordance with SOP-02 (Sample Identification Nomenclature).

SAP Worksheet #20.10 -- Torpedo Casing Disposal Area (UXO23) Field Quality Control Sample Summary Table

TORPEDO CASING DISPOSAL AREA (UXO 23)

(UFP-QAPP Manual Section 3.1.1)

Fixed-Base Laboratory Analyses

Matrix	Analytical Group	Concentration Level	Samples	Field Duplicates[1]	MS/MSDs[1]	Rinsate Blanks[2]	Source Blanks[2]	Total Samples to Lab
Solid	Explosives	Low to Moderate	20	1	1	0	0	22
Solid	Metals	Low to Moderate	20	1	1	0	0	22
Solid	TOC	TBD	3	0	0	0	0	3
Solid	CEC	TBD	3	0	0	0	0	3
Solid	pH	TBD	3	0	0	0	0	3
Aqueous	Explosives	Low to Moderate	0	0	0	1	0	1
Aqueous	Metals	Low to Moderate	0	0	0	1	1	2

CEC = Cation exchange capacity
MS/MSD = Matrix spike/matrix spike duplicate
TBD = To Be Determined
TOC = Total Organic Carbon

1 Field duplicates and MS/MSD samples will be collected at a frequency of 1 per 20.
2 Rinsate blanks and source blanks will be collected at a frequency of 1 per equipment and 1 per water source. Explosives anlaysis will not be conducted for source blanks because they are not reasonably expected.

Note: Field sample IDs are provided in Worksheet No. 18.10. QC sample IDs will be in accordance with SOP-02 (Sample Identification Nomenclature).

SAP Worksheet #21 -- Project Sampling SOP References Table

(UFP-QAPP Manual Section 3.1.2)

Reference Number	Title, Revision Date and/or Number	Originating Organization of Sampling SOP	Equipment Type	Modified for Project Work? (Y/N)	Comments
SOP-01	Sample Labeling	Tetra Tech	NA	N	Contained in Appendix D
SOP-02	Sample Identification Nomenclature	Tetra Tech	NA	N	Contained in Appendix D
SOP-03	Sample Custody and Documentation of Field Activities	Tetra Tech	Field logbook, sample log sheets, boring logs	N	Contained in Appendix D
SOP-04	Decontamination of Field Sampling Equipment	Tetra Tech	Decontamination equipment, scrub brushes, 5-gallon buckets, spray bottles, phosphate free detergent, DI water	N	Contained in Appendix D
SOP-05	Soil Coring and Sampling Using Hand Auger Techniques	Tetra Tech	Stainless steel auger bucket, extension rods, and T-handle	N	Contained in Appendix D
SOP-06	Borehole Advancement and Soil Coring for Soil SamplingUsing Direct-Push Technology	Tetra Tech	Drilling rig and accessories	N	Contained in Appendix D
SOP-07	Surface Water Sampling	Tetra Tech	Multi-parameter water quality meter, turbidity meter, peristaltic pump, silicone tubing, 0.45 µ filter	N	Contained in Appendix D
SOP-08	Sediment Sampling	Tetra Tech	Stainless steel or disposable trowels	N	Contained in Appendix D
SOP-09	Management of Investigation-Derived Waste	Tetra Tech	NA	N	Contained in Appendix D
SOP-10	Borehole and Soil Sample Logging	Tetra Tech	NA	N	Contained in Appendix D

Reference Number	Title, Revision Date and/or Number	Originating Organization of Sampling SOP	Equipment Type	Modified for Project Work? (Y/N)	Comments
SOP-11	Sample Preservation, Packaging, and Shipping	Tetra Tech	NA	N	Contained in Appendix D
SOP-12	Calibration and Care of Water Quality Meter	Tetra Tech	Multi-parameter water quality meter	N	Contained in Appendix D
SOP-13	Measurement of Water Levels in Monitoring Wells	Tetra Tech	Water level meter	N	Contained in Appendix D
SOP-14	Inspection of Existing Monitoring Wells	Tetra Tech	Hand tools	N	Contained in Appendix D
SOP-15	Monitoring Well Development	Tetra Tech	Surge block, stainless steel bailer, bailer rope, 12vdc submersible pump, surface pump, multi-parameter water quality meter, water level meter, water containers	N	Contained in Appendix D
SOP-16	Temporary Monitoring Well Installation	Tetra Tech	Drilling rig and accessories	N	Contained in Appendix D
SOP-17	Low-Flow Well Purging and Stabilization	Tetra Tech	12vdc submersible pump, peristaltic surface pump, multi-parameter water quality meter, water level meter, water containers,	N	Contained in Appendix D
SOP-18	Groundwater Sampling	Tetra Tech	12vdc submersible pump, peristaltic surface pump, multi-parameter water quality meter, water level meter, water containers, sample containers	N	Contained in Appendix D

Reference Number	Title, Revision Date and/or Number	Originating Organization of Sampling SOP	Equipment Type	Modified for Project Work? (Y/N)	Comments
SOP-19	Composite Sampling for Soil and Sediment	Tetra Tech	Stainless steel trowels and mixing bowls	N	Contained in Appendix D
SOP-20	Calibration and Use of Photoionization Detector	Tetra Tech	Photoionization air meter	N	Contained in Appendix D
SOP-21	MEC Management and Accountability	Tetra Tech	Metal Detector	N	Contained in Appendix D
SOP-22	Global Positioning System	Tetra Tech	GPS unit	N	Contained in Appendix D

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

(UFP-QAPP Manual Section 3.1.2.4)

Field Equipment	Activity[1]	Frequency	Acceptance Criteria	Corrective Action	Resp. Person	SOP Reference[2]	Comments
DPT Rig	Maintenance	Prior to daily use	HASP checklist	Correct deficiencies before operating	Subcontractor DPT Operator	SOP-06, SOP-16	
Hollow Stem Auger Rig	Maintenance	Prior to daily use	HASP checklist	Correct deficiencies before operating	Subcontractor RIG Operator	SOP-16	
Photoionization Detector	Calibrated in accordance with manufacturer's specifications	Prior to daily use	Prepared standards	Operator correction or replacement	FOL	SOP-20	
Multi-Parameter Water Quality Meter	Calibrated in accordance with manufacturer's specifications	Prior to daily use	Prepared standards	Operator correction or replacement	FOL	SOP-12	
Turbidity Meter	Calibrated in accordance with manufacturer's specifications	Prior to daily use	Prepared standards	Operator correction or replacement	FOL	SOP-12	
Water Level Indicator	Testing	Once upon receipt from vendor	0.01-foot accuracy	Operator correction or replacement	FOL	SOP-13	
GPS	Positioning	Beginning and end of each day GPS is used	Accuracy: sub-meter HDPO<3, number of satellites at least six	Wait for better signal, replace unit, or choose alternate location technique	FOL	SOP-22	

1 Activities may include: calibration, verification, testing, maintenance.

2 Specify the appropriate reference letter or number from the Project Sampling SOP References table (Worksheet 21).

SAP Worksheet #23 -- Analytical SOP References Table

(UFP-QAPP Manual Section 3.2.1)

Lab SOP Number	Title, Revision Date, and / or Number	Definitive or Screening Data	Matrix and Analytical Group	Instrument	Organization Performing Analysis	Modified for Project Work?[1] (Y/N)
09-3015	Microwave Assisted Acid Digestion of Aqueous Samples and Extracts for Total Metals Analysis by ICP or ICP-MS Spectroscopy Revision 9	Definitive	Groundwater, TAL Metals	Microwave Digester	ALSI Middletown	N
09-3051	Microwave Assisted Acid Digestion of Sediments, Sludges, Soils, and Oils Revision 0	Definitive	Soil and Sediment TAL Metals	Microwave Digester	ALSI Middletown	N
03-6010	Analysis of Total Metals by Inductively Coupled Plasma Using the TJA IRIS ICP Revision 13	Definitive	Soil, Sediment, and Groundwater TAL Metals	TJA Trace ICP	ALSI Middletown	N

Lab SOP Number	Title, Revision Date, and / or Number	Definitive or Screening Data	Matrix and Analytical Group	Instrument	Organization Performing Analysis	Modified for Project Work?[1] (Y/N)
03-6010IRIS	Analysis of Total Metals by Inductively Coupled Plasma Using the TJA Trace ICP Revision 5	Definitive	Soil, Sediment, and Groundwater TAL Metals	TJA IRIS ICP	ALSI Middletown	N
03-6020	Method 6020 – Determination of Trace Elements in Water and Waste by Inductively Coupled Plasma – Mass Spectrometry Revision 3	Definitive	Soil, Sediment, and Groundwater TAL Metals	Perkin Elmer ICP/MS (various)	ALSI Middletown	N
09-PD-Hg	Sample Preparation for the Determination of Mercury in Drinking Water Samples Revision 10	Definitive	Groundwater TAL Metals	NA	ALSI Middletown	N
09-PDS-Hg	Sample Preparation for the Determination of Mercury in Aqueous and Soil Samples Revision 4	Definitive	Soil and Sediment TAL Metals	NA	ALSI Middletown	N

Lab SOP Number	Title, Revision Date, and / or Number	Definitive or Screening Data	Matrix and Analytical Group	Instrument	Organization Performing Analysis	Modified for Project Work?[1] (Y/N)
03-Hg	Mercury by Cold-Vapor Atomic Absorption Using an Automated Continuous-Flow Vapor Generator Revision 13	Definitive	Soil, Sediment, and Groundwater, TAL Metals	CETAC Hg Analyzer	ALSI Middletown	N
02-5035	Closed-System Purge-and-Trap and Extraction for Volatile Organics in Soil and Waste Samples Revision 1	Definitive	Soil and Sediment VOCs	GC/MS (various)	ALSI Middletown	N
02-8260B	Volatile Organic Compounds by Gas Chromatography/ Mass Spectrometry (GC/MS): Capillary Column Technique Revision 10	Definitive	Soil, Sediment, and Groundwater, VOCs	GC/MS (various)	ALSI Middletown	N
09-8330W	Solid Phase Extraction of Water for the Analysis of Explosives by EPA Method 8330A (HPLC) Revision 3	Definitive	Surface and Groundwater Explosives	NA	ALSI Middletown	N

Lab SOP Number	Title, Revision Date, and / or Number	Definitive or Screening Data	Matrix and Analytical Group	Instrument	Organization Performing Analysis	Modified for Project Work?[1] (Y/N)
09-8330B Soil	Ultrasonication of Solids for the Analysis of Explosives by EPA Method 8330B (HPLC) Revision 0	Definitive	Soil and Sediment Explosives	NA	ALSI Middletown	N
1B-8330	Nitroaromatics and Nitroamines by HPLC with Ultraviolet Detection Revision 7	Definitive	Soil, Sediment, Surface and Groundwater Explosives	HPLC (various)	ALSI Middletown	N
19-COC	Standard Operating Procedure for Chain of Custody Entry Revision 4	Definitive	All	NA	ALSI Middletown	N
19-Rec/Han	Standard Operating Procedure for Sample Receipt/Sample Handling revision 12	Definitive	All	NA	ALSI Middletown	N
19-Waste Disposal	Waste Disposal revision 1	Definitive	All	NA	ALSI Middletown	N

Lab SOP Number	Title, Revision Date, and / or Number	Definitive or Screening Data	Matrix and Analytical Group	Instrument	Organization Performing Analysis	Modified for Project Work?[1] (Y/N)
LC/MS-CLO4	The Determination of Perchlorate in Water, Soil and Biota by Liquid Chromatography / Mass Spectrometry Revision 5	Definitive	Soil, Sediment, Surface Water, and Groundwater Perchlorate	LC/MS	DataChem Laboratories, Inc.	N
XX-DC-006	Chain-of-Custody and Laboratory Tracking, Revision 6	Definitive	All	NA	DataChem Laboratories, Inc.	N
LAB-004	Hazardous Waste Handling and Disposal, Revision 3	Definitive	All	NA	Datachem Laboratories, Inc.	N
QS-DC-001	Sample Receipt and Log-In (Environmental), Revision 14	Definitive	All	NA	DataChem Laboratories, Inc.	N

1 If yes, then specify the modification that has been made. Note that any analytical SOP modification made relative to project specific needs must be reviewed and approved by the Navy QAO.

TAL - Target Analyte List
ICP-MS - Inductively Coupled Plasma-Mass Spectrometer
VOC - Volatile Organic Compound
HPLC - High Performance Liquid Chromatograph
LC/MS - Liquid Chromatography/Mass Spectrometer

SAP Worksheet #24 -- Analytical Instrument Calibration Table

(UFP-QAPP Manual Section 3.2.2)

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference
CETAC Hg Analyzer	Linear calibration – 5 levels of standards plus blank	Each day of use.	Correlation coefficient >/= 0.995	Determine and correct reason for failure. Repeat calibration	Analyst/ Supervisor	03-Hg
	Initial calibration verification (ICV)	Immediately after calibration.	90-110 % of true value.	Re-analyze once. If still unacceptable repeat calibration.	Analyst/ Supervisor	03-Hg
	Continuing calibration verification (CCV)	After calibration, every 10 samples, end of run.	90-110 % of true value.	Re-analyze once. If still unacceptable re-analyze all associated samples. If re-analysis is not possible report with a qualifying comment.	Analyst/ Supervisor	03-Hg
TJA TRACE ICP	Linear calibration – 3 levels of standards plus blank	Each day of use.	Correlation coefficient >/= 0.995.	Determine and correct reason for failure. Repeat calibration.	ICP Analyst	03-6010
	ICV	Immediately after calibration.	90-110 % of true value.	Re-analyze once. If still unacceptable repeat calibration.	ICP Analyst	03-6010B
	CCV	After calibration, every 10 samples, end of run.	90-110 % of true value.	Re-analyze once. If still unacceptable re-analyze all associated samples. If re-analysis is not possible report with a qualifying comment.	ICP Analyst	03-6010B

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference
TJA TRACE ICP (Continued)	Initial calibration blank (ICB)/continuing calibration blank (CCB)	ICB and CCB are run at the beginning and every 10 samples of each analytical batch.	Must be <2.2 times the Method Detection Limit (MDL).	Re-analyze all associated samples. If re-analysis is not possible, report with a qualifying comment.	Analyst	03-6010
TJA IRIS ICP	linear calibration – 4 levels of standards plus blank	Each day of use.	Correlation coefficient >/= 0.995	Determine and correct reason for failure. Repeat calibration.	ICP Analyst	03-6010 IRIS
	ICV	Immediately after calibration.	90-110 % of true value.	Re-analyze once. If still unacceptable repeat calibration.	ICP Analyst	03-6010 IRIS
	CCV	After calibration, every 10 samples, end of run.	90-110 % of true value.	Re-analyze once. If still unacceptable re-analyze all associated samples. If re-analysis is not possible report with a qualifying comment.	ICP Analyst	03-6010 IRIS
	ICB/CCB	ICB and CCB are run at the beginning and every 10 samples of each analytical batch.	Must be <2.2 times the MDL.	Re-analyze all associated samples. If re-analysis is not possible, report with a qualifying comment.	Analyst	03-6010 IRIS

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference
GC/MS VOC	Minimum of 5 levels of calibration standards; 6 levels are usually run.	As needed, when CCV criteria cannot be met, of following major instrument maintenance.	Average response factor </= 15 %; if a linear or quadratic fit is used r^2>/=0.990.	Determine and correct reason for failure. Repeat calibration.	Gas Chromatograph/ Mass Spectrometer (GC/MS) Analyst	02-8260B
	Bromofluorobenzene (BFB) Tune	Prior to analysis and every 12 hours.	Mass - Criteria 50 - 15.0-40.0% of mass 95 75 - 30.0-60% of mass 95 95 - base peak, 100% relative abundance 96 - 5.0-9.0% of mass 95 173 - less than 2.0% of mass 174 174 - greater than 50.0% of mass 95 175 - 5.0-9.0% of mass 174 176 - greater than 95.05, but less than 101.0% of mass 174 177 - 5.0-9.0% of mass 176.	Determine and correct reason for failure. Re-analyze BFB before analyzing samples.	GC/MS Analyst	02-8260B
	ICV	Following initial calibration prior to the analysis of samples.	75-125 % recovery	Re-analyze once. If still unacceptable repeat calibration.	GC/MS Analyst	02-8260B

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference
GC/MS VOC (Continued)	CCV	Prior to the analysis of samples and every 12 hours.	System performance check compounds (SPCC) must meet response factors limits: Chloromethane 0.10 1,1-Dichloroethane 0.10 Bromoform 0.10 Chlorobenzene 0.30 1,1,2,2-Tetrachlorethane 0.30 continuing calibration checks (CCC); must have a % difference </= 20 %.	Re-analyze once. If still unacceptable repeat calibration.	GC/MS Analyst	02-8260B
HPLC - Explosives	Minimum of 5 levels of calibration standards; 6 levels are usually run.	As needed, when CCV criteria cannot be met, of following major instrument maintenance.	Average response factor </= 20 %; if a linear fit is used coefficient of determination ($r^{2)}$ >/=0.990.	Determine and correct reason for failure. Repeat calibration.	HPLC Analyst	1B-8330
	ICV	Following initial calibration prior to the analysis of samples.	±20% Difference.	Re-analyze once. If still unacceptable repeat calibration.	HPLC Analyst	1B-8330

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference
HPLC - Explosives (Continued)	CCV	Prior to the analysis of samples and every 12 hours or every 10 field samples, which ever is more frequent.	±20% Difference.	Re-analyze once. If still unacceptable repeat calibration.	HPLC Analyst	1B-8330
LC/MS - Perchlorate	Initial Calibration	When CCV fails	Correlation coefficient >/= 0.995.	New initial calibration.	Analyst	LC/MS-CLO4
	ICV	With each Initial	±15% Difference.	New initial calibration.		
	CCV	Daily before analyses.	±15% Difference.	New initial calibration.		
Perkin Elmer ICP/MS	Linear calibration – Minimum of 4 levels of standards plus blank.	Each day of use.	Correlation coefficient >/= 0.995	Determine and correct reason for failure. Repeat calibration.	ICP/MS Analyst	03-6020
	ICV	Immediately after calibration.	90	Re-analyze once. If still unacceptable repeat calibration.	ICP/MS Analyst	03-6020
	CCV	After calibration, every 10 samples, end of run	90	Re-analyze once. If still unacceptable re-analyze all associated samples. If re-analysis is not possible report with a qualifying comment.	ICP/MS Analyst	03-6020
	ICB/CCB	ICB and CCB are run at the beginning and every 10 samples of each analytical batch.	Must be <2.2 times the MDL.	Re-analyze all associated sample. If re-analysis is not possible, report with a qualifying comment.	Analyst	03-6020

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

(UFP-QAPP Manual Section 3.2.3)

Instrument / Equipment	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference
TJA Trace ICP	Clean torch assembly and spray chamber when discolored or when degradation in data quality is observed. Clean nebulizer, check argon, and replace peristaltic pump tubing as needed.	TAL Metals	Initial Calibration; Initial and Continuing Calibration Verification.	Initial Calibration – at the beginning of each day or when quality control criteria are not met. Initial Calibration Verification – Immediately after calibration. Continuing Calibration Verification – After every ten samples and at the end of the analytical sequence.	Initial Calibration – 0.995. Initial and Continuing Calibration Verification – 90-110 % Recovery.	Recalibrate and/or perform necessary equipment maintenance. Check calibration standards. Re-analyze affected metals. Record activities in maintenance logbook.	Metals Analyst	03-6010

Instrument / Equipment	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference
TJA IRIS ICP	Clean torch assembly and spray chamber when discolored or when degradation in data quality is observed. Clean nebulizer, check argon, and replace peristaltic pump tubing as needed.	TAL Metals	Initial Calibration; Initial and Continuing Calibration Verification.	Initial Calibration – At the beginning of each day or when quality control criteria are not met. Initial Calibration Verification – Immediately after calibration. Continuing Calibration Verification – After every ten samples and at the end of the analytical sequence.	Initial Calibration – 0.995. Initial and Continuing Calibration Verification – 90-110 % Recovery.	Recalibrate and/or perform necessary equipment maintenance. Check calibration standards. Re-analyze affected metals. Record activities in maintenance logbook.	Metals Analyst	03-6010 IRIS

Instrument / Equipment	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference
CETAC Mercury Analyzer	Clean optical cell when needed. Check lamp, gas pressure, replace peristaltic pump tubing as needed.	TAL Metals	Initial Calibration; Initial and Continuing Calibration Verification.	Initial Calibration – At the beginning of each day or when quality control criteria are not met. Initial Calibration Verification – Immediately after calibration. Continuing Calibration Verification – After every ten samples and at the end of the analytical sequence.	Initial Calibration – 0.995. Initial and Continuing Calibration Verification – 90-110 % Recovery	Recalibrate and/or perform necessary equipment maintenance. Check calibration standards. Re-analyze affected metals. Record activities in maintenance logbook.	Metals Analyst	03-Hg

Instrument / Equipment	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference
Volatile GC/MS	Check pressure and gas supply daily. Bake out trap and column, manual tune if tune criteria are not met, change septa as needed, change trap as needed.	VOC	Initial Calibration; Initial and Continuing Calibration Verification.	Initial Calibration – Instrument receipt, after major maintenance (new trap, column, etc.), when instrument quality control criteria are not met. Initial Calibration Verification - Following initial calibration prior to the analysis of samples. Continuing Calibration Verification – Prior to the analysis of samples and every 12 hours.	Refer to Worksheet #24 Instrument Calibration Table GC/MS VOC acceptance criteria.	Recalibrate and/or perform necessary equipment maintenance. Check calibration standards. Re-analyze affected analytes. Record activities in maintenance logbook.	Volatiles Analyst	02-8260B

Instrument / Equipment	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference
HPLC	Check pressure.	HPLC	Initial Calibration; Initial and Continuing Calibration Verification.	Initial Calibration – Instrument receipt, after major maintenance, when instrument quality control criteria are not met. Initial Calibration Verification - Following initial calibration prior to the analysis of samples. Continuing Calibration Verification – Prior to the analysis of samples and every 12 hours or every 10 field samples, whichever is more frequent.	Refer to Worksheet #24 Instrument Calibration Table HPLC acceptance criteria.	Recalibrate and/or perform necessary equipment maintenance. Check calibration standards. Re-analyze affected analytes. Record activities in maintenance logbook.	HPLC Analyst	1B-8330

Instrument / Equipment	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference
Perkin Elmer ICP/MS	Clean torch assembly and spray chamber when discolored or when degradation in data quality is observed. Clean nebulizer, check argon, and replace peristaltic pump tubing as needed. Check condition of cones and vacuum pump oil.	TAL Metals	Initial Calibration; Initial and Continuing Calibration Verification.	Initial Calibration – At the beginning of each day or when quality control criteria are not met. Initial Calibration Verification – Immediately after calibration. Continuing Calibration Verification – After every ten samples and at the end of the analytical sequence.	Initial Calibration – correlation coefficient 0.995. Initial and Continuing Calibration Verification – 90-110 % recovery of true value.	Recalibrate and/or perform necessary equipment maintenance. Check calibration standards. Re-analyze affected metals. Record activities in maintenance logbook.	Metals Analyst	03-6020

Instrument / Equipment	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference
LC/MS	3rd party Service-Preventive Maintenance (PM)	Perchlorate	Initial Calibration; Initial and Continuing Calibration Verification.	Every 6 months	Pass all criteria for Analysis	Vender will return	Analyst	LC-MS-CLO4
	Clean Inlet		Initial Calibration; Initial and Continuing Calibration Verification.	As Needed	Meet Sensitivity	Repeat		
	Clean Source		Initial Calibration; Initial and Continuing Calibration Verification.	As needed and each PM	Pass all criteria for Analysis	Repeat		
	Clean Rods		Initial Calibration; Initial and Continuing Calibration Verification.	As needed and each PM	Pass all criteria for Analysis	Repeat		

SAP Worksheet #26 -- Sample Handling System

(UFP-QAPP Manual Appendix A)

SAMPLE HANDLING SYSTEM

SAMPLE COLLECTION, PACKAGING, AND SHIPMENT
Sample Collection (Personnel/Organization): TBD/Tetra Tech
Sample Packaging (Personnel/Organization TBD/Tetra Tech
Coordination of Shipment (Personnel/Organization): TBD/Tetra Tech
Type of Shipment/Carrier: Overnight via Federal Express
SAMPLE RECEIPT AND ANALYSIS
Sample Receipt (Personnel/Organization): Sample Receiving Department./ALSI and DataChem
Sample Custody and Storage (Personnel/Organization):): Sample Receiving Department./ALSI and DataChem
Sample Preparation (Personnel/Organization): GC, GC/MS, and Metals Digestion Departments/ALSI and DataChem
Sample Determinative Analysis (Personnel/Organization): Metals, GC, and GC/MS Departments/ALSI and DataChem
SAMPLE ARCHIVING
Field Sample Storage (No. of days from sample collection): 24 to 48 hours
Sample Extract/Digestate Storage (No. of days from extraction/digestion):): Extracts may be disposed of 90 days after extraction ALSI, 30 days DataChem
Biological Sample Storage (No. of days from sample collection): NA
SAMPLE DISPOSAL
Personnel/Organization: : Sample Receiving Department/ ALSI and DataChem
Number of Days from Analysis: Samples may be disposed of 90 days after report mail date ALSI, 60 days DataChem

SAP Worksheet #27 – Sample Custody Requirements Table

(UFP-QAPP Manual Section 3.3.3)

Laboratory Chain of Custody

Chain of Custody (COC) documentation tracks the historical possession of samples. A completed Chain of Custody must accompany all samples entering the laboratory. This form provides essential information to the laboratory regarding sample collection and analyses required, and includes the Customer name, project name, sampler's name or initials, sample location, sampling date and time, number of containers, type of preservative used, sample type, special remarks concerning the sample or project, and analytical parameters requested.

Standard Operating Procedure 19-Rec/Han (ALSI) and QS-DC-001 (DataChem) provides instruction on reviewing and inspecting the chain of custody for discrepancies. This is accomplished by inspection and comparison of the samples received against the chain of custody to identify any discrepancies. Sample receiving will immediately notify the customer service department of samples received without a chain of custody via US Mail, Federal Express, UPS, etc. These samples will be placed on hold until the chain of custody is received from the Customer. For walk-in customers dropping off samples, a copy of the COC will be given to them to fill out before sample acceptance. Complete chain of custody documentation, including memos, transmittal forms, etc., are scanned into the ALSI database, filed, and properly retained by the laboratory

Sample preparation logs and sample analysis logs document the progression of extracts/digestates from preparation to analysis. The LIMS also tracks this progression and documents dates and times prepared and analyzed on the final laboratory analysis report. A more detailed internal chain of custody is available for use upon Customer request for special projects or for samples being tested for litigation purposes. This internal chain of custody is created electronically using functionality available in the laboratory LIMS. Standard Operating Procedure 19-COC (ALSI) and XX-DC-006 (DataChem) provides detailed instructions describing this procedure.

Upon arrival in the laboratory, samples are received by a sample custodian who ensures that a proper Chain of Custody accompanies all samples. The Chain of Custody will be signed by the person delivering the samples to relinquish the samples to the sample custodian. The sample custodian will then inspect and compare the samples to be received against the Chain of Custody to identify any discrepancies before signing the form and receiving the samples into the custody of the laboratory. The date and time relinquished/received is also recorded on the Chain of Custody. A

Cooler Receipt Checklist is also filled out on the Chain of Custody for each container received by a third party transporter (i.e. FedEx). Information relating to shipping, sample temperature, custody seals, Chain of Custody/label agreement, container condition, sample amount, and container size/type/preservation is recorded.

If discrepancies cannot be resolved at the time of sample receipt by Sample Receiving personnel Project Management will address them during the chain-of-custody review following LIMS entry.

SAP Worksheet #28 -- Laboratory QC Samples Table

Matrix	Groundwater
Analytical Group	Metals
Analytical Method / SOP Reference	SW-846 09-3015;03-6010; 03-6010IRIS, 03-6020

QC Sample	Frequency / Number	Method / SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Method Blank	One per digestion batch of 20 or fewer samples.	No analyte present at less than ½ QL.	Re-analyze the blank. If still unacceptable investigate the source of contamination. Samples in the batch must be < the QL or ≥ 10x the method blank. If not, samples must be re-digested and re-analyzed. If re-analysis is not possible, report with a qualifying comment.	Analyst	Bias/Contamination	No analyte detected > QL.

Matrix	Groundwater					
Laboratory Control Sample (LCS)	One per digestion batch of 20 or fewer samples.	Recovery within +/- 20 % of true value.	Re-analyze once. If still unacceptable determine source of problem. Re-analyze all associated sample. If re-analysis is not possible, report with a qualifying comment.	Analyst.	Accuracy/Bias	80-120 % recovery.
Matrix Spike (MS)	One per digestion batch of 20 or fewer samples.	Recovery +/- 20 % of true value if sample <10x spike added. Relative percent difference (RPD) </= 20% for duplicate spikes.	If batch LCS is acceptable flag result.	Analyst	Accuracy/Bias	Recovery +/- 20 % of true value if sample <10x spike added.
Matrix Spike Duplicate (MSD)	One per digestion batch of 20 or fewer samples.	RPD </= 20% for duplicate spikes.	Flag result.	Analyst	Precision	RPD </= 20% for duplicate spikes.
Serial Dilution	One per analytical batch of 20 or fewer samples.	5-fold dilution must agree within 10 % of the original result if the result is at least 100 times the reagent blank.	Interference must be suspected. Dilute sample to eliminate interference.	Analyst	Accuracy/Bias	5-fold dilution must agree within 10 % of the original result if the result is at least 100 times the reagent blank.

Matrix	Groundwater					
Internal Standards (Method 6020)	5 per sample if a full list of metals is being analyzed.	> 30% of the response in the initial calibration standard.	Flush the instrument with rinse blank and monitor the response in the calibration blank. If acceptable, Dilute sample by factor of 4, and reanalyze. If after flushing the calibration blank response is unacceptable, terminate the analysis and determine cause of drift.	Analyst	Precision/Accuracy/Bias	> 30% of the response in the initial calibration standard.
Interference Check Sample (ICS)	ICSA and ICSAB are run at the beginning and at the end of each analytical batch.	ICSA must be < 2.2 times the MDL. ICSAB must be ± 20 % true value.	If the ICSA or ICSAB fails at the beginning of the run, recalibrate. If the ICSA or ICSAB fails at the end of the run, flag results.	Analyst	Interference	ICSA must be < 2.2 times the MDL. ICSAB must be ± 20 % true value.

Matrix	Soil and Sediment
Analytical Group	Metals
Analytical Method / SOP Reference	SW-846 09-3051;03-6010; 03-6010IRIS, 03-6020

QC Sample	Frequency / Number	Method / SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Method Blank	One per digestion batch of 20 or fewer samples.	Less than ½ QL.	Re-analyze the blank. If still unacceptable investigate the source of contamination. Samples in the batch must be < the QL or ≥ 10x the method blank. If not, samples must be re-digested and re-analyzed. If re-analysis is not possible, report with a qualifying comment	Analyst	Bias/Contamination	Must be less than QL.
Laboratory Control Sample	One per digestion batch of 20 or fewer samples.	Recovery within +/- 20 % of true value.	Re-analyze once. If still unacceptable determine source of problem. Re-analyze all associated sample. If re-analysis is not	Analyst.	Accuracy/Bias	80-120 %

Matrix	Soil and Sediment					
			possible, report with a qualifying comment.			
Matrix Spike	One per digestion batch of 20 or fewer samples	Recovery +/- 20 % of true value if sample <10x spike added.	If batch Laboratory Control Sample is acceptable flag result.	Analyst	Accuracy/Bias	Recovery +/- 20 % of true value if sample <10x spike added.
Matrix Spike Duplicate	One per digestion batch of 20 or fewer samples	RPD </= 20% for duplicate spikes	Flag result.	Analyst	Precision	RPD </= 20% for duplicate spikes
Serial Dilution	One per analytical batch of 20 or fewer samples	5-fold dilution must agree within 10 % of the original result if the result is at least 100 times the reagent blank.	Interference must be suspected. Dilute sample to eliminate interference.	Analyst	Accuracy/Bias	5-fold dilution must agree within 10 % of the original result if the result is at least 100 times the reagent blank
Internal Standards (Method 6020)	5 per sample if a full list of metals is being analyzed	> 30% of the response in the initial calibration standard.	Flush the instrument with rinse blank and monitor the response in the calibration blank. If acceptable, Dilute sample by factor of 4, and reanalyze. If after flushing the calibration blank response is unacceptable, terminate the analysis and determine cause of drift.	Analyst	Precision/Accuracy/Bias	> 30% of the response in the initial calibration standard.

Matrix	Soil and Sediment					
Interference Check Sample (ICS)	ICSA and ICSAB are run at the beginning and at the end of each analytical batch.	ICSA must be < 2.2 times the MDL. ICSAB must be ± 20 % true value.	If the ICSA or ICSAB fails at the beginning of the run, recalibrate. If the ICSA or ICSAB fails at the end of the run, flag results.	Analyst	Interference	ICSA must be < 2.2 times the MDL. ICSAB must be ± 20 % true value.

Matrix	Groundwater
Analytical Group	Mercury
Analytical Method / SOP Reference	SW-846 09-PD-Hg;03-Hg

QC Sample	Frequency / Number	Method / SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Method Blank	One per digestion batch of 20 or fewer samples.	Less than ½ QL.	Re-analyze the blank. If still unacceptable investigate the source of contamination. Samples in the batch must be < the QL or ≥ 10x the method blank. If not, samples must be re-digested and re-analyzed. If re-analysis is not possible, report with a qualifying comment.	Analyst	Bias/Contamination	Less than the QL.
Laboratory Control Sample (LCS)	One per digestion batch of 20 or fewer samples.	Recovery within +/- 15 % of true value.	Re-analyze once. If still unacceptable determine source of problem. Re-analyze all associated sample. If re-analysis is not possible, report with a qualifying comment.	Analyst	Accuracy/Bias	Recovery within +/- 15 % of true value.

Matrix	Groundwater					
Matrix Spike (MS)	One per every 10 samples with a minimum of one per digestion batch.	Recovery +/- 20 % of true value if sample <10x spike added.	If batch Laboratory Control Sample is acceptable flag result.	Analyst	Accuracy/Bias	Recovery +/- 20 % of true value if sample <10x spike added.
Matrix Spike Duplicate (MSD)	One per every 10 samples with a minimum of one per digestion batch.	RPD </= 20% for duplicate spikes.	Flag result.	Analyst	Precision	RPD </= 20% for duplicate spikes.

Matrix	Soil and Sediment
Analytical Group	Mercury
Analytical Method / SOP Reference	09-PDS-Hg;03-Hg

QC Sample	Frequency / Number	Method / SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Method Blank	One per digestion batch of 20 or fewer samples.	Less than ½ QL.	Re-analyze the blank. If still unacceptable investigate the source of contamination. Samples in the batch must be < the QL or ≥ 10x the method blank. If not, samples must be re-digested and re-analyzed. If re-analysis is not possible, report with a qualifying comment.	Analyst	Bias/Contamination	Less than the QL.
Laboratory Control Sample (LCS)	One per digestion batch of 20 or fewer samples.	Recovery within +/- 20 % of true value.	Re-analyze once. If still unacceptable determine source of problem. Re-analyze all associated sample. If re-analysis is not possible, report with a qualifying comment.	Analyst.	Accuracy/Bias	Recovery within +/- 20 % of true value.

Matrix	Soil and Sediment					
Matrix Spike (MS)	One per every 10 samples with a minimum of one per digestion batch.	Recovery +/- 20 % of true value if sample <10x spike added.	If batch Laboratory Control Sample is acceptable flag result.	Analyst	Accuracy/Bias	Recovery +/- 20 % of true value if sample <10x spike added.
Matrix Spike Duplicate (MSD)	One per every 10 samples with a minimum of one per digestion batch.	RPD </= 20% for duplicate spikes.	Flag result.	Analyst	Precision	RPD </= 20% for duplicate spikes.

Matrix	Groundwater
Analytical Group	Volatiles
Analytical Method / SOP Reference	SW-846 02-8260B

QC Sample	Frequency / Number	Method / SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Method Blank	One per 12 hour tune period.	Less than ½ QL.	Re-analyze the blank. If still unacceptable investigate the source of contamination. Samples in the batch must be < the QL or ≥ 10x the method blank. If not, samples must be re-analyzed. If re-analysis is not possible, report with a qualifying comment	Analyst.	Bias/Contamination	Less than the QL.

Matrix	Groundwater					
Laboratory Control Sample (LCS)	One per 12 hour tune period.	Control Limits listed in DoD QSM Table D-4.	Re-analyze once. If still unacceptable re-analyze all associated samples. If re-analysis is not possible, report with a qualifying comment. If the LCS recoveries are biased high and sample results are < QL data is not affected and results are acceptable.	Analyst.	Accuracy/Bias	Control Limits listed in DoD QSM Table D-4.
Matrix Spike (MS)	One per batch of 20 or fewer samples	Control Limits listed in DoD QSM Table D-4.	If batch Laboratory Control Sample is acceptable flag result. If batch Laboratory Control Sample is not acceptable re-analyze sample and QC.	Analyst	Accuracy/Bias	Control Limits listed in DoD QSM Table D-4.
Matrix Spike Duplicate (MSD) or Sample Duplicate	One per batch of 20 or fewer samples	Control Limits listed in DoD QSM Table D-4.	Flag results.	Analyst	Precision	Control Limits listed in DoD QSM Table D-4.

Matrix	Groundwater					
Internal Standards (IS)	Three per sample.	Retention time +/- 0.50 minutes; IS area within -50% to +100% of last calibration verification standard or if an initial calibration was last analyzed the Level 5 calibration standard.	Re-analyze samples undiluted and/or at a dilution to confirm matrix effects. If acceptable IS cannot be obtained due to matrix interferences report with a qualifying comment.	Analyst	Precision/Accuracy/Bias	Retention time +/- 0.50 minutes; IS area within -50% to +100% of last calibration verification standard or if an initial calibration was last analyzed the Level 5 calibration standard.
Surrogates	Four per sample.	Statistically derived limits.	If a matrix interference can be identified report with a qualifying comment. If not, re-analyze to confirm matrix interference. If confirmed report with a qualifying comment.	Analyst	Accuracy/Bias	Statistically derived limits

Matrix	Soil
Analytical Group	Volatiles
Analytical Method / SOP Reference	SW-846 02-5035; 02-8260B

QC Sample	Frequency / Number	Method / SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Method Blank	One per 12 hour tune period.	Less than ½ QL.	Re-analyze the blank. If still unacceptable investigate the source of contamination. Samples in the batch must be < the QL or ≥ 10x the method blank. If not, samples must be re-analyzed. If re-analysis is not possible, report with a qualifying comment	Analyst.	Bias/Contamination	Less than the QL.

Matrix	Soil					
Laboratory Control Sample (LCS)	One per 12 hour tune period	Control Limits listed in DoD QSM Table D-5.	Re-analyze once. If still unacceptable re-analyze all associated samples. If re-analysis is not possible, report with a qualifying comment. If the LCS recoveries are biased high and sample results are <QL data is not affected and results are acceptable.	Analyst.	Accuracy/Bias	Control Limits listed in DoD QSM Table D-5.
Matrix Spike (MS)	One per batch of 20 or fewer samples.	Control Limits listed in DoD QSM Table D-5.	If batch Laboratory Control Sample is acceptable flag result. If batch Laboratory Control Sample is not acceptable re-analyze sample and QC.	Analyst	Accuracy/Bias	Control Limits listed in DoD QSM Table D-5.
Matrix Spike Duplicate (MSD) or Sample Duplicate	One per batch of 20 or fewer samples.	Control Limits listed in DoD QSM Table D-5.	Flag results.	Analyst	Precision	Control Limits listed in DoD QSM Table D-5.

Matrix	Soil					
Internal Standards (IS)	Three per sample.	Retention time +/- 0.50 minutes; IS area within -50% to +100% of last calibration verification standard or if an initial calibration was last analyzed the Level 5 calibration standard.	Re-analyze samples undiluted and/or at a dilution to confirm matrix effects. If acceptable IS cannot be obtained due to matrix interferences report with a qualifying comment.	Analyst	Precision/Accuracy/Bias	Retention time +/- 0.50 minutes; IS area within -50% to +100% of last calibration verification standard or if an initial calibration was last analyzed the Level 5 calibration standard.
Surrogates	Four per sample.	Statistically derived limits.	If a matrix interference can be identified report with a qualifying comment. If not, re-analyze to confirm matrix interference. If confirmed report with a qualifying comment.	Analyst	Accuracy/Bias	Statistically derived limits

Matrix	Surface and Groundwater
Analytical Group	Explosives
Analytical Method / SOP Reference	SW-846 09-8330W; 1B-8330

QC Sample	Frequency / Number	Method / SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Method Blank	One per batch of 20 or fewer samples.	Less than ½ QL.	Re-analyze the blank. If still unacceptable investigate the source of contamination. Samples in the batch must be < the QL or ≥ 10x the method blank. If not, samples must be re-analyzed. If re-analysis is not possible, report with a qualifying comment	Analyst.	Bias/Contamination	Less than the QL.

Matrix	Surface and Groundwater					
Laboratory Control Sample (LCS)	One per batch of 20 or fewer samples.	Control Limits listed in DoD QSM Table D-12.	Re-analyze once. If still unacceptable re-analyze all associated samples. If re-analysis is not possible, report with a qualifying comment. If the LCS recoveries are biased high and sample results are <QL data is not affected and results are acceptable.	Analyst.	Accuracy/Bias	Control Limits listed in DoD QSM Table D-12.
Matrix Spike (MS)	One per batch of 20 or fewer samples.	Control Limits listed in DoD QSM Table D-12.	If batch Laboratory Control Sample is acceptable flag result. If batch Laboratory Control Sample is not acceptable re-analyze sample and QC.	Analyst	Accuracy/Bias	Control Limits listed in DoD QSM Table D-12.
Matrix Spike Duplicate (MSD) or Sample Duplicate	One per batch of 20 or fewer samples.	Control Limits listed in DoD QSM Table D-12.	Flag results.	Analyst	Precision	Control Limits listed in DoD QSM Table D-12.
Surrogates	One per Sample	± 50% of true value.	If a matrix interference can be identified report with a qualifying comment. If not, re-analyze to confirm matrix interference. If confirmed report with a qualifying comment.	Analyst	Accuracy/Bias	± 50% of true value.

Matrix	Soil and Sediment
Analytical Group	Explosives
Analytical Method / SOP Reference	09-8330B Soil; 1B-8330

QC Sample	Frequency / Number	Method / SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Method Blank	One per batch of 20 or fewer samples.	Less than ½ QL.	Re-analyze the blank. If still unacceptable investigate the source of contamination. Samples in the batch must be < the QL or ≥ 10x the method blank. If not, samples must be re-analyzed. If re-analysis is not possible, report with a qualifying comment	Analyst	Bias/Contamination	Less than the QL.

Matrix	Soil and Sediment					
Laboratory Control Sample (LCS)	One per batch of 20 or fewer samples.	Control Limits listed in DoD QSM Table D-13.	Re-analyze once. If still unacceptable re-analyze all associated samples. If re-analysis is not possible, report with a qualifying comment. If the LCS recoveries are biased high and sample results are <QL data is not affected and results are acceptable.	Analyst.	Accuracy/Bias	Control Limits listed in DoD QSM Table D-13.
Matrix Spike (MS)	One per batch of 20 or fewer samples.	Control Limits listed in DoD QSM Table D-13.	If batch Laboratory Control Sample is acceptable flag result. If batch Laboratory Control Sample is not acceptable re-analyze sample and QC.	Analyst	Accuracy/Bias	Control Limits listed in DoD QSM Table D-13.
Matrix Spike Duplicate (MSD) or Sample Duplicate	One per batch of 20 or fewer samples.	Control Limits listed in DoD QSM Table D-13.	Flag results.	Analyst	Precision	Control Limits listed in DoD QSM Table D-13.

Matrix	Soil and Sediment					
Surrogates	One per Sample.	± 50% of true value.	If a matrix interference can be identified report with a qualifying comment. If not, re-analyze to confirm matrix interference. If confirmed report with a qualifying comment.	Analyst	Accuracy/Bias	± 50% of true value.

Matrix	Surface Water, Groundwter, Soil and Sediment
Analytical Group	Perchlorate DataChem Laboratories, Inc.
Analytical Method / SOP Reference	SW864-6850 LC/MS-CLO4

QC Sample	Frequency / Number	Method / SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Method Blank	One per twenty or analytical batch.	Less than ½ QL.	Re-analyze the blank. If still unacceptable investigate the source of contamination. Samples must be re-analyzed.	Analyst	Bias/Contamination	Less than the QL.
Laboratory Control Sample (LCS)	One per twenty or analytical batch.	85-115% recovery.	Re-prepare and re-analyze all samples in batch.	Analyst	Accuracy/Bias	85-115% recovery.
Matrix Spike (MS)	One per twenty or analytical batch.	80-120 % recovery.	Flag data.	Analyst	Accuracy/Bias	80-120 % recovery.
Matrix Spike Duplicate (MSD)	One per twenty or analytical batch.	+/_15% RPD.	Flag data	Analyst	Precision	+/_15% RPD

SAP Worksheet #29 -- Project Documents and Records Table

(UFP-QAPP Manual Section 3.5.1)

Document	Where Maintained
Sample Collection Documents and Records Field logbook (and sampling notes) Field sample forms (e.g. boring logs, sample log sheets, drilling logs, etc.) Chain-of-custody records Sample shipment airbills Equipment calibration logs Photographs Field Task Modification Forms Sampling and Analysis Plan Field Sampling SOPs	Tetra Tech project file, results will be discussed in subject document.
Laboratory Documents and Records Sample receipt/log-in form Sample storage records Sample preparation logs Standard traceability logs Equipment calibration logs Sample analysis run logs Equipment maintenance, testing , and inspection logs Field Task Modification Reports Reported field sample results Reported results for standards, quality control checks, and quality control samples Data completeness checklists Sample storage and disposal records Telephone logs Extraction/clean-up records Raw data	Tetra Tech project file, long-term data package storage at third-party professional document storage firm (BRM), results will be discussed in subject document.
Data Assessment Documents and Records Field Sampling Audit Checklist (if an audit is conducted) Analytical Audit Checklist (if an audit is conducted) Data Validation Memoranda	Tetra Tech project file, results will be discussed in subject document.

Document	Where Maintained
Other Documents HASP All versions of SAP All versions of Reports (e.g., SI, RI, FS, etc.)	Tetra Tech project file

SAP Worksheet #30 -- Analytical Services Table

Matrix	Analytical Group	Sample Locations/ID Number	Analytical Method	Data Package Turnaround Time	Laboratory / Organization (name and address, contact person and telephone number)	Backup Laboratory / Organization (name and address, contact person and telephone number)
Aqueous	Metals	See Worksheet #18	SW-846 6010B/6020A	21 calendar days	Scott Brunk Analytical Laboratory Services, Inc. 34 Dogwood Lane Middletown, PA 17057 Phone: 800-794-7709	NA
Aqueous	VOCs	See Worksheet #18	SW-846 8260B	21 calendar days		NA
Aqueous	Perchlorate	See Worksheet #18	SW-846 6850	21 calendar days		NA
Aqueous	Explosives	See Worksheet #18	SW-846 8330B	21 calendar days		NA
Solid	Metals	See Worksheet #18	SW-846 6010B/6020A	21 calendar days		NA
Solid	VOCs	See Worksheet #18	SW-846 8260B	21 calendar days		NA
Solid	Explosives	See Worksheet #18	SW-846 8330B	21 calendar days		NA
Soil	Perchlorate	See Worksheet #18	SW-846 6850	21 calendar days		NA
Solid	CEC	See Worksheet #18	SW-846 9081	21 calendar days		NA
Solid	pH	See Worksheet #18	SW-846 9045D	21 calendar days		NA
Solid	TOC	See Worksheet #18	Lloyd Kahn	21 calendar days		NA

Matrix	Analytical Group	Sample Locations/ID Number	Analytical Method	Data Package Turnaround Time	Laboratory / Organization (name and address, contact person and telephone number)	Backup Laboratory / Organization (name and address, contact person and telephone number)
Aqueous	Perchlorate	See Worksheet #18	SW-846 6850	21 calendar days	Kevin Griffiths Data Chem Laboratories, Inc. 960 West LeVoy Drive Salt Lake City, UT 84123 Phone: 801-904-4302	NA
Soil	Perchlorate	See Worksheet #18	SW-846 6850	21 calendar days		NA

CEC - Cation Exchange Capacity
NA - Not applicable
TBD - To be determined
TOC - Total Organic Carbon
VOCs - Volatile Organic Compounds

SAP Worksheet #31 -- Planned Project Assessments Table

(UFP-QAPP Manual Section 4.1.1)

Assessment Type	Frequency	Internal or External	Organization Performing Assessment	Person(s) Responsible for Performing Assessment (title and organizational affiliation)	Person(s) Responsible for Responding to Assessment Findings (title and organizational affiliation)	Person(s) Responsible for Identifying and Implementing Corrective Action (CA) (title and organizational affiliation)	Person(s) Responsible for Monitoring Effectiveness of CA (title and organizational affiliation)
Field Supervision	Daily	Internal	Tetra Tech	Tetra Tech FOL	Tetra Tech FOL	Tetra Tech FOL and Field Crew	Tetra Tech FOL, PM, QAM
Project Supervision	Monthly	Internal	Tetra Tech	Tetra Tech PM	Tetra Tech FOL	Tetra Tech FOL	Tetra Tech PM, FOL, Program Manager
Laboratory Systems Audit	Every 18 months	External	NFESC	NFESC	Laboratory QA Manager	Laboratory QA Manager	Laboratory QA Manager
Field Sampling Systems Audit	1 per contract year	Internal	Tetra Tech	TBD	PM	Auditor and QAM Tetra Tech	QAM Tetra Tech

SAP Worksheet #32 -- Assessment Findings and Corrective Action Responses

Assessment Type	Nature of Deficiencies Documentation	Individual(s) Notified of Findings (name, title, organization)	Timeframe of Notification	Nature of Corrective Action Response Documentation	Individual(s) Receiving Corrective Action Response (name, title, organization)	Timeframe for Response
Field Supervision	Site log book	Ralph Basinski, Tetra Tech PM, Fred Ramser Tetra Tech FOL	Immediately	Entry in site log book	Ralph Basinski, Tetra Tech PM, Fred Ramser Tetra Tech FOL	24 hours
Project Supervision	Written report	John Trepanowski, Program Manager, Tetra Tech Garth Glenn, Deputy Program Manager Tetra Tech	Quarterly	Written memo	Ralph Basinski, Tetra Tech	Within a week of notification
Field sampling system audit	Audit checklist (as per IRCDQM) and written audit report	Ralph Basinski, Tetra Tech PM, Fred Ramser Tetra Tech FOL, John Trepanowski, Program Manager, Tetra Tech Garth Glenn, Deputy Program Manager Tetra Tech	Dependant on findings; if major, a stop work maybe issued immediately; if minor, within 1 week of audit	Written memorandum	Tom Johnston, QAM, Tetra Tech TBD, Auditor, Tetra Tech, Program Manager. John Trepanowski, Tetra Tech	Within 4 weeks of notification
Laboratory systems audit	Written audit report	Chris Pugliano, Laboratory QAM, ALSI	Not specified by NFESC	Letter	NFESC	Specified by NFESC

FOL - Field Operations Leader
IRCDQM - Navy Installation Restoration Chemical Data Quality Manual
NFESC - Naval Facilities Engineering Service Center
PM - Project Manager
QAM - Quality Assurance Manager

SAP Worksheet #33 -- QA Management Reports Table

(UFP QAPP Manual Section 4.2)

Type of Report	Frequency (daily, weekly monthly, quarterly, annually, etc.)	Projected Delivery Date(s)	Person(s) Responsible for Report Preparation (title and organizational affiliation)	Report Recipient(s) (title and organizational affiliation)
Data validation report	Per SDG	Within 3 weeks of receipt of complete laboratory data	DVM or designee Tetra Tech	Tetra Tech PM and Tetra Tech project file
Major analysis problem identification (Internal memo)	When persistent analysis problems are detected	Immediately	QAM Tetra Tech	Tetra Tech PM, Tetra Tech QAM, Tetra Tech Program Manager, and Tetra Tech project file
Project monthly progress report	Monthly for duration of project	Monthly	PM Tetra Tech	RPM Navy, project file
Field progress reports	Daily, oral, during the course of sampling	Everyday field sampling occurs	FOL Tetra Tech	Tetra Tech PM
Laboratory QA report	When significant plan deviations result from unanticipated circumstances	Immediately	Subcontracted laboratories	QAM or Project Chemist Tetra Tech, project file
Audit reports	In conjunction with audits	After completion of audits (usually 3 weeks)	Auditor(s)	Tetra Tech PM, Tetra Tech QAM, and audited entity

DVM - Data Validation Manager
FOL - Field Operations Leader
QAM - Quality Assurance Manager
PM - Project Manager
SDG - Sample Delivery Group

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

(UFP-QAPP Manual Section 5.2.1)

Verification Input	Description	Internal / External	Responsible for Verification (name, organization)
Chain-of-custody forms	A Tetra Tech representative will review and sign the chain-of-custody form to verify that all samples listed are included in the shipment to the laboratory and that the sample information is accurate. The forms will be signed by the sampler and a copy will be retained for the project file, the Project Manager, and the data validators. See SOP 03.	Internal	Tetra Tech, field personnel
QAPP Sample tables	Verify that all proposed samples listed in the QAPP tables have been collected.	Internal	Tetra Tech, field personnel
Sample log sheets	Verify that information recorded in the log sheets is accurate and complete.	Internal	Tetra Tech, field personnel
Sample coordinates	Verify that sample locations are correct and in accordance with the QAPP proposed locations. Take into account the potential for locations to have been updated.	Internal	Tetra Tech, field personnel
Field QC samples	Check that field QC samples listed in Worksheet #20 were collected as required.	Internal	Tetra Tech, field personnel
Chain-of-custody forms	The laboratory sample custodian will review the sample shipment for completeness, integrity, and sign accepting the shipment. The data validators will check that the chain-of-custody form was signed/dated by the Tetra Tech field personnel relinquishing the samples and also by the laboratory sample custodian receiving the samples for analyses.	Internal/ External	1 - Laboratory sample custodian 2 - Tetra Tech, data validators
Analytical data package	All analytical data packages will be verified internally for completeness by the laboratory performing the work. The laboratory QAM will sign the case narrative for each data package.	Internal	Laboratory QAM

Verification Input	Description	Internal / External	Responsible for Verification (name, organization)
Analytical data package	The data package will be verified for completeness by Tetra Tech data validators. Missing information will be requested from the laboratory and validation will be suspended until missing data are received.	External	Tetra Tech, data validators
Analytical data package and Electronic data deliverables	The electronic data will be verified against the chain-of-custody and hard copy data package for accuracy and completeness. Laboratory analytical results will be verified and compared to the electronic analytical results for accuracy. Sample results will be evaluated for laboratory contamination and will be qualified for false positives using the laboratory method/preparation blank summaries. Positive results reported between the method detection limit and the reporting limit will be qualified as estimated. Extraneous laboratory qualifiers will be removed from the validation qualifier.	External	Tetra Tech, data validators

FOL - Field Operations Leader
PM - Project Manager
QAPP - Quality Assurance Project Plan

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

(UFP-QAPP Manual Section 5.2.2)

Step IIa / IIb	Validation Input	Description	Responsible for Validation (name, organization)
IIa	Field SOPs	Ensure that all sampling SOPs were followed and that any field deviations were documented.	Tetra Tech PM, field personnel
IIa	Analytical SOPs	Ensure that the laboratory followed the analytical SOPs cited in the SAP and that any method deviations were approved by Tetra Tech and documented in the case narrative.	Tetra Tech project chemist or data validators
IIa	Chain-of-custody	Ensure that the custody and integrity of the samples was maintained from collection to analysis and that custody records are complete and any deviations are recorded	Tetra Tech project chemist or data validators
IIa	Holding times	Ensure that the samples were shipped and stored at the required temperature and sample pH for chemically-preserved samples met the requirements listed in Worksheet #19. Verify that the analyses were performed within the holding times listed in Worksheet #19.	Tetra Tech project chemist or data validators
IIa	Data results	Check the summary form results against the raw data. Check calculations for accuracy.	Tetra Tech project chemist or data validators
IIa	Standards	Ensure that the standards used in the field and laboratory are traceable and meet the contract, method, and procedural requirements .	Tetra Tech project chemist or data validators
IIa/IIb	Laboratory data results for accuracy	Ensure that the laboratory QC samples listed in Worksheet #28 were analyzed and that the measurement performance criteria listed in Worksheet #12 were met for all field samples and QC analyses. Verify that specified field QC samples were collected and analyzed and that the analytical QC criteria set up for this project were met.	Tetra Tech project chemist or data validators
IIa/IIb	Field and laboratory duplicate analyses for precision	Ensure the field sampling precision by checking the relative percent difference (RPD) for field duplicate samples. Verify the laboratory precision by checking the RPD or percent difference values from laboratory duplicate analyses; matrix spike/matrix spike duplicates; and laboratory control sample/laboratory control sample duplicates. Ensure compliance with the methods and project accuracy goals listed in Worksheets #12.	Tetra Tech project chemist or data validators
IIa/IIb	Sample results for representativeness	Ensure that the laboratory recorded the temperature at sample receipt and the pH of the chemically preserved samples.	Tetra Tech project chemist or data validators
IIb	PQLs for sensitivity	Ensure that the project quantitation limits listed in Worksheet #15 were achieved.	Tetra Tech project chemist or data validators

Step IIa / IIb	Validation Input	Description	Responsible for Validation (name, organization)
IIa/IIb	Project action limits	Discuss the impact of matrix interferences or sample dilutions performed because of the high concentrations of one or more contaminants, on the other target compounds reported as non-detected. Document this usability issue and inform the PM.	Tetra Tech project chemist or data validators
IIb	Analytical data Deviations	Determine the impact of any deviation from sampling or analytical methods and SOPs requirements and matrix interferences effect on the analytical results.	Tetra Tech project chemist or data validators

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

Step IIa / IIb	Matrix	Analytical Group	Validation Criteria	Data Validator
IIa and IIb	Aqueous and Solid	Metals	Criteria for SW-846 6010B/6020A listed in Worksheets #12, #15, #24, #25, and #28, DOD QSM (January 2006). If not included in the aforementioned the logic outlined in U.S. EPA Region 3 Modifications to the Laboratory Data Validation Functional Guidelines for Evaluating Inorganic Analyses (April 1993) should be used to apply qualifiers to data.	Data Validation Specialist (Tetra Tech)
IIa and IIb	Aqueous and Solid	VOCs	Criteria for SW-846 8260B listed in Worksheets #12, #15, #24, #25, and #28, DOD QSM (January 2006). If not included in the aforementioned the logic outlined in U.S. EPA Region 3 Modifications to the Laboratory Data Validation Functional Guidelines for Evaluating Organic Analyses (September 2004) should be used to apply qualifiers to data.	Data Validation Specialist (Tetra Tech)

Step IIa / IIb	Matrix	Analytical Group	Validation Criteria	Data Validator
IIa and IIb	Aqueous and Solid	Explosives	Criteria for SW-846 8330B listed in Worksheets #12, #15, #24, #25, and #28, DOD QSM (January 2006). If not included in the aforementioned the logic outlined in U.S. EPA Region 3 Modifications to the Laboratory Data Validation Functional Guidelines for Evaluating Organic Analyses (September 2004) should be used to apply qualifiers to data.	Data Validation Specialist (Tetra Tech)
IIa and IIb	Solid	TOC, CEC, and pH	Method-specific criteria listed in Worksheets #12, #15, #24, #25, and #28.	Data Validation Specialist (Tetra Tech)

CEC - Cation exchange capacity
TOC - Total organic carbon
VOC - Volatile organic compound

SAP Worksheet #37 -- Usability Assessment

(UFP-QAPP Manual Section 5.2.3)

Data Usability Assessment

The usability of the data directly affects whether project objectives can be achieved. The following characteristics will be evaluated at a minimum. The results of these evaluations will be included in the project report. The characteristics will be evaluated for multiple concentration levels if the evaluator determines that this is necessary. To the extent required by the type of data being reviewed, the assessors will consult with other technically competent individuals to render sound technical assessments of these data characteristics:

Completeness

- For each matrix that was scheduled to be sampled, the FOL acting on behalf of the project team will prepare a table listing planned samples/analyses to collected samples/analyses. If deviations from the scheduled sample collection or analyses are identified, the Tetra Tech PM and risk assessor will determine whether the deviations compromise the ability to meet project objectives. If they do, the Tetra Tech PM will consult with the Navy RPM and other project team members, as necessary (determined by the Navy RPM), to develop appropriate corrective actions.

Precision

- The Project Chemist acting on behalf of the project team will determine whether precision goals for field duplicates and laboratory duplicates were met. This will be accomplished by comparing duplicate results to precision goals identified in Worksheets 12 and 28. This will also include a comparison of field and laboratory precision with the expectation that field duplicate results will be no less precise than laboratory duplicate results. If the goals are not met, or data have been flagged as estimated (J qualifier), limitations on the use of the data will be described in the project report.

Accuracy

- The Project Chemist acting on behalf of the project team will determine whether the accuracy/bias goals were met for project data. This will be accomplished by comparing percent recoveries of LCS, laboratory control sample duplicate (LCSD), MS, MSD, and surrogate compounds to accuracy goals identified in Worksheet 28. This assessment will include an

evaluation of field and laboratory contamination; instrument calibration variability; and analyte recoveries for surrogates, matrix spike, and laboratory control samples. If the goals are not met, limitations on the use of the data will be described in the project report. Bias of the qualified results and a description of the impact of identified non-compliances on a specific data package or on the overall project data will be described in the project report.

Representativeness

- A project scientist identified by the Tetra Tech PM and acting on behalf of the project team will determine whether the data are adequately representative of intended populations, both spatially and temporally. This will be accomplished by verifying that samples were collected and processed for analysis in accordance with the SAP, by reviewing spatial and temporal data variations, and by comparing these characteristics to expectations. The usability report will describe the representativeness of the data for each matrix and analytical fraction. This will not require quantitative comparisons unless professional judgment of the project scientist indicates that a quantitative analysis is required.

Comparability

- The Project Chemist acting on behalf of the project team will determine whether the data generated under this project are sufficiently comparable to historical site data generated by different methods and for samples collected using different procedures and under different site conditions. This will be accomplished by comparing overall precision and bias among data sets for each matrix and analytical fraction. This will not require quantitative comparisons unless professional judgment of the Project Chemist indicates that such quantitative analysis is required.

Sensitivity

- The Project Chemist acting on behalf of the project team will determine whether project sensitivity goals listed in Worksheet 15 are achieved. The overall sensitivity and quantitation limits from multiple data sets for each matrix and analysis will be compared. If sensitivity goals are not achieved, the limitations on the data will be described. The Project Chemist will enlist the help of the project risk assessor to evaluate deviations from planned sensitivity goals.

Project Assumptions and Data Outliers

- The Tetra Tech Project Manager and designated team members will evaluate whether project assumptions were valid. This will typically be a qualitative evaluation but may be supported by quantitative evaluations. The type of evaluation depends on the assumption being tested.

Quantitative assumptions include assumptions related to data distributions (e.g., Normal versus log-normal) and estimates of data variability. Potential outliers will be removed if a review of the associated documentation indicates that the results have an assignable cause that renders them inconsistent with the rest of the data. During this evaluation, the team will consider whether outliers could be indications of unanticipated site conditions.

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

After completion of the data validation (data validation procedures are presented in Worksheets 35 and 36), the data and data quality will reviewed to determine whether sufficient data of acceptable quality are available for decision making. In addition to the evaluations described above, a series of inspections and statistical analyses will be performed to estimate these characteristics. The statistical evaluations will include simple summary statistics for target analytes, such as maximum concentration, minimum concentration, number of samples exhibiting non-detected results, number of samples exhibiting positive results, and the proportion of samples with detected and non-detected results. The project team members identified by the project manager will assess whether the data collectively support the attainment of project objectives. They will consider whether any missing or rejected data have compromised the ability to make decisions or to make the decisions with the desired level of confidence. The data will be evaluated to determine whether missing or rejected data can be compensated by other data. Although rejected data will generally not be used, there may be reason to use them in a weight of evidence argument, especially when they supplement data that have not been rejected. If rejected data are used, their use will be supported by technically defensible rationales.

For statistical comparisons and mathematical manipulations, non-detected values will be represented by a concentration equal to one-half the sample-specific reporting limit. Duplicate results (original and duplicate) will not be averaged for the purpose of representing the range of concentrations. However, the average of the original and duplicate samples will be used to represent the concentration at a particular sampled location.

Identify the personnel responsible for performing the usability assessment:

The Tetra Tech PM, Project Chemist, FOL, and Project Scientist will be responsible for conducting the listed data usability assessments. The data usability assessment will be reviewed with the Navy RPM, the U.S. EPA Remedial Project Manager, and the state of Maryland PM. The review will take place either

in a face to face meeting or a teleconference depending on the extent of identified deficiencies. If no significant deficiencies are identified, the data usability assessment will simply be documented in the project report and reviewed during the normal document review cycle.

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

The data will be presented in tabular format, including data qualifications such as estimation (J, UJ) or rejection (R). Written documentation will support the non-compliance estimated or rejected data results. The project report will identify and describe the data usability limitations and suggest re-sampling or other corrective actions, if necessary.

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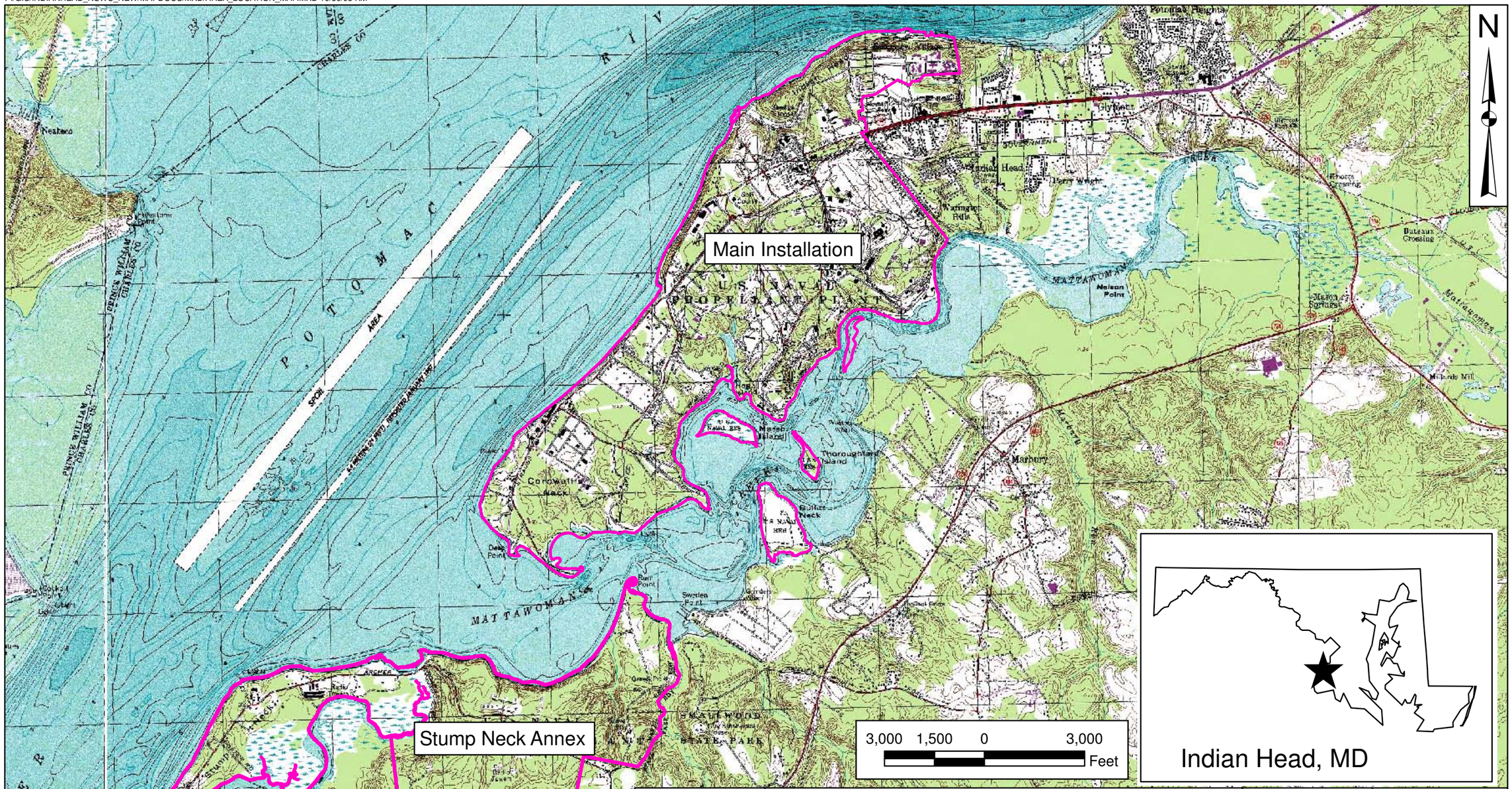

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COST/SCHEDULE-AREA			APPROVED BY — / DATE —
SCALE AS NOTED			FIGURE NO. FIGURE 1-1 / REV 0

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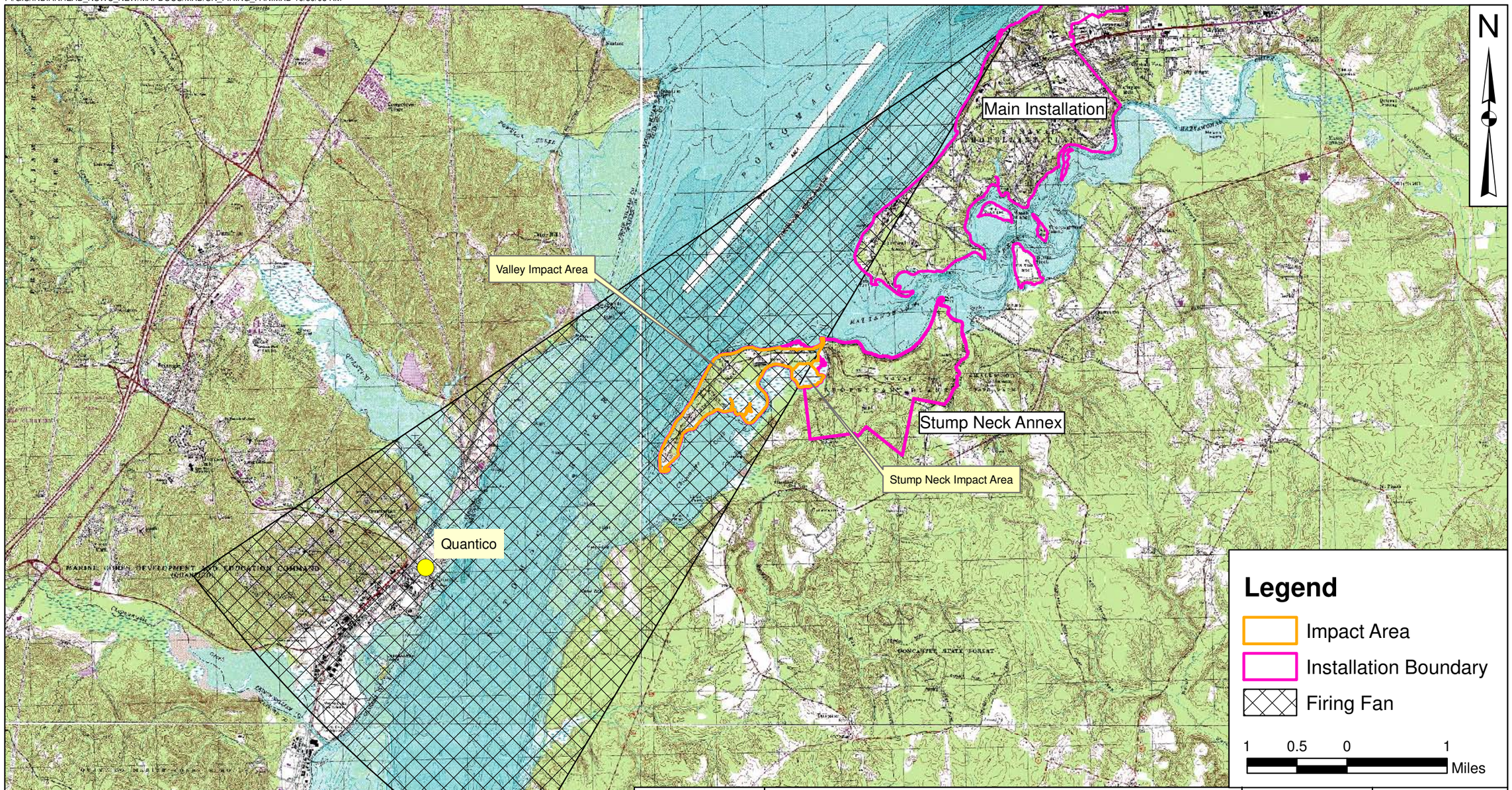

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COST/SCHEDULE-AREA		NAVAL SUPPORT FACILITY INDIAN HEAD	APPROVED BY	DATE
		INDIAN HEAD, MARYLAND	—	—
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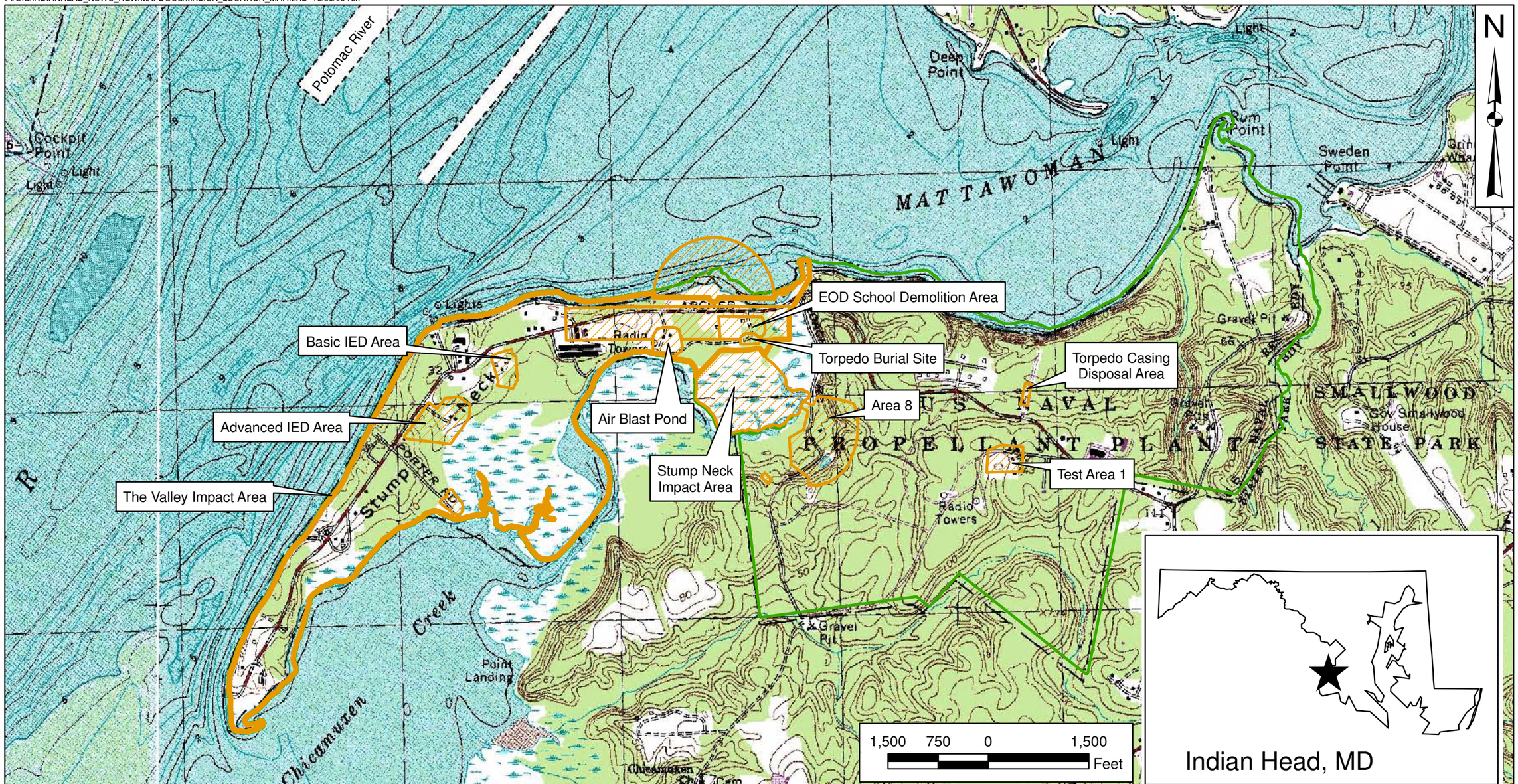

Legend

- MRP Site Boundary for Valley Impact Area
- MRP Site Boundary
- Installation Boundary

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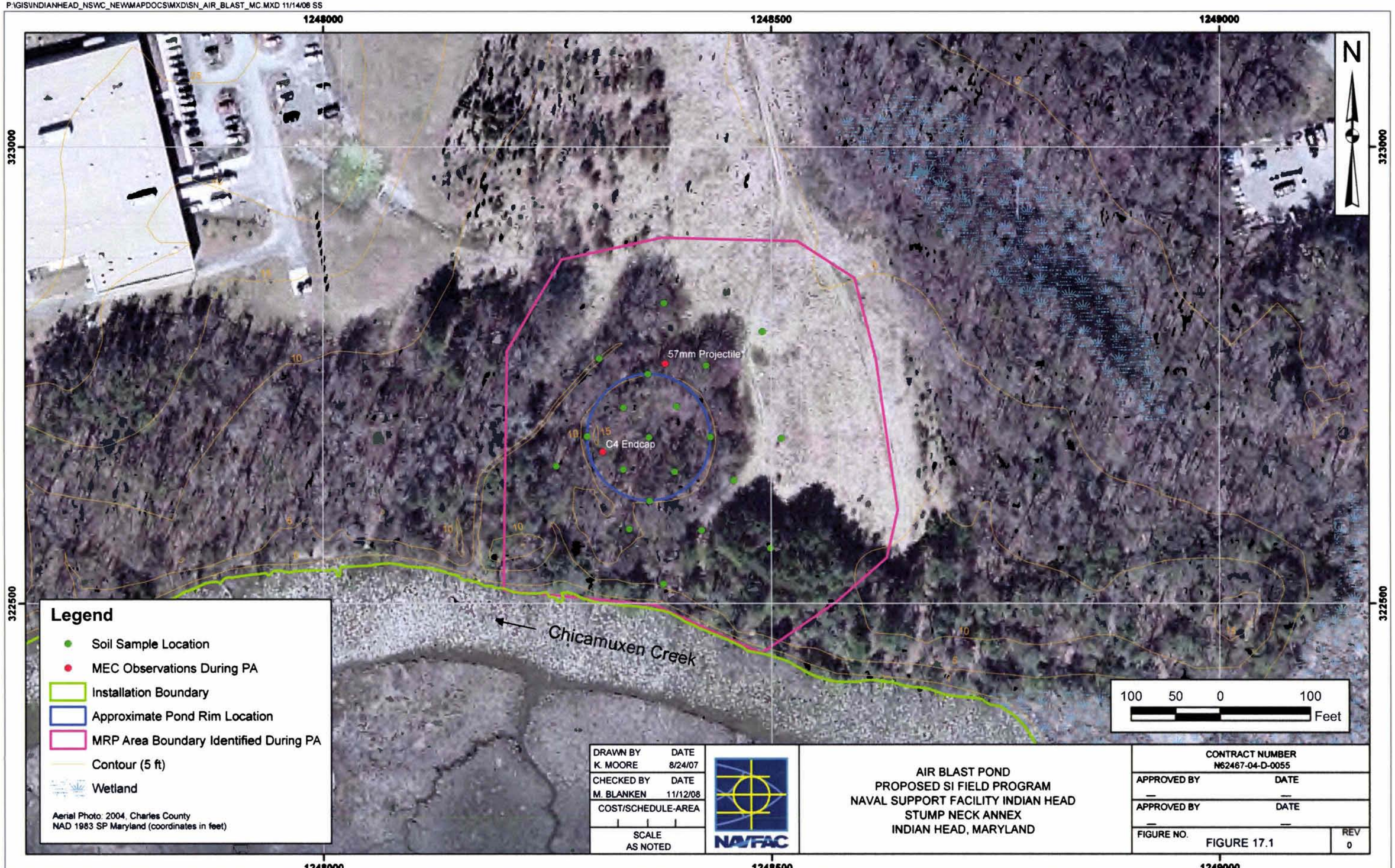

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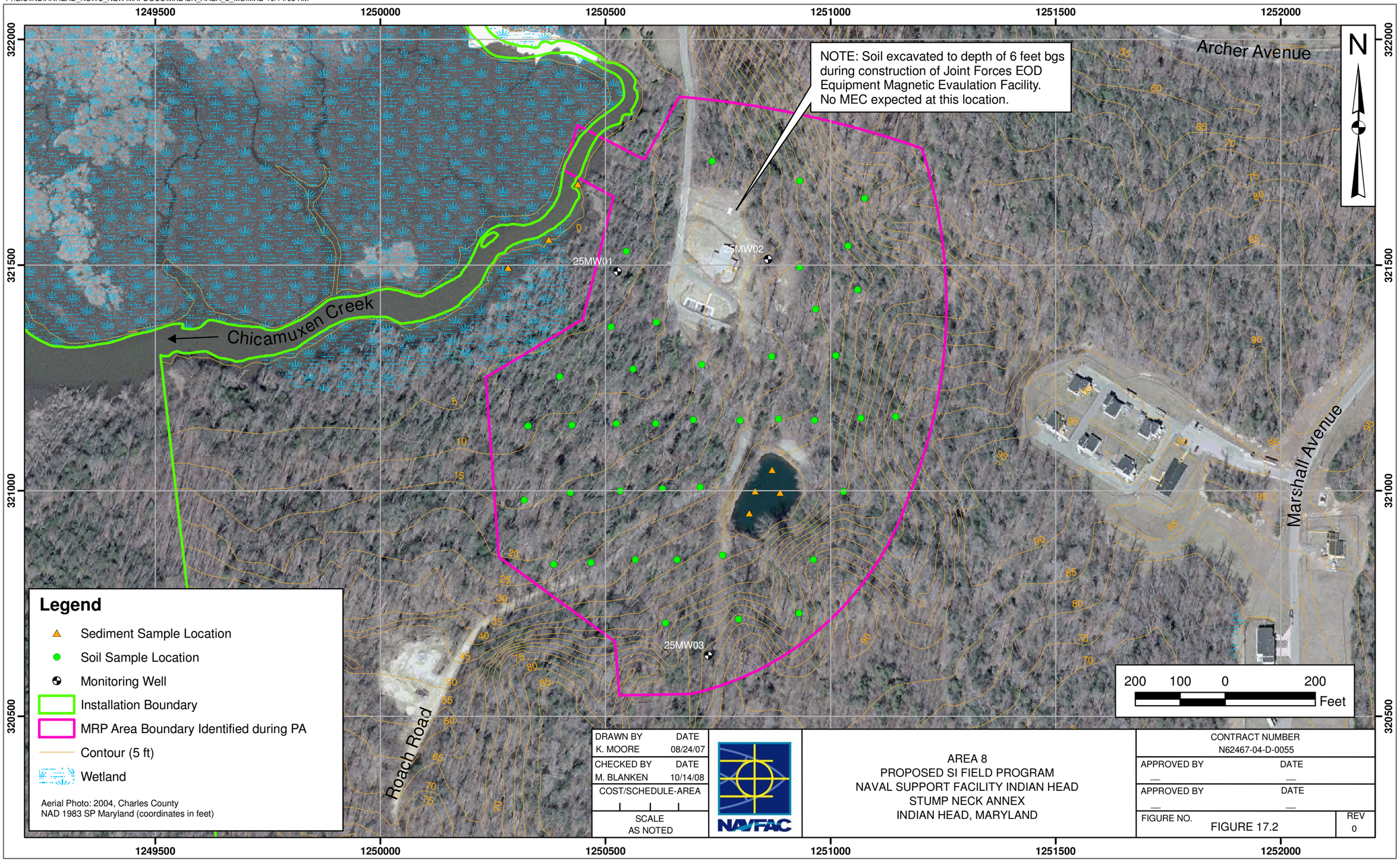

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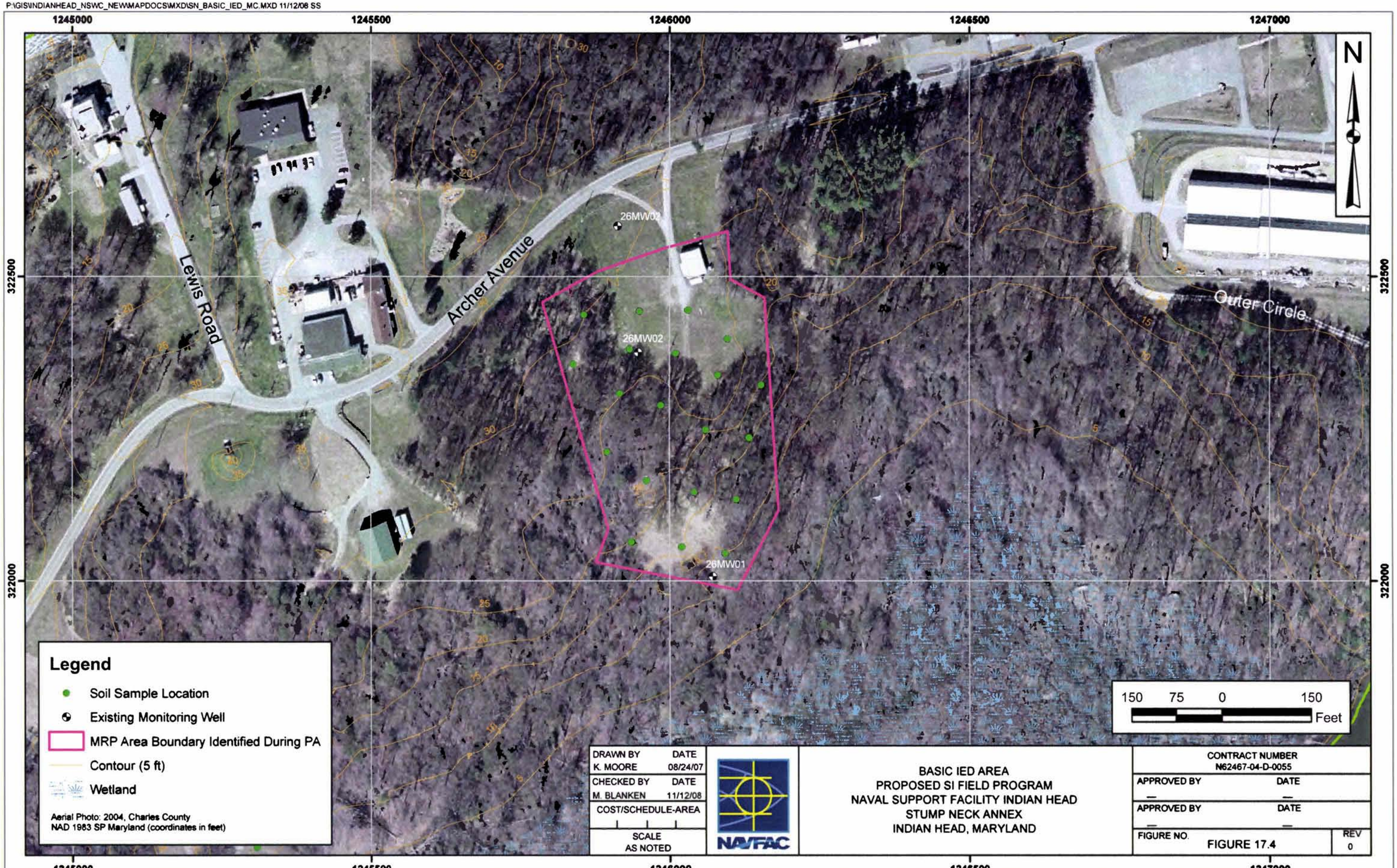

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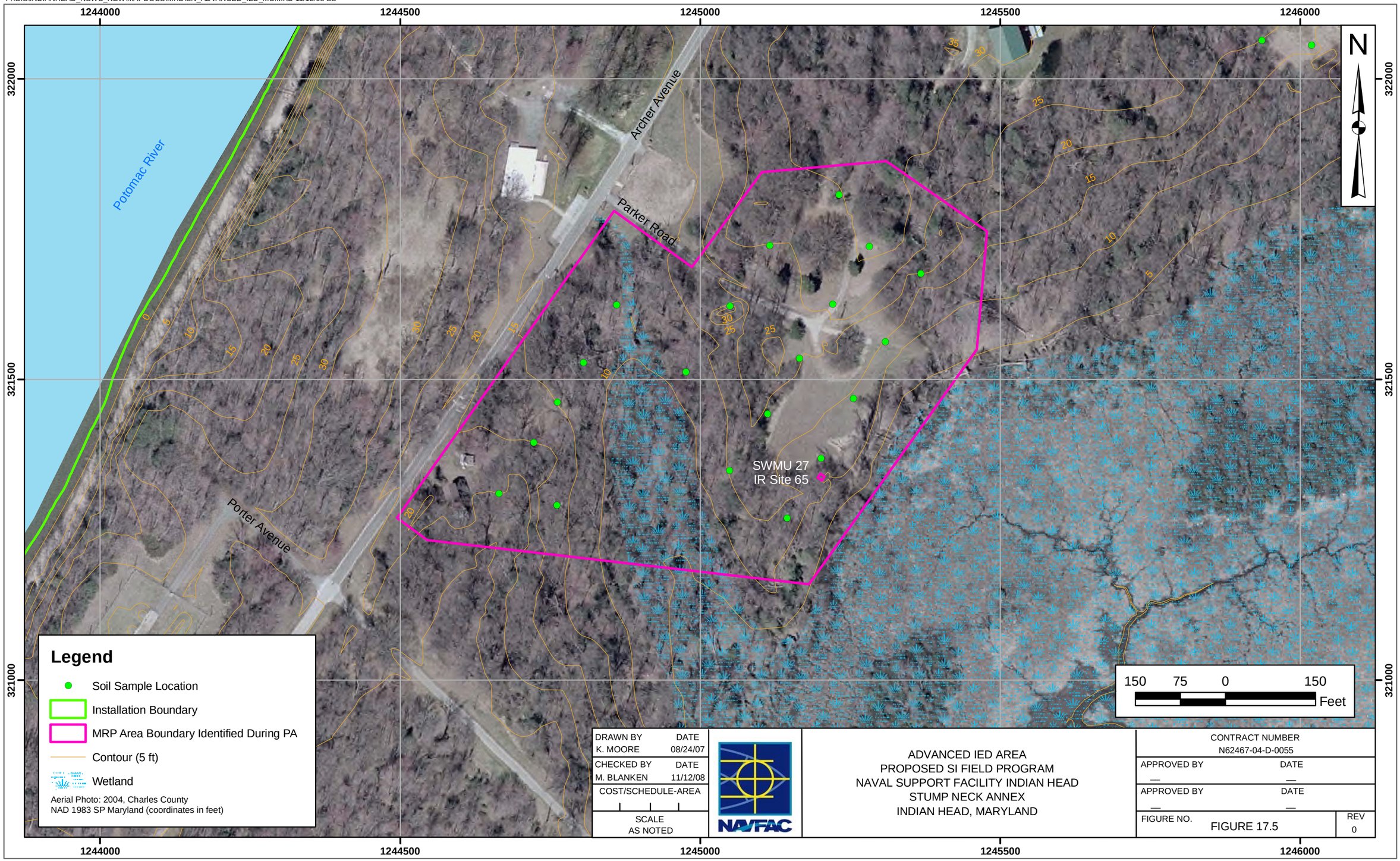

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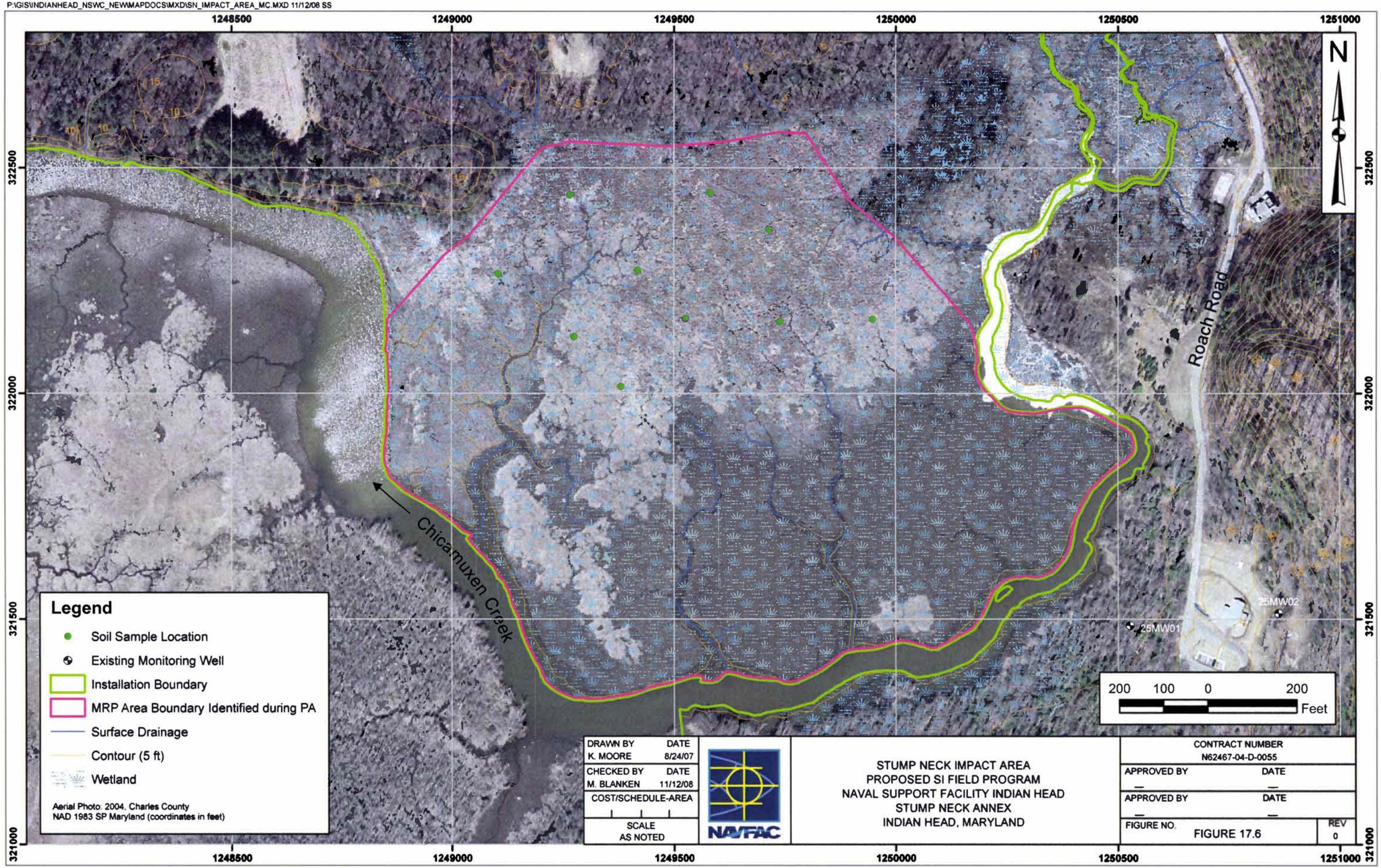

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TEST AREA 1
PROPOSED SI FIELD PROGRAM
NAVAL SUPPORT FACILITY INDIAN HEAD
STUMP NECK ANNEX
INDIAN HEAD, MARYLAND

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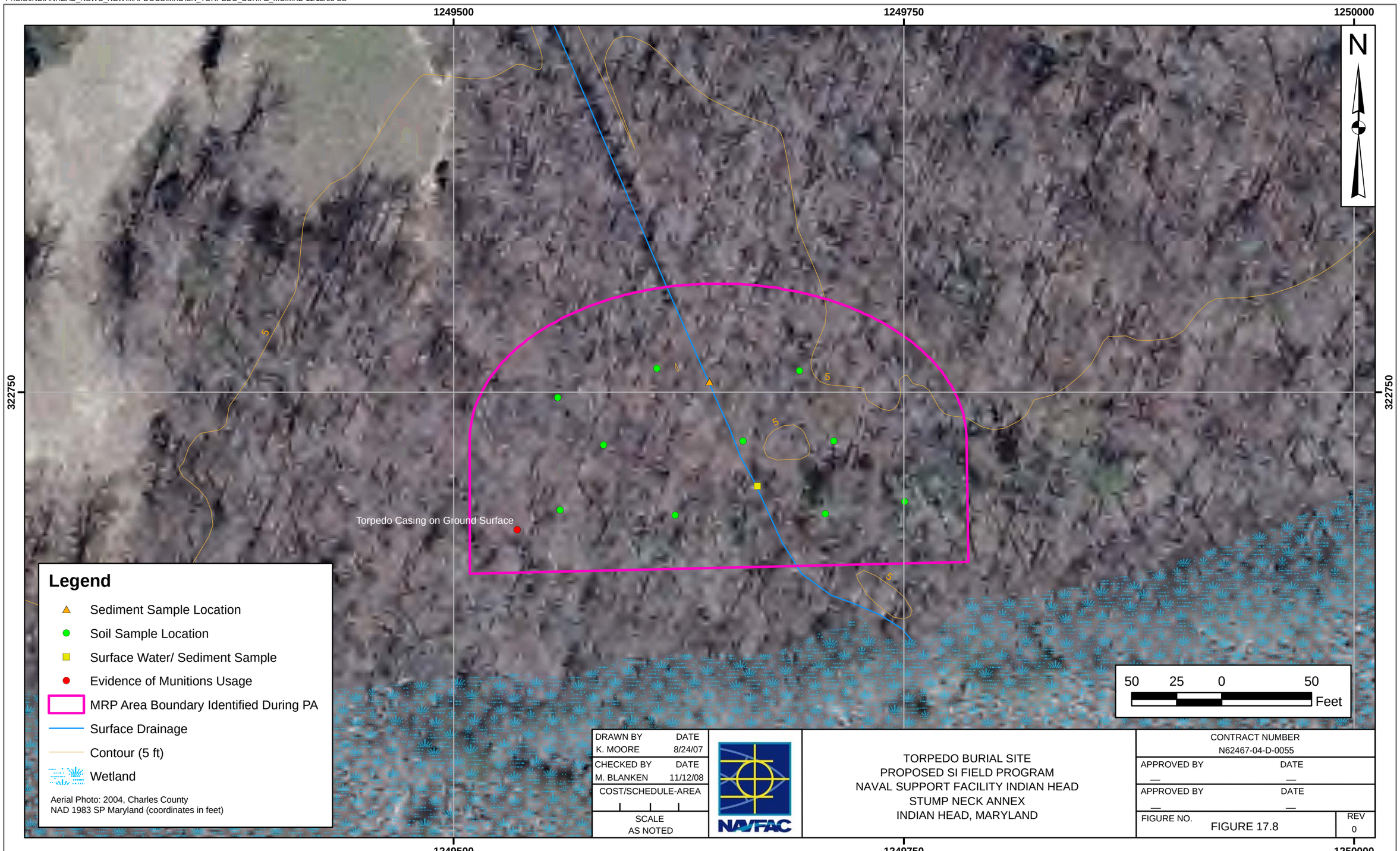

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TORPEDO BURIAL SITE
PROPOSED SI FIELD PROGRAM
NAVAL SUPPORT FACILITY INDIAN HEAD
STUMP NECK ANNEX
INDIAN HEAD, MARYLAND

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TORPEDO CASING DISPOSAL AREA
PROPOSED SI FIELD PROGRAM
NAVAL SUPPORT FACILITY INDIAN HEAD
STUMP NECK ANNEX
INDIAN HEAD, MARYLAND

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APPENDIX A

UFP SAP FOR MEC

CONTAINED IN VOLUME II OF II

APPENDIX B

CONCEPTUAL SITE MODEL

APPENDIX B: CONCEPTUAL SITE MODEL

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SAP Worksheet #10 Appendix -- Problem Definition, Site History and Background

(UFP-QAPP Manual Section 2.5.2)

This Worksheet 10 Appendix presents a detailed conceptual site model (CSM) for each of the 10 MEC sites located at the NSF Indian Head - Stump Neck Annex. The CSM is a description of a site and its environment that is based on existing knowledge. It describes the sources of MEC at a site; actual, potentially complete, and incomplete exposure pathways; current and reasonable proposed future uses of the property; and potential receptors. The source-receptor interaction is a descriptive output of a CSM.

The initial CSMs were developed as part of the Preliminary Assessment (PA) Report (Malcolm Pirnie, 2005), which is one of the initial steps in the CERCLA process. The CSMs, which were presented in the PA Report, have been reviewed and modified as necessary based on additional information obtained during the Tetra Tech site visits and scoping meetings conducted during the preparation of this UFP SAP for the SI. The CSMs for each of the sites will be updated as additional information is obtained. Updated versions of the CSMs, which incorporate data obtained in the SI field effort, will be presented in the report prepared after all SI fieldwork is completed.

This introductory section for Problem Definition, Site History and Background includes general information on the site background and facility history and general descriptions of the geology, hydrology, endangered species, cultural settings, and natural resources on an installation-wide basis at the Stump Neck Annex. The Problem Definition for each of the 10 sites addressed in this UFP SAP has been prepared and is presented here to more completely describe the CSM and define the problem for each of the 10 MEC sites (Sections 10.1 through 10.10 of this appendix). This appendix includes the Problem Definition in terms of the site-specific CSM and contains in detail the initial step (Step 1) of the DQO process, with site-specific maps for each site. A brief summary of the problem, which is detailed in this appendix for each of the 10 MEC sites, is included in Sections 10.1 through 10.10.

10-1 GENERAL INTRODUCTION AND PROBLEM DEFINITION FOR WORKSHEET #10 APPENDIX

The Navy has conducted various testing, training, and disposal activities related to military munitions at the Stump Neck Annex, NSF Indian Head, Maryland, since it was established in 1890 as a Naval Ordnance Station. The general locations of the NSF Indian Head Main Installation and Stump Neck Annex are shown on Map 10-1. NSF Indian Head is located in northwestern Charles County, Maryland, approximately 25 miles southwest of Washington, D.C. The Stump Neck Annex covers approximately 1,100 acres on the Stump Neck peninsula at the confluence of the Potomac River and Chicamuxen

Creek in Charles County, Maryland. Stump Neck Annex was acquired by the Navy in 1901 to support activities at the 2,300-acre Indian Head Main Installation. These two Navy properties are not contiguous; the Indian Head Main Installation is northeast of the Stump Neck Annex across Mattawoman Creek. General Smallwood State Park and private property parcels are located east and southeast, respectively, of Stump Neck Annex, and the Chicamuxen Wildlife Management Area (WMA) is to the south across Chicamuxen Creek.

The Valley Impact Area and Stump Neck Impact Area are both located on the Stump Neck Annex (Map 10-2). These two areas received fire from the Valley Gun Proving Site located on the Main Installation of NSF Indian Head from 1891 through 1921. Various caliber guns (4-inch through 16-inch) were fired into these two areas. The projected firing fan from the Main Installation to the impact areas covers several of the sites discussed in this UFP SAP. In addition to fire from the gun proving site, the Stump Neck Impact Area received impacts from a firing range set up in the vicinity of Rum Point. Marine Corps Base (MCB) Quantico was also permitted to fire large artillery at the Stump Neck Annex for several years until 1934.

As a result of the Navy's explosives and munitions training activities, MEC may be present at various sties throughout the Stump Neck Annex. The term MEC includes Discarded Military Munitions (DMM), Unexploded Ordnance (UXO), and MC in high enough concentrations to pose an explosive hazard. This UFP SAP will cover the 10 sites presented in Table 10-1. A separate UFP SAP has been prepared to investigate five small arms ranges located on the Stump Neck Annex. The Navy is following the CERCLA process for the investigation of these sites.

The initial phase of the CERCLA process, the PA Report, was completed in September 2005 and identified 17 "other than operational range sites" or Munitions Response Areas/Munitions Response Sites (MRA/Ss) at the Stump Neck Annex for further investigation (Malcolm Pirnie, 2005). Closed, transferred, and transferring military ranges and sites not located on an operational range are considered "other than operational." Two of the sites identified in the PA Report, the Old Demolition Area and Test Area 2, are considered to be currently active sites and are therefore not included in this UFP SAP.

The locations of the 10 sites presented in this UFP SAP are shown on Map 10-3. The Malcolm Pirnie (2005) PA Report used five primary sources of information to support the facility data collection effort, including historical archives, personal interviews, installation data repositories [including the Administrative Record (AR)], visual surveys, and off-facility data sources and repositories such as local libraries and museums. Table 10-1 summarizes the 10 sites at the Stump Neck Annex that are further discussed in this UFP SAP.

10-2 GENERAL STUMP NECK ANNEX PROBLEM DEFINITION INFORMATION

Established in 1890, NSF Indian Head is the Navy's oldest ordnance station. Throughout its long and distinguished history, the facility has proved guns, armor, and propellants, developed and manufactured powder and propellants, and is recognized as a leader in energetics research and development. Shortly after operations commenced, additional property was acquired by the Navy to increase the size of the installation. The most notable acquisition was of Stump Neck Annex as an impact area and safety buffer in 1901.

With the opening of the nearby Dahlgren Naval Proving Ground in the early 1930s, the primary focus of Indian Head turned to powder manufacturing. Additional acquisition and improvement to the installation continued through the 1960s to increase operational capacity and safety buffers required for the manufacture, testing, and storage of energetic materials.

Stump Neck Annex has played a key role in the development of Explosive Ordnance Devise (EOD) research and training. In 1941, Stump Neck Annex was chosen as an isolated location for the practical instruction syllabus associated with the Navy's Advanced Mine School in Washington, D.C. The remote location and proximity to the new Explosives Investigation Laboratory (Main Installation) made Stump Neck an ideal choice.

Shortly thereafter, the requirements for "bomb disposal," ordnance demilitarization (enemy and allied), and reverse engineering of foreign ordnance grew increasingly important, mainly due to World War II. The newly formed EOD unit at Stump Neck Annex responsible for these tasks had grown such that individual EOD detachments could be deployed for mission support. Stump Neck Annex could then be used to support the powder plant and a school for EOD officers and enlisted personnel. In 1953, the Naval EOD Technical Center was formed at the Stump Neck Annex with the purpose of training EOD personnel in all service branches. The training function was renamed the Naval School, Explosive Ordnance Disposal (NAVSCOLEOD). In 1993, the Naval EOD Technical Center was renamed the Naval Explosive Ordnance Disposal Technical Division (NAVEODTECHDIV), a division of the newly established Naval Ordnance Center. The NAVEODTECHDIV operated until 1999, at which time it was relocated to Eglin Air Force Base, Florida. Stump Neck Annex is home to the Improvised Explosive Device (IED) School where research is conducted on render safe technologies for items encountered in hostile situations by law enforcement and security personnel. EOD Technology Division is a tenant of Stump Neck Annex. Their mission is to utilize technology to develop and deliver EOD information, tools, and equipment and to meet the needs of Joint Services EOD operating forces and other customers.

In recent decades, NSF Indian Head has come to be known as a center of excellence in the development and manufacturing of specialized energetic materials used in demolition and propulsion. Now under the direction of the Naval Sea Systems Command (NAVSEA), the current mission of NSF Indian Head is as follows:

- To provide services in energetics for all warfare centers through engineering, fleet and operational support, manufacturing technology, limited production, and industrial base support.

- To provide research, development, testing, and evaluation of energetic materials, ordnance devices and components, and other engineering standards including chemicals, propellants, propulsion systems, explosives, pyrotechnics, warheads, and simulators.

- To provide support to all warfare centers, military departments, and the ordnance industry for special weapons, explosives safety, and ordnance environmental issues.

Table 10-2 summarizes the key milestones in the history of NSF Indian Head.

10-3 PHYSICAL AND ENVIRONMENTAL CHARACTERISTICS

The following sections provide general information for Stump Neck Annex including climate, topography, geology, soil and vegetation types, hydrology, hydrogeology, cultural and natural resources, and threatened, endangered, and protected species.

10-3.1 Climate

Stump Neck Annex, located on the eastern shore of the Potomac River in Charles County, Maryland, has a continental-type climate with four well-defined seasons. Located in the middle latitudes of North America, atmospheric flow is from west to east. The Potomac River and its tributaries significantly affect the climate, moderating extreme temperatures and causing higher humidity in the region. In the winter, the Blue Ridge and Appalachian mountain ranges located west of the Stump Neck Annex obstruct the cold, continental air. The coldest period occurs in late January and early February, with low temperatures averaging 29 degrees Fahrenheit (ºF). July is the warmest month, with average high temperatures of 85ºF. Annual precipitation is well distributed, with July and August as the wettest months. Average annual precipitation is 44 inches. Maximum snow accumulation averages 9 inches between November and March. The growing season lasts approximately 190 days, starting in mid-April.

10-3.2 Topography

NSF Indian Head occupies two peninsulas along the eastern shore of the Potomac River. The Stump Neck Annex is on the southern peninsula, and the Main Installation is located on the northern peninsula. The two peninsulas are separated by Mattawoman Creek. The general topography of the mainland areas of Charles County can be described as gently rolling lands with a few steep slopes. These areas include many drainage swales and streams. Shoreline areas at NSF Indian Head are generally steeply sloped.

The Stump Neck Annex has a relatively low topographic profile. The highest point is the northeastern portion of the peninsula at an elevation of approximately 140 feet above mean sea level (msl). The lowest points lie along the shorelines of the Stump Neck Annex adjacent to Mattawoman Creek and Chicamuxen Creek. These areas are mostly flat, tidal marsh areas, although several 50- to 60-foot bluffs exist along Mattawoman Creek.

10-3.3 Geology

The Stump Neck Annex lies within the Atlantic Coastal Plain Physiographic Province 8 to 10 miles east of the Fall Line that marks the western extent of the physiographic province. The regional geology consists of a sedimentary wedge of Cretaceous to Quaternary fluvial and marine deposits overlying crystalline Precambrian metamorphic and igneous bedrock. The sedimentary wedge dips and thickens eastward and ranges in thickness from 550 feet to 900 feet in the vicinity of the Stump Neck Annex (Vroblesky and Fleck, 1991; Hiortdahl, 1990). These sedimentary deposits lie unconformably on the crystalline basement rock surface, which dips to the east. The geologic units underlying NSF Indian Head, in stratigraphically ascending order, are the Lower Cretaceous Potomac Group, Tertiary Aquia Formation of the Pamunkey Group, fluvial-estuarine deposits of Tertiary to early Quaternary age, and undivided Quaternary deposits.

The lithology of the Potomac Group consists of interbedded clay, silt, sand, and gravel deposited in fluviodeltaic environments (Hiortdahl, 1990). The Potomac Group ranges in thickness from 650 to 750 feet in the vicinity of the Stump Neck Annex (Vroblesky and Fleck, 1991; Harsh and Laczniak, 1990) and consists of three geologic units (in ascending stratigraphic order): the Patuxent Formation, Arundel Formation, and Patapsco Formation. The Patuxent Formation consists of sand and pebbles with thin clay interbeds and is 300 to 400 feet thick in the study area. The Arundel Formation generally consists of a massive clay with abundant lignite and siderite concretions and is less than 100 feet thick beneath most of the study area. The Patapsco Formation generally consists of sand and silt separated by thick clay layers. The interpreted thickness of the Patapsco Formation in the study area varies from about 200 feet to more than 450 feet (Hiortdahl, 1997).

The Aquia Formation (Upper Paleocene) consists of marine deposits of olive black to olive gray, micaceous, glauconitic quartz sand interbedded with sand, silt, and clay. The formation is 0 to 80 feet thick in the NSF Indian Head peninsula area. The younger units of the Pamunkey Group and the Chesapeake Group have been removed by erosion in the study area.

Overlying the Aquia Formation are fluvial-sedimentary deposits consisting of gravel, sand, and loam. These sediments are referred to as “upland deposits” and range in age from Pliocene to early Pleistocene (Hiortdahl, 1997). The upland deposits crop out at the surface in the northern portion of NSF Indian Head where surface elevations exceed 40 feet above msl. However, beneath most of the study area, the surficial sediments consist of Pleistocene paleochannel deposits and Holocene alluvial and paludal deposits (Hiortdahl, 1997). These deposits consist of gravel, sand, silt, clay, and peat mixtures with irregular bedding and with an aggregate thickness of 0 to approximately 40 feet. The Aquia Formation and younger upland deposits are missing in many locations in the NSF Indian Head peninsula area due to erosion and deposition in Pleistocene and Holocene paleochannels. Where this occurs, the overlying Quaternary deposits directly overlie the Cretaceous formations.

10-3.4 Soil and Vegetation Types

Charles County is located in the inner Potomac Coastal Plain geologic province. The soils in this area are derived from unconsolidated marine sediments that vary from sandy to clayey in texture and from excessively well drained to poorly drained. Hydric and erodible soils are prevalent. High water tables, severe erosion, earthslides, and hardpans are common.

The United States Department of Agriculture (USDA) mapped the soils of the Stump Neck Annex in the Soil Survey of Charles County, Maryland (1974). The main soil series in this area are the Beltsville, Keyport, and Elkton silt loams. Additional soil types found at the Stump Neck Annex include cut-and-fill land, gravelly land, tidal marsh, and Mattawan soil. The following discussion is a description of the soil types at the Stump Neck Annex.

The eastern area of the Stump Neck Annex is primarily composed of Beltsville silt loam, with a small area of gravelly land. Beltsville series soils consist of silt and sand with moderate amounts of clay. They are nearly level to moderately sloping, moderately deep, strongly acidic, slowly permeable, and well drained. Gravelly land is composed of gravelly deposits with unidentifiable soil types due to severe erosion.

The western and central areas of the peninsula are primarily composed of tidal marsh and Keyport silt loam. Tidal marshes consist of materials ranging from sand to clay, with occurrences of peat and muck. The Keyport silt loam is a clayey silt loam that is slowly permeable.

A small area in the western end of the Stump Neck Annex is comprised of Mattawan loamy sand and cut-and-fill land. The Mattawan Series consists of soils that are nearly level to gently sloping, moderately well drained to well drained, and slowly permeable. These soils formed on uplands in a sandy mantle over loamy sediment. Cut-and-fill lands are areas where native soils have been removed and graded or filled with other material or soil.

The land around the Stump Neck Annex is heavily vegetated. There are five basic vegetation types present including pine, hardwood, pine-hardwood mix, tidal and non-tidal wetlands, and urban landscape. The hardwoods and pine-hardwood mix can be further subdivided into upland and wetlands divisions. Most of the forested land is either second or third growth; little, if any, virgin forest remains. The most abundant trees are Virginia pine, sweet gum, red oak, and yellow poplar.

Hardwood forest dominates approximately 1,075 acres (nearly 50 percent) of NSF Indian Head. Species common to the upland portions of hardwood forests include red, white, and chestnut oak, tulip poplar, and hickories. The wetland portion is typically comprised of red maple, sweet gum, green ash, and American sycamore.

Along the shoreline of the Potomac River, the following species are common: black persimmon, grape, sea myrtle, false indigo, poison ivy, Virginia creeper, and phlox. In addition, the following grasses are present: gama grass, panic grass, bermuda grass, and finger grass. Marsh areas dominate along the shores of Mattawoman Creek, and they are characterized by jewelweed, alger, marsh cattail, weedgrass, sedge, three square bulrush, wild rice, saltmarsh cordgrass, smartweed, and marsh mallow.

10-3.5 Hydrology

The three primary waterways in the area are the Potomac River, Mattawoman Creek, and Chicamuxen Creek. The Potomac River and Mattawoman Creek border the Main Installation, and the Potomac River, Mattawoman Creek, and Chicamuxen Creek border the Stump Neck Annex. The Potomac River is a continuous, slow-moving, slightly brackish, tidal tributary to the Chesapeake Bay. Mattawoman Creek and Chicamuxen Creek are tributaries to the Potomac River and are also tidally influenced. Both have large floodplains and contain large expanses of tidal wetlands and swamps. Many small streams cross the area, most of which drain directly into one of the three major waterways.

The Stump Neck Annex is bordered by and contains large tracts of both tidal and non-tidal wetlands. Wetlands and floodplains are valuable habitats for wildlife, important groundwater recharge areas, and filters for surface water runoff, thus minimizing siltation and erosion. They are also important aesthetic buffers, scientific resources, and in some cases, recreational areas.

Based on the drainage divides presented in the 1983 Initial Assessment Study (IAS) conducted at NSF Indian Head, the majority of the natural drainage at the Stump Neck Annex flows to both Mattawoman Creek and Chicamuxen Creek (Hart, 1983). Treated wastewater effluent is discharged directly to the Potomac River or Mattawoman Creek and is also discharged from outfalls to tributaries of these two waterways. The wastewater consists of industrial, sanitary, and storm effluents or combinations thereof.

10-3.6 Hydrogeology

The hydrogeologic framework of the Indian Head area consists of a surficial aquifer and three major underlying confined aquifers: the lower Patapsco aquifer, upper Patuxent aquifer, and lower Patuxent aquifer. The upper Patapsco aquifer is considered a poor producer of groundwater in the area and is not considered to be a major aquifer at NSF Indian Head. Rather than continuous bodies of sands, the individual confined aquifers consist of multiple sand layers interbedded with lower permeability layers. The aquifers are described in detail below.

Shallow, unconfined to semi-confined groundwater at NSF Indian Head occurs in the surficial aquifer from near surface to approximately 45 feet below ground surface (bgs), with water table elevations ranging from sea level to approximately 65 feet above msl. Depending on location, the surficial aquifer is composed of Quaternary paleochannel deposits, Tertiary to Quaternary upland deposits, the Aquia Formation, or sediments of the Patapsco Formation. Typically, shallow groundwater occurs in perched water-bearing zones and is recharged from infiltration (Hart, 1983). In some lowland areas, surface water intrusion may be an additional source of recharge of the shallow aquifer along the edges of water bodies and during periods of high tide. Shallow groundwater flow follows topography and discharges to local surface water bodies.

The descriptions and hydrogeologic properties of the confined aquifers presented in this section are derived primarily from Andreasen (1999).

The top of the lower Patapsco aquifer lies at 70 to 200 feet below sea level in the study area, with a thickness ranging from 65 to 140 feet. The transmissivity of the lower Patapsco aquifer ranges from

about 190 to 700 square feet per day (ft^2/d) near Indian Head. The aquifer is underlain by relatively low permeability sediments of the Patapsco Formation and by the low-permeability Arundel Clay. In most places, the Arundel Clay serves as an effective confining unit between the lower Patapsco and upper Patuxent aquifers, although a hydraulic connection occurs where the Arundel Clay is thin or more heterogeneous.

The lower Patapsco aquifer is the principal water-supply aquifer at NSF Indian Head, and potable water wells that supply the facility are typically screened in multiple sand layers within this aquifer at an average depth of 200 to 300 feet. These potable water wells serve approximately 4,050 people, including civilian and enlisted Navy employees and contractor employees. According to the installation, there are two potable wells located on the Stump Neck Annex. Well #42 SN was installed in 1945 and currently has minimal output. The other well, #2012 SN, was installed in 1953. NSF Indian Head is considering several rehabilitation options including closing #42 SN and using #2012 SN as the main well or installing an additional well on Stump Neck Annex. There are also several private wells near Rum Point. These wells are tested quarterly or monthly, if regularly used. Although none of the NSF Indian Head wells supply reserves or residences beyond the facility boundaries, the lower Patapsco aquifer is used extensively for domestic and municipal water supplies in northwestern Charles County. Several production wells are screened in this aquifer northeast of NSF Indian Head, in and near the Towns of Indian Head and Potomac Heights.

The upper Patuxent aquifer lies at 400 to 600 feet below sea level in the study area and is about 50 to 70 feet thick. The transmissivity of the upper Patuxent aquifer ranges from about 150 to 2,600 ft^2/d in northwestern Charles County. Relatively low-permeability sediments of the Patuxent Formation underlie this aquifer.

The top of the lower Patuxent aquifer lies at 800 to 1,000 feet below sea level in the study area and is about 100 feet thick. Few potable water wells are screened in the lower Patuxent aquifer due to availability of water from the overlying confined aquifers. The lower Patuxent aquifer is underlain by crystalline basement rock. Water levels in the upper and lower Patuxent aquifer are generally similar due to the leaky nature of the intervening confining unit.

10-3.7 Cultural and Natural Resources

A Phase I Cultural Resources Survey and Supplemental Architectural Investigations were conducted at Stump Neck in 1996 (R.C. Goodwin & Associates, 1996). As a result, 33 sites were identified and investigated. Only 17 of 33 were recommended for Phase II evaluations to determine their eligibility for

listing on the National Register of Historic Places. Five of these 17 sites that potentially occur within the former ranges included in the SI are as follows:

- Site 18CH388 – overlaps the Old Skeet and Trap Range (UXO 15) and Marine Rifle Range (UXO 14).
- Sites 18CH391, 18CH628, and 18CH630 – overlap the Rum Point Skeet Range (UXO 16).
- Site 18CH644 – overlaps the Small Arms Range (UXO 17).

The architectural evaluation verified three National Register-eligible historic districts and identified one additional district, as follows: the Indian Head Residential Historic District containing 64 contributing resources; the Naval Powder Factory District containing 124 contributing resources; the Naval Proving Ground Historic District containing no contributing resources; and the Extrusion Plant Historic District containing 63 contributing resources. An additional area of the base, the Polaris facility, was recommended for further research, as it was considered potentially eligible for the National Register as an exceptionally significant area. The exact locations of the contributing resources within these districts were not available.

10-3.8 Endangered and Special Status Species

According to the 1997 Wildlife Management Plan, four endangered species are reported to be located within the Stump Neck Annex. Three of these four species, the American bald eagle, rainbow snake, and joint-vetch (flowering plant of the pea family), are federally endangered. The fourth species, the scaly blazing-star (perennial herb), is a species of special concern in the State of Maryland. As of the July 2001 Threatened and Endangered Plant/Animal Species of Charles County, Maryland report, the Maryland Department of Natural Resources Wildlife and Heritage Service still listed these four species as federally and state endangered.

Protected species that are known to or have the potential to inhabit Stump Neck Annex are listed in Table 10-3.

TABLE 10-1

**SUMMARY OF OTHER THAN OPERATIONAL RANGES
NAVAL SUPPORT FACILITY INDIAN HEAD
INDIAN HEAD, MARYLAND**

Site Name	Site No.	Size (acres)	Purpose	Dates of Use
Air Blast Pond	UXO 01	3.72	Testing of bulk explosives	1955-1975
Area 8	UXO 02	22.61	Training on and defusing of explosive devices	1957-1999
EOD School Demolition Area	UXO 28	4.64	Demolition area	1944-1949
Basic IED Area	UXO 04	3.79	Training and demonstration of IEDs	1957-1996
Advanced IED Area	UXO 05	10.07	Training and demonstration of IEDs	1953-1995
Stump Neck Impact Area	UXO 10	32.88	Impact area	1891-1940
Test Area 1	UXO 21	4.52	Communication experiments, AA&D training, IED/IND training, robotics training	1950-1980s
Valley Impact Area	UXO 26	694	Safety danger zone	1891-1921 (Quantico fired in area 1931 - 1934)
Torpedo Burial Site	UXO 12	0.88	Burial of torpedoes	Late 1940s-Early 1950s
Torpedo Casing Disposal Area	UXO 23	0.74	Burial of torpedo casings	1950s

AA&D - Advanced Access and Disablement
EOD - Explosive Ordnance Device
IED - Improvised Explosive Device
IND - Improvised Nuclear Device

TABLE 10-2

**TIMELINE OF HISTORICAL EVENTS
NAVAL SUPPORT FACILITY INDIAN HEAD
INDIAN HEAD, MARYLAND
PAGE 1 OF 2**

Time Period	NSF Indian Head Milestones
1890 - 1900	• Constructed on 659 acres on Cornwallis Neck in 1890 as the Naval Proving Ground to test guns, armor, shells and mounts. • By 1891, added the 222.75-acre Mount Pleasant Farm.
1900 - 1910	• Factory constructed for smokeless powder production. • Stump Neck Annex property purchased in 1901 to extend firing range.
1910 -1920	• Work gradually increased from proving of guns and armor to include standardization of shells and powder. • Acquired 1,160 acres of land adjacent to the Main Installation in 1918. • 161 acres acquired for a railroad right-of-way running from the Naval Proving Ground to the Pennsylvania Railroad junction at White Plains, Maryland; 13.8-mile railroad spur constructed.
1920 - 1940	• Mission gradually shifted from a Naval gun proving ground to a chemical factory, research laboratory, and Explosive D factory. • Facility changed name to the Naval Powder Factory. • All proving ground activities were moved to Dahlgren, Virginia.
1940 - 1950	• Navy established Explosives Investigation Laboratory where extensive examination of captured enemy ordnance was performed. • Practical applications for the EOD School moved from Washington, D.C., to Stump Neck Annex. • Joint Forces EOD School led by Navy formed in 1947. • Propellant research and development added to installation mission. • Jet Propulsion Research Lab founded (1940-1944).
1950 - 1960	• Facility changed its name to the Naval Propellant Plant. • Research and development on the Polaris and other rocket programs began.
1960 - 1980	• Rum Point, an 80-acre promontory in the Mattawoman Creek, was acquired by condemnation in 1966. • Bullets Neck, a separate 47-acre promontory in the Mattawoman Creek, was purchased in five small acquisitions (1965-1966). • The Naval Propellant Plant changed its name to the Naval Ordnance Station to reflect the diversification from propellants into related fields of chemistry, engineering, and production contract management.

TABLE 10-2

**TIMELINE OF HISTORICAL EVENTS
NAVAL SUPPORT FACILITY INDIAN HEAD
INDIAN HEAD, MARYLAND
PAGE 2 OF 2**

Time Period	NSF Indian Head Milestones
1980 - 1990	• Full-scale production at the Naval Ordnance Station concentrated on several processes/products too unprofitable, too dangerous, or too difficult for the private sector. • The Naval Ordnance Station became the center of excellence for the following technologies: guns, rockets and missiles; energetic chemicals; ordnance devices; missile weapon simulators; explosive process development engineering; and explosive safety, occupational safety and health, and environmental protection.
1990 - present	• EOD School on Stump Neck closed in 1999. • Currently, the mission of NSF Indian Head is to ensure operational readiness of U.S. and allied forces by providing the full spectrum of technical capabilities necessary to rapidly move any “energetics” product from concept through production to operational deployment.

TABLE 10-3

**SUMMARY OF KNOWN OR POTENTIAL PROTECTED SPECIES
NAVAL SUPPORT FACILITY INDIAN HEAD
INDIAN HEAD, MARYLAND**

Ecological Receptor	Species
Federal Endangered	• Rainbow snake
	• Joint-vetch
Federal Threatened	None reported
State Endangered	Scaly blazing-star
State Threatened	None reported

Sources of data include

- NSF Indian Head Wildlife Management Plan, 1997.
- Threatened and Endangered Plant/Animal Species of Charles County, Maryland, July 2001, Maryland Department of Natural Resources.

INDIVIDUAL MRP SITE-SPECIFIC CHARACTERISTICS/PROBLEM DEFINITIONS

The following SAP appendix sections (10.1 through 10.10) provide specific information about each of the other than operational ranges located on Stump Neck Annex, NSF Indian Head, Maryland, including history and range description, land use, access controls and restrictions, visual survey observations and results, contaminant migration routes, and receptors.

Problem Definition/Conceptual Site Model for the Air Blast Pond (UXO 01)

10.1 AIR BLAST POND

10.1.1 History and Site Description

The Air Blast Pond was identified as a 3.72-acre range in the Navy Range Inventory. The Naval Ordnance Laboratory (NOL) used the Air Blast Pond for bulk high explosives testing from 1955 to 1975. The NOL discontinued this use in 1975, and the activity was moved to Naval Surface Warfare Center Dahlgren Division (NSWCDD). The Air Blast Pond is located approximately 100 feet north of Chicamuxen Creek, and it is accessed by a dirt road that intersects Archer Avenue. The area surrounding the Air Blast Pond is wooded to the north, south, east, and west. Two intermittent streams are present at the range.

The Air Blast Pond is an unlined earthen pit approximately 100 feet in diameter with a capacity of approximately 1.3 million gallons. The pit is surrounded by a man-made earthen berm approximately 10 feet high. The pond was filled with water from Chicamuxen Creek by means of a 14-inch-diameter steel pipe at a rate of 1,300 gallons per minute. Water was periodically discharged through the same pipe (industrial outfall IW32) into Chicamuxen Creek. According to Diana Rose of the NSF Indian Head Environmental Office, permits were not issued for the discharges from the Air Blast Pond. The pond was emptied and refilled two to three times per year. The pond reportedly developed a slow leak and periodically needed to be refilled (topped off).

To test the bulk high explosives, cables were strung across the pond between two 97-foot-tall towers to measure the concussion factors of various explosives. Test explosives were detonated above and in the water. The tests were observed on range as well as recorded by the NOL. According to the 1998 RCRA Facility Investigation/Verification Investigation (RFI/VI), three to four detonation events (shots) were conducted per day, with an estimated 1,500 shots over the unit's active life. A map of the Air Blast Pond from the 1998 RFI/VI report is provided as Figure10.1-1. The explosives tested include Pentolite, HBX-1,

HBX-2, H-6, and C4. Although the Air Blast Pond was designed to capture the detonations within the pond, the nature of the operations conducted at the range produced a spray of detonated explosives (MC) during testing.

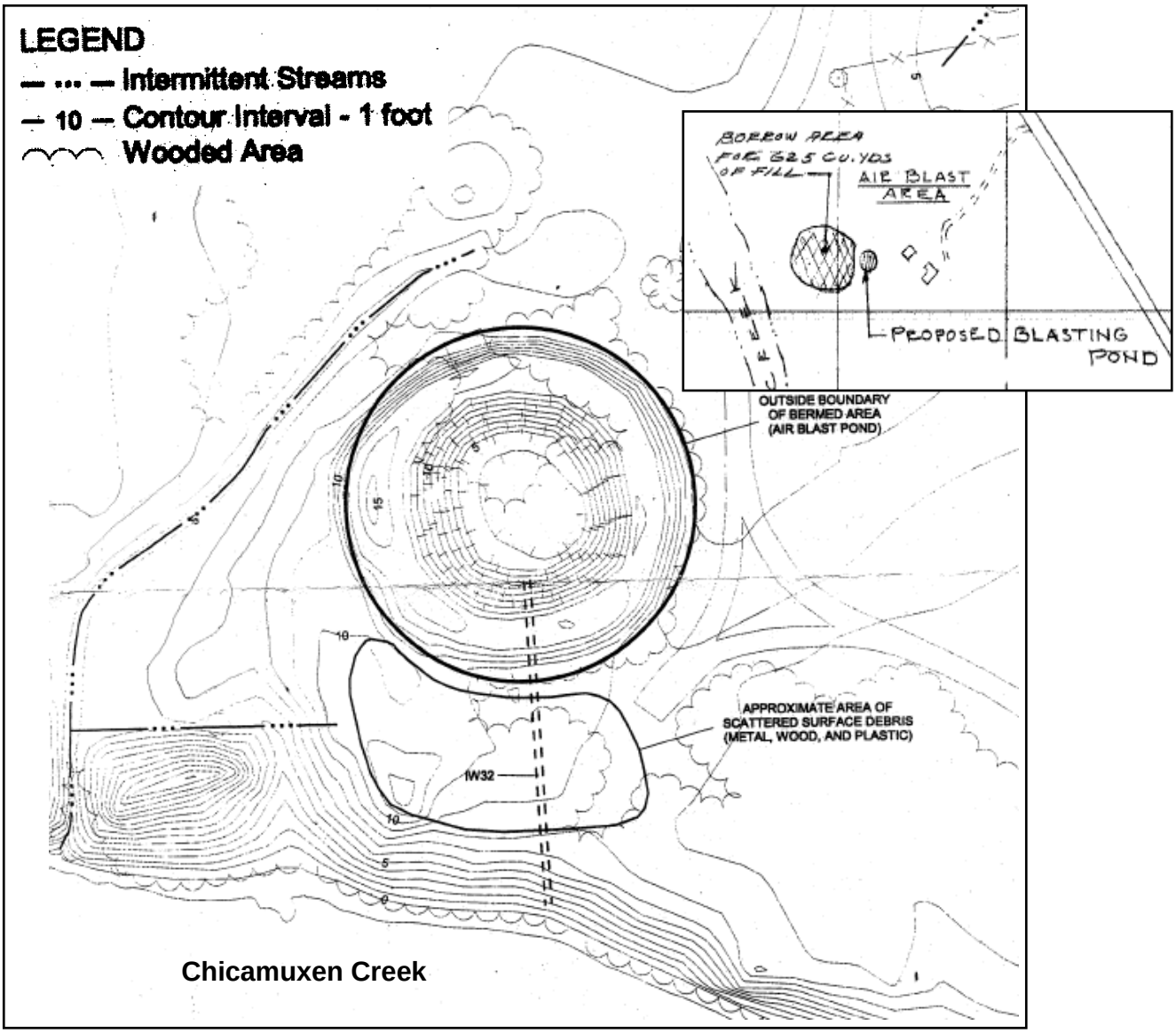

Figure 10.1-1: Air Blast Pond Layout as Depicted in 1998 RFI/VI (D. Perry, 1998)

Construction plans for the Air Blast Pond are dated 1956. The 1956 Location Plan (Figure10.1-2) identifies an on-range borrow area for fill west of the constructed pond. It is assumed that fill material from this borrow pit was used to construct the earthen berm at the Air Blast Pond. Figure 10.1-3 shows

the cross section of the pit, including existing grade, final grade, and diameter of the pit. Figure 10.1-4 shows the 1956 Plot Plan and design of the Air Blast Pond. The original building, septic field, storm drain, discharge pipe, and berm are identified on this figure. The RFI/VI also identifies a sump pit in the southeastern portion of the pond and a pump with gate valve and strainer at the discharge point to Chicamuxen Creek.

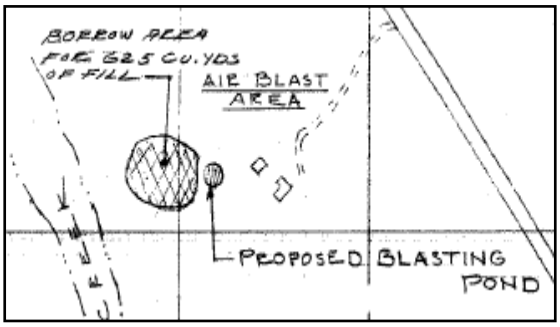

Figure 10.1-2: 1956 Location Plan for Air Blast Pond Showing Borrow Area

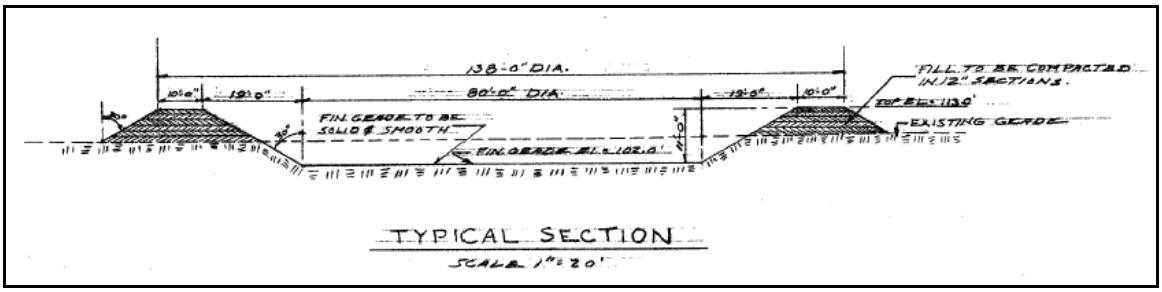

Figure 10.1-3: 1956 Profile of Construction for Air Blast Pond

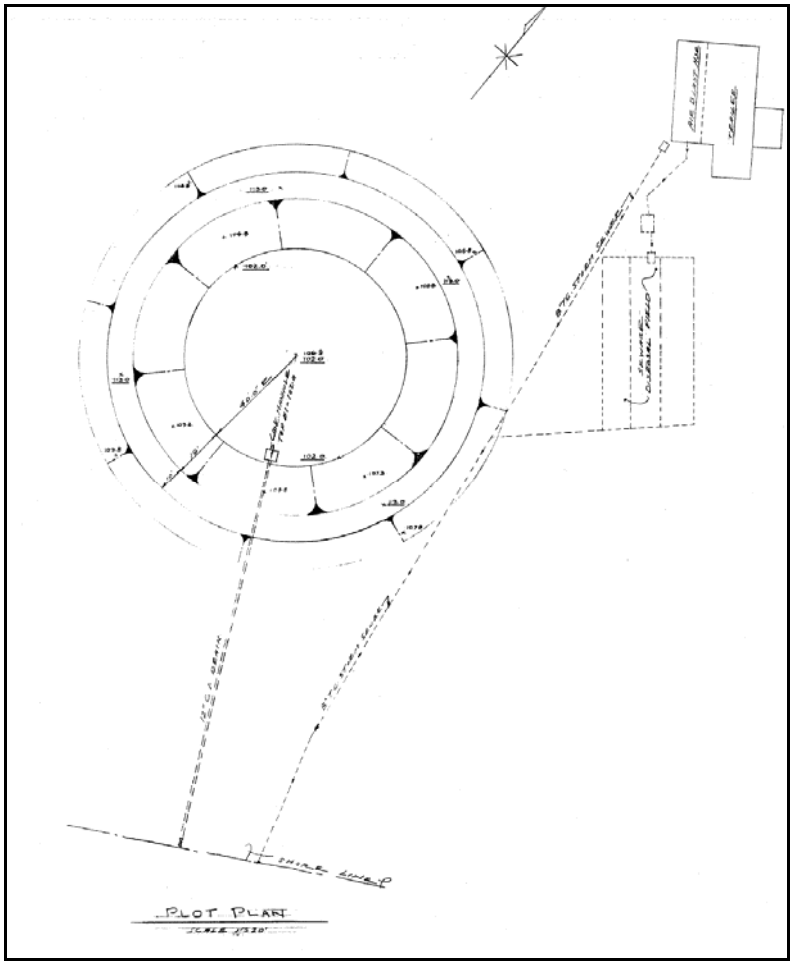

Figure 10.1-4: 1956 Design of Air Blast Pond

The pit currently contains no water and is overgrown with small trees, grass, and other vegetation. Several rusted metal pipes standing upright on the earthen floor of the pit were reportedly used to hold monitoring devices while the Air Blast Pond was operational. Additional metal pipes and wire scattered on the berm were reportedly used to anchor the center supports. The wooded area between the pit and Chicamuxen Creek contains scattered metal and wood debris. Solid steel cylinders and rusted drums were found in this area. The cylinders were reportedly used for explosive shaped charge tests, but use was discontinued, and the cylinders were left at the range. Buildings were present at the range to support activities at the Air Blast Pond. These buildings have since been razed, but other structures associated with operation of the pond still exist. These remaining structures include a wooden observation platform, stairs, a wooden bunker, and a concrete and wooden tank with platform. The concrete and wooden tank was used to hold cameras that recorded the underwater explosions. The location and general features of the Air Blast Pond are displayed on Map 10.1-1 located at the end of Section10.1 of this appendix.

The Air Blast Pond boundaries were identified in the Navy Range Inventory. The buildings, discharge piping, and scattered surface debris are included within the range boundary. In 1991, the Air Blast Pond was identified as SWMU#6, Installation Restoration (IR) Site #62, pursuant to the requirements of the RCRA Corrective Action Permit issued in 1990 by USEPA. The Navy completed an RFI/VI in January 1998, and the results are summarized in Section 10.1.6 and Table 10-1 of this appendix.

There is no record of additional testing or MEC usage at the Air Blast Pond. However, the Air Blast Pond is located within the estimated firing fan from The Valley, located at NSF Indian Head, Main Installation. Thus, there is a potential for munitions associated with The Valley to be present at the Air Blast Pond. Refer to Section 5.7 in the Final PA Report for the Main Installation, Indian Head for information on The Valley. Information on The Valley is also provided in Section 10.8 of this appendix, The Valley Impact Area.

Topography

Section 10-3.2 of this appendix provides a general description of the topography of the Stump Neck Annex. The topography of the Air Blast Pond is dominated by the earthen berm, and elevations at the site range from 0 to 50 feet above msl. The berm slopes steeply from 16 to 50 feet above msl. The area surrounding the Air Blast Pond is relatively level at approximately 16 feet above msl.

Geology

Section 10-3.3 of this appendix provides a geologic description for Indian Head and the Stump Neck Annex. Subsurface conditions at the Air Blast Pond were investigated through the drilling and logging of four soil borings during the 1998 RFI/VI. The subsurface materials were relatively consistent across the area, both vertically and horizontally. The material encountered in and beneath the berm generally consisted of a 9- to 12-foot thickness of natural, reworked material classified as silty sand and was generally underlain by sand and gravel. The fill material used to construct the berm was obtained from a borrow pit immediately west of the pond. The northern portion of the area was underlain by silty clay. No waste material was reported to have been encountered during the 1998 RFI/VI subsurface investigation.

Soil and Vegetation Types

Section 10-3.4 of this appendix provides a description of the soil and vegetation types at Indian Head and the Stump Neck Annex. According to the Soil Survey of Charles County, the predominant soil type associated with the Air Blast Pond is sand-silt to sand-clay (USDA, 1974). Specifically, Keyport silt loam

with a 2 to 5 percent slopes is present. Vegetation surrounding the Air Blast Pond is primarily woodland, with grassland surrounding the access road and location of the former buildings (see Figure 10.1-5).

Figure 10.1-5 Vegetation Surrounding the Air Blast Pond

Hydrology

Section 10-3.5 of this appendix provides a description of hydrology at Indian Head and the Stump Neck Annex. An intermittent unnamed tributary runs along the northwestern edge of the Air Blast Pond and empties into Chicamuxen Creek. A smaller intermittent unnamed tributary south of the pit runs perpendicular to and intersects the larger stream approximately 75 feet before it empties into Chicamuxen Creek. Chicamuxen Creek discharges to the Potomac River.

Hydrogeology

Section 10-3.6 of this appendix provides a description of hydrogeology at Indian Head and the Stump Neck Annex. No monitoring wells were installed at the Air Blast Pond during the RFI/VI. Based on topography and the proximity to Chicamuxen Creek, groundwater is presumed to flow toward and discharge into Chicamuxen Creek. Due to the nature of historical activities at the Air Blast Pond, the pond likely discharged large volumes of water into the subsurface through infiltration.

Cultural and Natural Resources

General cultural and natural resources for the Stump Neck Annex are provided in Section 10-3.7 of this appendix. According to the 2003-2004 Stump Neck Annex Hunting Map, hunting is permitted at the Air Blast Pond. The Chicamuxen WMA is located on the opposite side of Chicamuxen Creek from the Air Blast Pond.

Although the potential for cultural resources exists for the area in which the range is located, there have not been any specific archeological or cultural sites identified at the Air Blast Pond. Approximately 30 shovel tests were conducted in this area in August 1996 during the Phase I Cultural Resources Survey of Stump Neck Annex and Supplemental Architectural Investigations. No sites were identified on the Maryland Register of Historic Places (State Register) or the National Register of Historic Places.

Endangered and Special Status Species

As discussed in Section 10-3.8 of this appendix, endangered and special status species are reported to exist at the Stump Neck Annex. The reported endangered and special status species have the potential to inhabit the area, but none are known to inhabit the Air Blast Pond.

10.1.2 Visual Survey Observations and Results

Figure 10.1-6: Overgrown Berm at the Air Blast Pond

A visual survey of the Air Blast Pond was conducted on June 24, 2003, by Malcolm Pirnie personnel. Ms. Heidi Morgan, NSF Indian Head Environmental Office, accompanied the team. The area was visually inspected by walking along the berm of the Air Blast Pond. The area south of the pond and surrounding the dirt access road were also visually inspected. Current conditions of the berm are shown in Figure 10.1-6. An end cap for a C-4 block and a 57 mm projectile were observed on the berm of the pond (see Map 10-1.1). Figure 10.1-7 shows the flag at the northern side of the berm that marks the spot of the 57 mm projectile. The 57 mm projectile is rusted, and the cutting groves on the copper rotating band indicated that it had been fired. The C-4 end cap was found on the southwestern portion of the berm.

Figure 10.1-7: Flag on Berm Identifying Location of 57 mm Projectile

Figure 10.1-8: Metal Drums Located South of Pond

Figure 10.1-9: Wooden Debris

Wooden debris, metal drums, and several steel cylinders were observed around the berm of the pond. (Figures 10.1-8, 10.1-9, and 10.1-10). There are several rusted metal pipes standing upright on the earthen floor of the pit, and metal pipes are also exposed in the berm.

A wooden platform is located at the northwestern side of the berm, and a concrete and wooden tank with a platform is located adjacent to the stairs at the northeastern side of the berm (Figure 10.1-11). The stairs on the interior and exterior of the berm are wooden. A dilapidated wooden bunker is located at the western side of the berm. No evidence of the towers was identified during the visual survey. Multiple flags were located along the rim of the berm. According to installation personnel, the flags represent sampling locations for the RFI/VI. At the time of the visual survey, the intermittent streams surrounding the pit were dry.

Figure 10.1-10: Steel Cylinders Discarded on the Range

Figure 10.1-11: Current View of Berm, Stairs, and Concrete Tank

A visual depiction of the range reconnaissance is provided on Map 10.1-1 located at the end of Section 10.1. Additional range/site details are illustrated on Map 10.1-2 also located at the end of Section 10.1.

10.1.3 Munitions and Munitions-Related Materials Associated with the Site

This section describes the munitions and munitions-related materials known or suspected to be at the range. This includes both MEC and non-hazardous munitions-related debris (e.g., fragmentation, base plates, inert mortar fins).

Records indicate that bulk high explosives were tested at the range from 1955 to 1975. However, a 57 mm projectile was discovered during the visual survey (Figure 10.1-12). The source of the 57 mm projectile is unknown because its use is inconsistent with bulk explosives testing. The Air Blast Pond is overlapped by the firing fan from The Valley located at NSF Indian Head, Main Installation. Thus, there is a potential for munitions associated with The Valley to be present at the Air Blast Pond. Information on The Valley is provided in Section 10.8 of this appendix, The Valley Impact Area.

Figure 10.1-12: 57-mm Projectile Identified During the 2003 Visual Survey

The northern portion of the Air Blast Pond is overlapped by the Marine Rifle Range. Refer to Section 5.6 of the PA Report for details on the Marine Rifle Range.

The Air Blast Pond is not suspected to contain chemical warfare material (CWM)-filled munitions, electrically fused munitions, or depleted uranium (DU)-associated munitions.

10.1.4 MEC Presence

The entire range has been subdivided and categorized into one of three levels of MEC presence including: known MEC areas, suspected MEC areas, and areas where no evidence exists to indicate that MEC is known or is suspected to be at the range. The categories of MEC presence at the site are discussed below. The Air Blast Pond is located within the estimated firing fan from The Valley, located at NSF Indian Head, Main Installation. Thus, there is a potential for munitions associated with The Valley to be present at the Air Blast Pond. Information on The Valley is provided in Section 10.8 of this appendix, The Valley Impact Area. Only MEC presence specifically related to the Air Blast Pond is considered.

Map 10.1-3 illustrates the munitions characterization of the Air Blast Pond and is provided at the end of Section 10.1 of this appendix.

Known MEC Areas

The only known MEC at the Air Blast Pond is the 57 mm projectile identified during the visual survey. Thus, the area immediately surrounding the 57 mm projectile is identified as a known MEC area (Map 10.1-1).

Suspected MEC Areas

The remainder of the Air Blast Pond is identified as an area where evidence of MEC is suspected. Because the source of the 57 mm projectile is unknown, there is the potential for similar MEC to be located throughout the remainder of the Air Blast Pond. The suspect MEC area is depicted on Map 10.1-1.

Areas Not Suspected to Contain MEC

There are no areas at the Air Blast Pond not suspected to contain MEC.

10.1.5 Ordnance Penetration Estimates

The depth to which munitions penetrate below the ground surface depends on many factors, including the type of soil, angle of impact, size of the munitions, velocity at impact, and range-specific environmental conditions. Over the years, the DoD has studied and modeled munitions penetration depths and has issued various guidance and technical documents on the subject. Maximum probable penetration depths were estimated following guidance listed in the latest draft (July 2002) of the DoD Directive on Explosives Safety issued by the DoD Explosives Safety Board (DDESB) [DoD Directive 6055.9 (DoD Ammunition and Explosives Safety Standards)]. The directive refers to TM 5.855.1 and NAVFAC P-1080.

The estimated penetration depth for the 57 mm projectile found at the Air Blast Pond, if fired, ranges from 4 feet in sandy soil to 8.5 feet in clayey soil. Air Blast Pond is overlapped by the firing fan from The Valley located at NSF Indian Head, Main Installation. Thus, there is a potential for munitions associated with The Valley to be present at the Range. The ordnance penetration depth associated with munitions fired from The Valley is provided in Section 10.8 of this appendix.

10.1.6 Munitions Constituents

Based on historical uses at the Air Blast Pond, suspected MC include the following:

- Pentolite (a mixture of TNT and PETN)
- HBX-1 (a mixture of RDX, TNT, and aluminum)
- HBX-2 (a mixture of RDX, TNT, and aluminum)
- H-6 (a mixture of RDX, TNT, and aluminum)
- C-4 (a mixture of RDX and plasticizer; over 90 percent is RDX)
- Composition B (a 59/40/1 mixture of RDX, TNT, and beeswax)

Maximum charge weights were 8 pounds per shot. The use of C-4 was confirmed by the finding of a C-4 end cap on the berm during the visual survey (Figure 10.1-13).

Figure 10.1-13: End Cap of C-4 Block Identified During the 2003 Visual Survey

As part of the 1998 RFI/VI, surface soil, subsurface soil, and sediment samples were collected. Five initial field screening samples (one at 6 to 12 inches, one at 12 to 24 inches, and three at 0 to 6 inches) were collected from three locations within the pond (Figure 10.1-14). These samples were analyzed using field test kits sensitive to the explosives TNT and RDX. Four samples were then collected from locations surrounding the pond and were analyzed using the field test kits. Field screening sample locations are shown on Figure 10.1-15. Explosives were not detected in these samples. Seven surface soil samples and seven subsurface soil samples were collected and analyzed for Appendix IX metals, Appendix IX VOCs, Appendix IX SVOA, and explosives (Figure 10.1-14). Three surface soil samples,

ABPSS01 through ABPSS03, were collected from locations within the pond. Four surface soil samples, ABPSS04 through ABPSS07, were collected from the top of the berm. Soil borings ABPSB01 through ABPSB04 were advanced at locations in the top of the berm equidistant around the pond. Seven subsurface soil samples were collected from the four soil borings. Four sediment samples, ABPSD01 through ABPSD04, were also collected and analyzed for Appendix IX metals, Appendix IX VOCs, Appendix IX SVOA, and explosives. Groundwater samples were not collected as part of this investigation.

Two VOCs, 3 SVOCs, and 15 inorganics were detected in surface soil (0 to 2 feet bgs). No VOCs or SVOCs were present in surface soil at concentrations in excess of Risk-Based Concentrations (RBCs) or Soil Screening Levels (SSLs). Arsenic was the only inorganic in surface soil detected at concentrations that exceeded the RBC for industrial exposures. Two VOCs, one SVOC, and 13 inorganics were detected in subsurface soil (2 to 12 feet bgs), none at concentrations in excess of RBCs or SSLs. Two VOCs, 15 SVOCs, and 14 inorganics were detected in sediment samples. Arsenic was the only analyte in sediment detected at concentrations that exceeded the RBC for industrial exposures (3.8 mg/kg). No explosives were detected in any of the samples. Results are presented in Table 10.1-1.

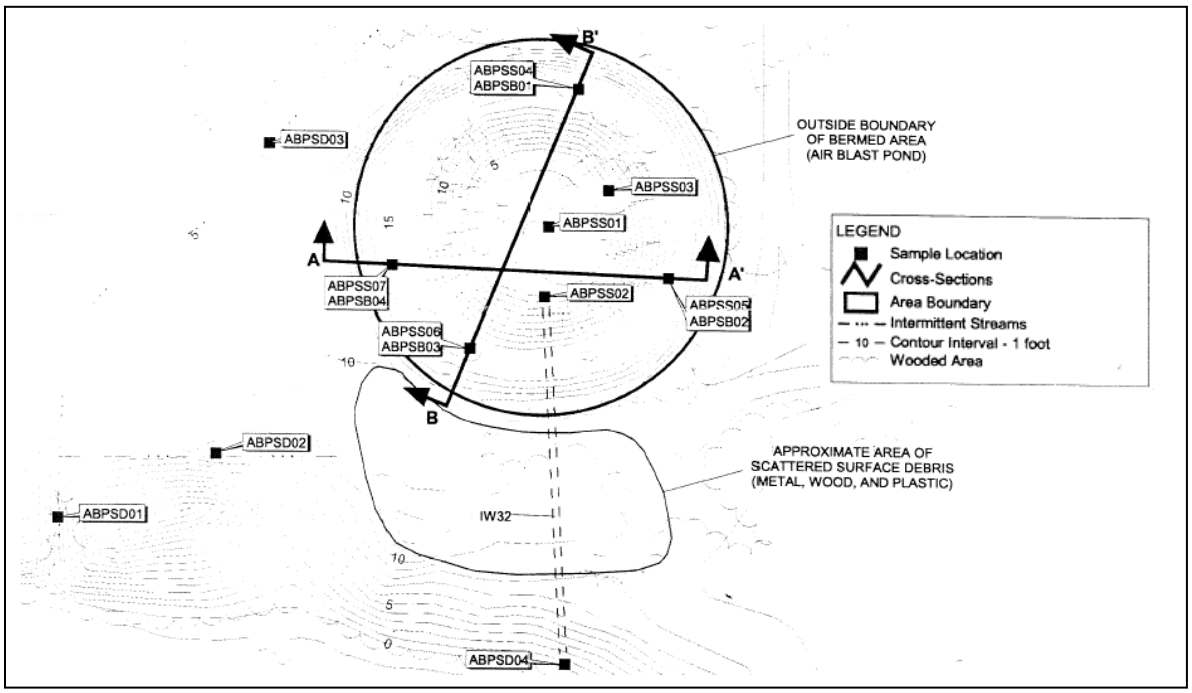

Figure 10.1-14: RFI/VI Sample Locations

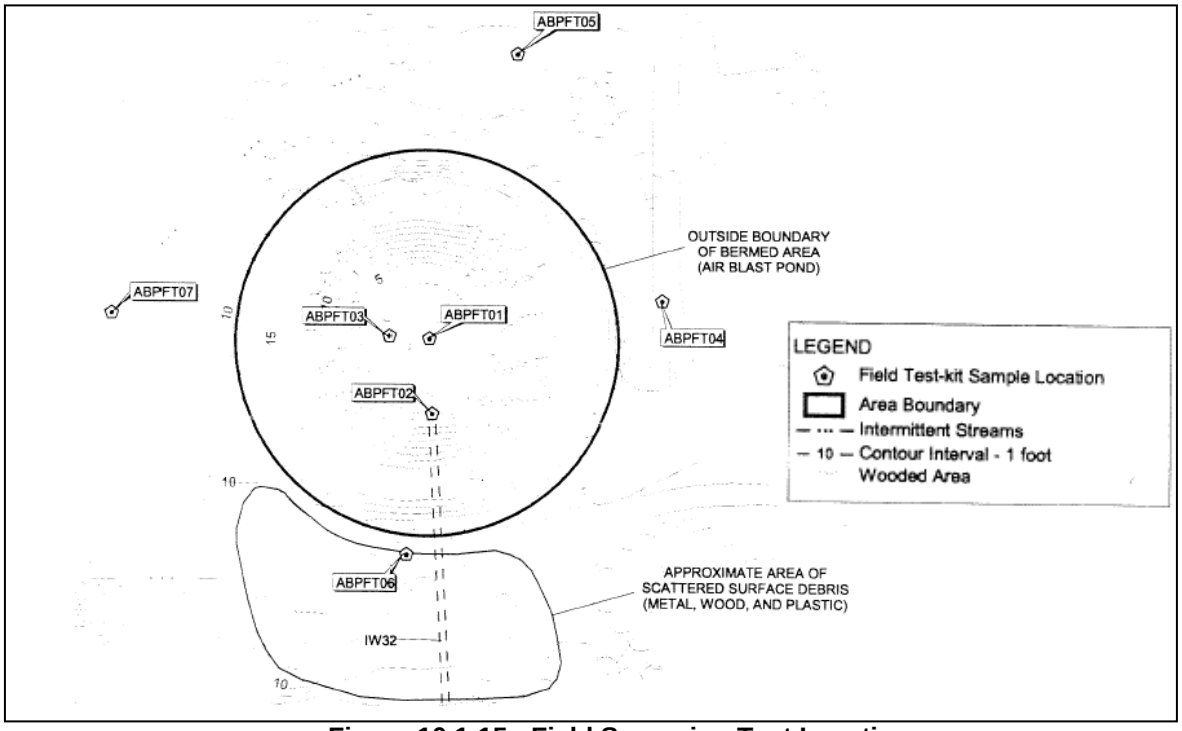

Figure 10.1-15: Field Screening Test Locations

TABLE 10.1-1

**1998 AIR BLAST POND SOIL AND SEDIMENT RESULTS
NAVAL SUPPORT FACILITY INDIAN HEAD
INDIAN HEAD, MARYLAND
PAGE 1 OF 6**

Parameter	SURFACE SOIL SAMPLES				
	ABPSS01	ABPSS02	ABPSS03	ABPSS04	
				Sample	Duplicate
VOLATILES (mg/kg)					
Acetone	---	---	---	---	---
Styrene	92	---	---	---	---
SEMIVOLATILES (mg/kg)					
bis(2-Ethylhexyl) phthalate	51 J	---	110 J	---	---
Chrysene	---	---	---	---	---
Phenanthrene	---	---	---	---	---
METALS (mg/kg)					
Antimony	0.46 L	---	0.24 L	0.36 L	0.28 L
Arsenic	9.6	---	1.7	3.0	2.9
Barium	8.2	6.2	15.5	49.6 J	40.0 J
Beryllium			0.22	0.47	0.51
Cadmium	0.69	0.59 K	0.22 K	---	---
Chromium	5.9 J	4.3 J	9.8 J	22.1 J	26.3 J
Cobalt	2.3	0.59	1.1	3.1	2.5
Copper	33.8	33.1	20.8	9.1	8.5
Lead	47.0 J	8.2 J	15.0 J	10.0 J	8.9 J
Mercury	0.02	0.02	0.05	0.06	0.04
Nickel	7.6	1.2	2.8	6.2	5.6
Selenium	1.1	0.29	0.58	0.98	0.95
Silver	---	---	---	---	---
Vanadium	6.5	5.0	15.0	30.6	32.4
Zinc	80.8 J	58.8 J	19.7 J	22.0 J	21.1 J

TABLE 10.1-1

**1998 AIR BLAST POND SOIL AND SEDIMENT RESULTS
NAVAL SUPPORT FACILITY INDIAN HEAD
INDIAN HEAD, MARYLAND
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Parameter	ABPSS05	ABPSS06		ABPSS07
		Sample	Duplicate	
VOLATILES (mg/kg)				
Acetone	2000	---	---	660 J
Styrene	---	---	---	---
SEMIVOLATILES (mg/kg)				
bis(2-Ethylhexyl) phthalate	---	---	2600 J	---
Chrysene	---	67 J	---	---
Phenanthrene	---	63 J	---	---
METALS (mg/kg)				
Antimony	0.58 L	0.30 L	---	0.24 J
Arsenic	2.5	2.8	2.7	1.7
Barium	32.9 J	27.8 J	12.5 J	47.0 J
Beryllium	0.41	0.27	0.21	0.44
Cadmium	---	0.16	---	---
Chromium	22.4 J	15.9 J	9.9 J	10.2 J
Cobalt	2.2	2.4	3.9	4.0
Copper	7.6	10.9	12.6	17.3
Lead	8.9 J	8.4 J	9.3 J	9.1 J
Mercury	0.04	0.03	0.04	0.03
Nickel	4.5	5.5	3.6	4.1
Selenium	1.1	0.77	0.61	0.58
Silver	---	---	0.08	---
Vanadium	28.3	19.4	16.3	16.2
Zinc	19.2 J	25.1 J	13.8 J	20.3

TABLE 10.1-1

**1998 AIR BLAST POND SOIL AND SEDIMENT RESULTS
NAVAL SUPPORT FACILITY INDIAN HEAD
INDIAN HEAD, MARYLAND
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Parameter	SUBSURFACE SOIL SAMPLE RESULTS			
	ABPSB01	ABPSB02	ABPSB02	ABPSB03
VOLATILES (mg/kg)				
Acetone	---	830 J	530 J	---
Methylene Chloride	---	---	---	---
SEMIVOLATILES (mg/kg)				
bis(2-Ethylhexyl) phthalate	2100 J	---	---	---
METALS (mg/kg)				
Antimony	---	0.48 L	0.24 L	---
Arsenic	3.0	2.5	1.8	---
Barium	70.8 J	38.5 J	27.7 J	37.1 J
Beryllium	0.40	0.47	0.40	---
Chromium	18.5 J	24.2	28.2 J	13.8 J
Cobalt	3.2	2.8	1.1	2.9
Copper	11.9	7.6	---	9.4
Lead	14.7 J	9.4 J	6.6 J	7.9 J
Mercury	0.05	0.04	---	---
Nickel	5.9	5.5	3.1	---
Selenium	0.85	0.67	0.70	1.8
Vanadium	26.5	30.3	28.8	19.0
Zinc	21.6	19.7 J	13.7 J	20.0 J

TABLE 10.1-1

**1998 AIR BLAST POND SOIL AND SEDIMENT RESULTS
NAVAL SUPPORT FACILITY INDIAN HEAD
INDIAN HEAD, MARYLAND
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Parameter	ABPSB03	ABPSB04	ABPSB04
VOLATILES (mg/kg)			
Acetone	600 J	1100 J	970 J
Methylene Chloride	---	7 J	---
SEMIVOLATILES (mg/kg)			
bis(2-Ethylhexyl) phthalate	---	---	1200 J
METALS (mg/kg)			
Antimony	---	0.37 L	0.34 L
Arsenic	1.4	2.7	3.5
Barium	22.9 J	40.4 J	21.1 J
Beryllium	0.40	0.50	0.45
Chromium	22.7 J	14.3 J	19.4 J
Cobalt	1.5	3.9	2.6
Copper	---	6.6	6.5
Lead	6.3 J	12.8 J	5.6 J
Mercury	---	0.03	0.02
Nickel	3.0	5.5	3.2
Selenium	0.65	0.76	1.2
Vanadium	23.1	22.5	20.9
Zinc	12.8 J	22.8 J	13.2 J

TABLE 10.1-1

**1998 AIR BLAST POND SOIL AND SEDIMENT RESULTS
NAVAL SUPPORT FACILITY INDIAN HEAD
INDIAN HEAD, MARYLAND
PAGE 5 OF 6**

Parameter	SEDIMENT SAMPLE RESULTS			
	ABPSD01	ABPSD02	ABPSD03	ABPSD04
VOLATILES (mg/kg)				
1,1,1 Trichloroethane	---	2 J	2 K	---
Carbon Disulfide	---	---	---	3 J
SEMIVOLATILES (mg/kg)				
Acenapthylene	---	---	170 J	---
Anthracene	---	---	160 J	---
Benzo(a)anthracene	---	---	580 J	---
Benzo(a)pyrene	---	---	510 J	---
Benzo(b)fluoranthene	---	---	950 J	---
Benzo(g,h)perylene	---	---	320 J	---
Benzo(k)fluoranthene	---	---	720 J	---
bis(2-ethylhexyl) phthalate	---	---	150 J	58 J
Chrysene	---	---	810 J	---
Di-n-butyl phthalate	---	---	---	40 J
Dibenzo(a,h)anthracene	---	---	130 J	---
Fluoranthene	---	---	860 J	---
Indeno(1,2,3-cd)pyrene	---	---	340 J	---
Phenanthrene	---	---	99 J	---
Pyrene	---	---	970 J	---
METALS (mg/kg)				
Arsenic	1.5	2.9	5.8	1.2
Barium	19.0 J	23.5 J	80.6 J	18.3 J
Beryllium	---	0.37 K	0.52 K	---
Cadmium	---	---	0.39 K	0.18 K
Chromium	10.7 J	18.7 J	20.0 J	6.4 J
Cobalt	1.1	1.9	4.4	2.1
Copper	5.7	15.5	90.0	8.6
Lead	9.3	14.2	141	7.9
Mercury	0.03	0.02	0.12	0.03
Nickel	2.3	4.1	11.5	4.3
Selenium	0.51	0.89	1.1	0.35
Tin	---	---	10.0	---

TABLE 10.1-1

**1998 AIR BLAST POND SOIL AND SEDIMENT RESULTS
NAVAL SUPPORT FACILITY INDIAN HEAD
INDIAN HEAD, MARYLAND
PAGE 6 OF 6**

Parameter	ABPSD01	ABPSD02	ABPSD03	ABPSD04
METALS (mg/kg) (Continued)				
Vanadium	18.2 J	30.9 J	40.5 J	9.1 J
Zinc	15.9 J	18.3 J	337 J	32.9 J

J = Estimated positive result
K = Estimated high positive result
L = Estimated low positive result
--- = Not detected

Arsenic in surface soil was determined to be the only constituent of potential concern (COPC). However, the maximum concentration detected (9.6 mg/kg) is similar to the 95 percent upper tolerance limit value established for base-wide background surface soil (4.25 mg/kg) and background soil concentrations reported for the State of Maryland (7.1 mg/kg). Therefore, as a result of the soil and sediment investigation at the Air Blast Pond, no further action was recommended in the 1998 RFI/VI.

The Air Blast Pond is located within the estimated firing fan from The Valley, located at NSF, Indian Head, Main Installation. Thus, there is a potential for munitions associated with The Valley to be present at the Air Blast Pond. Refer to Section 10.8 of this appendix for information on The Valley. Only the munitions constituents that specifically relate to the Air Blast Pond are considered.

10.1.7 Contaminant Migration Routes

Samples collected during the 1998 RFI/VI indicate that no explosive compounds were present in soil at the Air Blast Pond. Therefore, there are no contaminant migration routes for MC at the Air Blast Pond.

10.1.8 Receptors

Potential human receptors of MEC include authorized Navy personnel (military and civilian), visitors, contractors, maintenance workers, recreational users (hunters), and trespassers. Plant and animal biota are also potential MEC receptors. Examples of ecological receptors potentially present at the site include deer, wild turkey, and waterfowl.

Nearby Populations

Charles County contains approximately 261.5 people per square mile according to the 2000 United States Census. NSF Indian Head and its tenant commands employ approximately 3,600 military and civilian personnel. Indian Head is the county's largest employer. Over 76 percent of the employees at the base live within Charles County. Approximately 500 military and family members live on the installation; however, no military or family members live on Stump Neck Annex. Recreation on and around the installation includes hunting and fishing by permit. The Chicamuxen WMA is located adjacent to the Air Blast Pond, and it is used by recreational hikers, hunters, and fishers. Residential properties are located within 2 miles south of the range.

Buildings Near/Within Site

The buildings associated with the Air Blast Pond have been demolished, and no buildings remain at the range. Based on installation maps and interviews, it is estimated that the buildings were demolished in the mid-1990s. Table 10.1-2 lists the details of the former buildings, and Figure 10.1-16 shows the locations of the former buildings.

TABLE 10.1-2

AIR BLAST POND BUILDING DESCRIPTION
NAVAL SUPPORT FACILITY INDIAN HEAD
INDIAN HEAD, MARYLAND

Building No.	Location	Date Built	Use	Status
2001	Northeast of pond	1946	NOL Office	Demolished
2002	Northeast of pond	1955	NOL Air Blast Pond Control House	Demolished
2003	Northeast of pond	1956	NOL Air Blast Pond	Demolished
2064	Northeast of pond	1946	NOL Ordnance Storage	Demolished
2097	Northeast of pond	1946	NOL Camera Building	Demolished

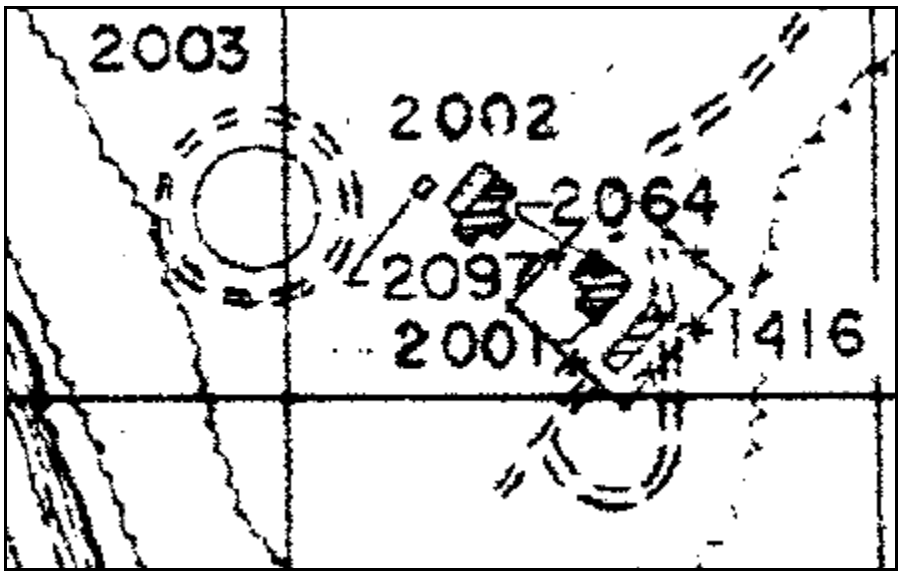


Figure 10.1-16 1983 Map Showing Former Buildings and Pond

Other structures associated with the pond still exist; however, they are in disrepair. These structures include a wooden observation platform, stairs, a wooden bunker, and a concrete and wooden tank with platform (see Figure 10.1-17 and Figure 10.1-18).

Figure 10.1-17: Wooden Bunker Still Present at the Air Blast Pond

Figure 10.1-18: Concrete Tank Still Present at the Air Blast Pond

Utilities On/Near Site

A sanitary sewer line runs through the Air Blast Pond. The sanitary sewer line was probably left in place after the buildings were demolished. The construction plans identify a septic field near the buildings and an 8-inch storm drain leading to the creek. The historic storm sewer line is shown on the 1956 design plan, Figure 10.1-4.

10.1.9 Land Use

Prior to construction of the Air Blast Pond, the area was undeveloped. A 1949 map showing the conditions at Stump Neck lists this area as "cultivated." From 1955 to 1975, the range was used by the NOL for testing bulk high explosives. After the NOL relocated the training to Dahlgren, the buildings were demolished. The Air Blast Pond and surrounding area are currently unused. According to the installation, there are no planned changes at the Air Blast Pond.

10.1.10 Access Controls/Restrictions

No public access is authorized at the Stump Neck Annex. Signs, partial fencing, locked/secured gates, login book/office check-in, and vehicle security patrols are used to control the entire facility. The Air Blast Pond is surrounded by forests on the north, south, east, and west. Chicamuxen Creek borders the range to the south; access from the water is not controlled. According to the 2003-2004 Stump Neck Annex Hunting Map, hunting is permitted within the Air Blast Pond site. There are no access control features specific to the Air Blast Pond.

According to the Master Plan Update, many of the soil types on Stump Neck and Indian Head have load-bearing capacity limitations as a result of high water tables and extreme erodability conditions. Based on this information, the installation has limited construction and use of septic systems in specific areas of concern. The Air Blast Pond is located in an area with a seasonal high water table. The range is also located in a restricted area in which a waiver is required for septic systems.

10.1.11 Conceptual Site Model

A general description of the CSM exposure pathway analysis for the Air Blast Pond site is included in Section 10.1-7. The CSM describes the range and its environmental setting. The CSM presents information regarding: (1) MEC and/or MC known or suspected to be at the range; (2) current and future reasonably anticipated or proposed uses of the real property; and (3) actual, potentially complete, or incomplete exposure pathways that link them. The CSM is the basis for the risk evaluation, prioritization, and remediation cost estimate.

A key element of the CSM is the exposure pathway analysis. For MEC, a complete or potentially complete exposure pathway must include the following components: (1) a source (e.g., location where MEC are expected to be found); (2) access (e.g., controlled or uncontrolled access, items on the surface or within the subsurface); (3) an activity (e.g., non-intrusive grounds maintenance or intrusive construction); and (4) receptors (e.g., Navy personnel [military and civil servants], construction workers, recreational users, authorized visitors, ecological receptors). It is important to recognize that environmental mechanisms (e.g., erosion) and/or human intervention may result in the repositioning of MEC.

For MC, a complete or potentially complete exposure pathway must include the following components: (1) a source (e.g., location where MC are expected to be found); (2) an exposure medium (e.g., surface soil); (3) an exposure route (e.g., dermal contact); and (4) receptors (e.g., Navy personnel [military and civil servants], construction workers, recreational users, authorized visitors, ecological receptors). If the point of exposure is not at the same location as the source, the pathway may also include a release mechanism (e.g., volatilization) and a transport medium (e.g., air).

The potential interactions between the source and receptors are assessed differently for MEC and MC. For MEC, interaction between the potential receptors and MEC source has two components. The receptor must have access to the source and must engage in some activity that results in contact with individual MEC items within the source area. For MC, interaction between the source and receptors involves an MC release mechanism, an exposure medium containing the MC, and an exposure route that places the receptor into contact with the contaminated medium. An exposure pathway is incomplete if

any one component is lacking and unlikely to be present in the future. All potential exposure pathways are typically initially considered and then information on current and reasonably anticipated future conditions is used to assess whether an exposure pathway is complete, potentially complete, or incomplete.

The following CSM exposure pathways analysis focuses only on the Air Blast Pond and does not consider impacts from The Valley firing fan. For exposure pathway analysis for The Valley Impact Area, refer to Section 10.8 of this appendix.

At the Air Blast Pond, evidence found during the 2003 visual survey suggests that MEC may be present; however, the density of the MEC is not known. Therefore, potentially complete pathways exist for human and ecological receptors for MEC in subsurface soil. This includes receptors for hand/tread underfoot contact and surface intrusive work that may be conducted at the Air Blast Pond. These activities include, but are not limited to, excavation, plowing, tilling, construction, and environmental sampling for human receptors. Ecological receptors may come in contact with MEC through burrowing, nesting, or feeding activities that disturb surface soil. Trespassers are anticipated to be exposed via non-intrusive surface soil activities at the range, but it is unlikely they would be exposed to subsurface soil through intrusive activities. MEC are not expected in the subsurface. An Exposure Pathway Analysis figure for MEC is presented as Figure 10.1-19. Based on sampling results from the 1998 RFI/VI, there is no MC present at the Air Blast Pond. Graphical illustrations of the Air Blast Pond are presented as Figures 10.1-20 and 10.1-21.

Figure 10.1-19: MEC Exposure Pathway Analysis

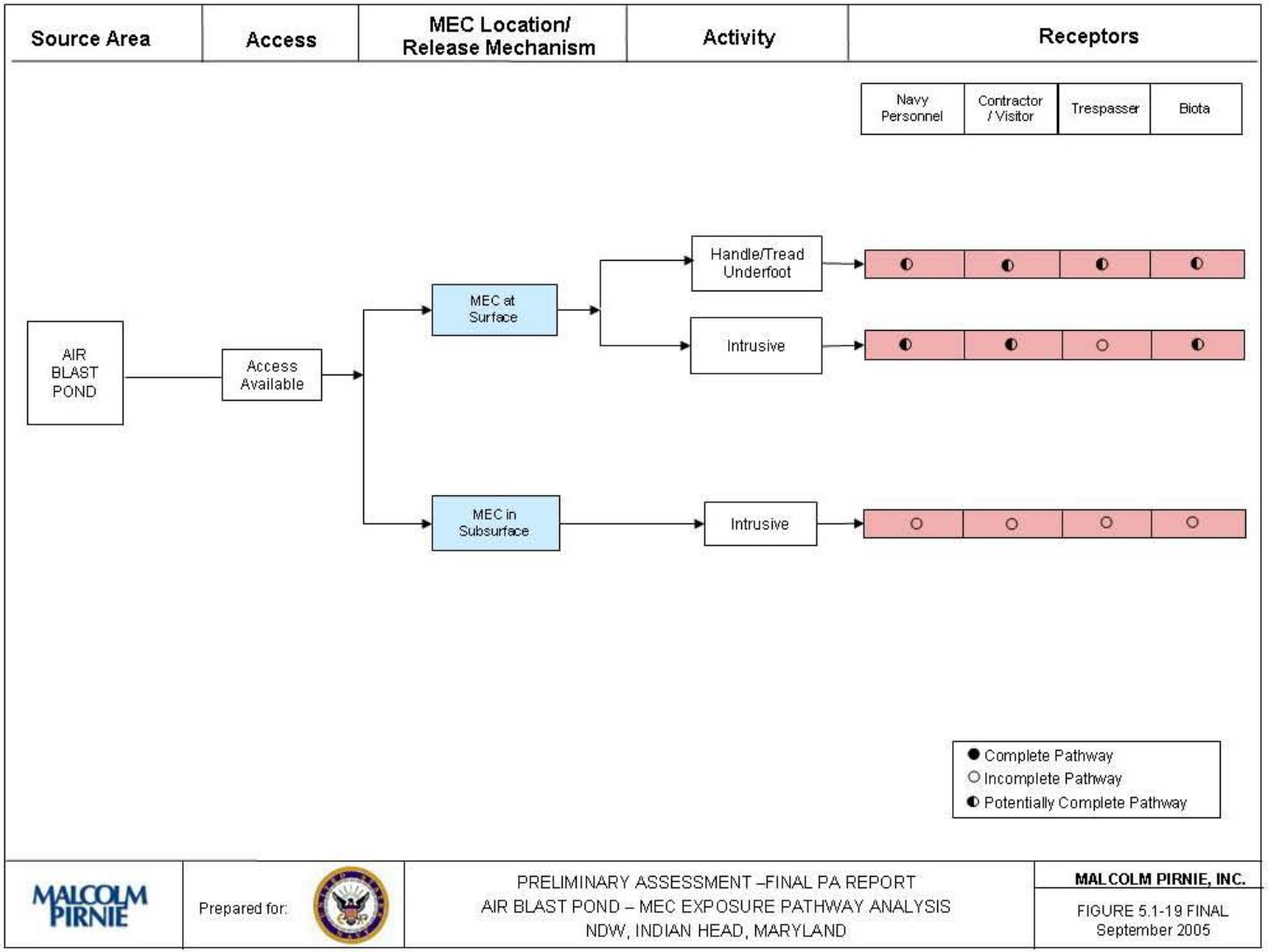


Figure 10.1-20: Air Blast Pond Graphical Illustration

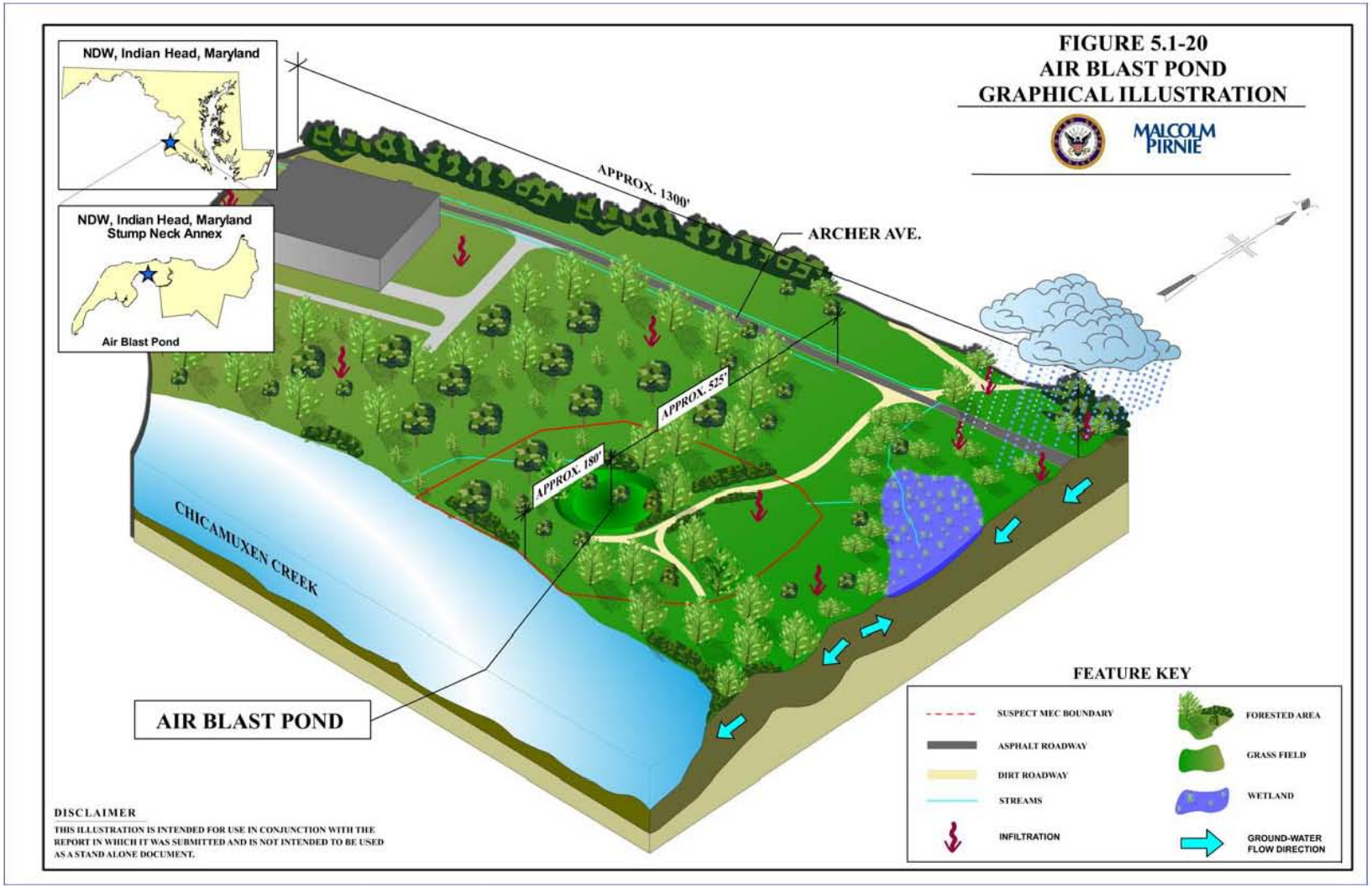
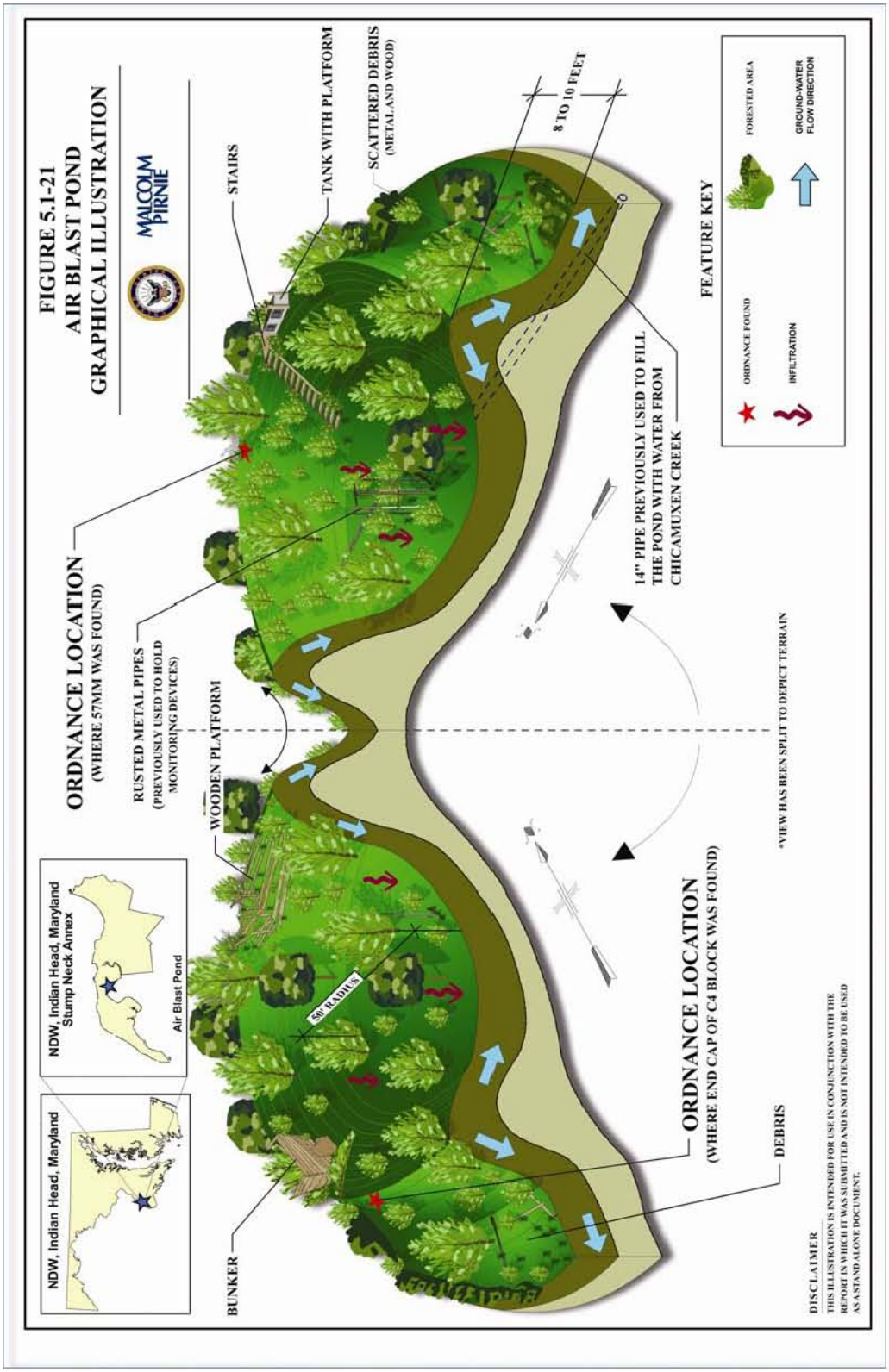


Figure 10.1-21: Air Blast Pond Graphical Illustration



10.1.12 Problem Definition Summary

The Air Blast Pond is a 3.72-acre site located in the central portion of NSF Indian Head, Stump Neck Annex. The Air Blast Pond was used by the NOL for testing bulk high explosives from 1955 to 1975. The bulk explosives were suspended over a water-filled man-made earthen pit approximately 100 feet in diameter, and repercussion factors in the water were measured. Potential MC-related materials include Pentolite, HBX-1, HBX-2, H-6, and C-4. A 57 mm projectile was found during a 2003 visual survey, but the source of the projectile is unknown. The Air Blast Pond is currently undeveloped and wooded. Limited sampling of soil and sediment was conducted in 1998. No energetic compounds were detected in the samples. Arsenic in surface soil and sediment was the only COPC identified during the investigation. However, arsenic levels were found to be close to background levels; thus “No further action” was recommended. No groundwater samples were collected during the 1998 RFI/VI.

Munitions Types

Records indicate that bulk high explosives were tested at the range. However, a 57 mm projectile was discovered during the 2003 visual survey. The source of the 57 mm projectile is unknown.

Maximum Probable Penetration Depth

The range was reportedly used for testing concussion factors of various bulk high explosives suspended above or in the water. Based on this information, there is no associated penetration depth for the bulk high explosives. However, the 57 mm projectile observed on the berm has an estimated penetration depth of 4 feet in sandy soil to 8.5 feet in clayey soil.

MEC Density

Based on the discovery of the 57 mm projectile during the site visit and the historical data describing munitions fired into The Valley Impact Area, the entire 3.72 acre of wooded and grassy fields of the Air Blast Pond site (beyond the 57 mm projectile discovery location) is suspected to contain MEC. The density of MEC at the Air Blast Pond is presumed to be medium because MEC was discovered during the range visit. The location of the 57 mm projectile is classified as a known MEC area within the Air Blast Pond site. The detection of this isolated munitions item during the site visit may be indicative of other similar munitions items in the area.

MEC Scrap/Fragments

Various types of Munitions Debris (MD) were observed during the visual survey of the range. These items included an end cap for a C-4 block and random MEC debris. MD was not observed outside the general vicinity of the pond.

Associated Munitions Constituents

Based on the explosive detonations historically conducted at the Air Blast Pond, suspected MC in the area include the following:

- Pentolite (a mixture of TNT and PETN)
- HBX-1 (a mixture of RDX, TNT, and aluminum)
- HBX-2 (a mixture of RDX, TNT, and aluminum)
- H-6 (a mixture of RDX, TNT, and aluminum)
- C-4 (a mixture of RDX and plasticizer, over 90 percent is RDX)
- Composition B (a 59/40/1/ mixture of RDX, TNT and beeswax)

As part of the 1998 RFI/VI, surface soil, subsurface soil, and sediment samples were collected. No MC were detected in samples.

Migration Routes/Release Mechanisms

No migration routes are considered for the Air Blast Pond because sampling results confirmed that MC are not present in soil.

Relationship of MEC/MC Sources to Habitat and Potential Receptors

Receptors may contact MEC in subsurface soil. Receptors may have contact with MC directly through surface water/soil or indirectly through the food chain (bioaccumulated in plants and animals).

Problem Definition/Conceptual Site Model For Area 8 (UXO 02)

10.2 AREA 8

10.2.1 History and Site Description

Area 8, the Underwater Ordnance Training Area, is a 22.61-acre range in the central portion of the Stump Neck Annex south of Archer Avenue along Roach Road. Roach Road bisects Area 8 in an approximate north-to-south direction. A 1-acre former 10- to 15-foot deep explosive test pond was located in the southern portion of Area 8. A volleyball court was also once present southeast of former Building 2104. The Joint Services EOD Equipment Magnetic Evaluation Facility (Building 2210) is currently located on the former range. The building and its associated parking lot and landscaping were constructed in 2003. The remainder of Area 8 is undeveloped and heavily wooded, with trails throughout the woods. Area 8 is surrounded by the former Munitions Disassembly Facility to the north, Chicamuxen Creek to the north and northwest, the current Munitions Disassembly Facility to the east, and undeveloped property to the south, northeast, and southwest.

Area 8 was identified as a 20-acre range in the Navy Range Inventory and as a 9.6-acre range in the RFI/VI Report. The Area 8 footprint was revised based on field reconnaissance, historical maps, and additional data obtained from the PA. Buffer areas were applied to the water and air shot locations to determine the revised boundary of Area 8. The test location in the Chicamuxen Creek was also included in the revised footprint for Area 8. For the purpose of this report, Area 8 is determined to be 23 acres.

Area 8 was identified as SWMU #25, IR Site #63, in 1991 pursuant to the requirements of the RCRA Corrective Action Permit issued in 1990 by USEPA. The Navy completed a VI in June 1996.

The EOD School classified Area 8 as part of Division IV, Underwater Ordnance and Diving (classroom and practical). Division IV included two practical training areas, the underwater ordnance practical training area (Area 8, Building 19) and a diving locker (Building 1444) located at NSF Indian Head, Main Installation. Area 8 was the Underwater Ordnance Training Area used to train military personnel to defuse explosives devices from 1957 until 1999 when the EOD School relocated to Eglin Air Force Base. The pond was last used in 1993. Between 1957 and 1999, Area 8 was used in support of Navy EOD Basic Training and Very Important people (VIP) courses. The basic courses were used to test the students' abilities to locate, identify, and gather intelligence from an item, dispose of the item, and render the item safe. The VIP courses were provided to high-ranking officers from different branches of the United States military and foreign services, along with civilian and governmental agencies, for good will purposes or for abbreviated instruction.

Navy EOD students received an additional 2 months of training on underwater devices, such as mines and torpedoes, at the EOD School. Navy students, who were qualified divers, would be required to confront Area 8. The Navy students would be required to confront any of the 72 test procedures or "problems" salting the mud and waters at Area 8. Each practice item was connected to a half-pound block of TNT, located at a safe designated distance. The practice item was designed to detonate under the same conditions that a real device would. The explosive would be set off if the student did not follow proper procedures to disarm the device. This hands-on practice was used to teach students what would happen when an improper procedure was used while deactivating a device. Students practiced on an assortment of devices including foreign devices (e.g. Soviet), World War II torpedoes, and Civil War ordnance. According to Mr. Gordon Miller, a retired EOD technician, there was also a line of underwater mines area near the pond. Inert underwater mines were set up along the road for render-safe procedures. Mr. Miller also mentioned that torpedoes were used in the pond and that students were responsible for two to three problems/procedures a day.

Area 8 included numerous water and air shot locations. In addition, the pond located in Area 8 was used to train military personnel to defuse underwater explosive devices and was used for testing demolition charges including primers, detonators, fuzes, and squibs. Training exercises at Area 8 were performed 10 months out of the year, and approximately 12 classes used the training course each year. It is estimated that approximately 50 to 75 pounds of ordnance (net explosive weight) were used at this training facility every year. No more than 0.5 pound of explosives was used at the air or water shot locations during training exercises. The types of ordnance used included TNT block, PETN, military dynamite, blasting caps, detonation cord, and similar devices.

The water and air shot locations were the primary locations for training and testing activities. The known 41 water shot and 30 air shot locations are located throughout Area 8 as shown on Figure 10.2-1. The 28 water shot locations to the west of Roach Road are known as the "A-side" locations. The 13 water shot and 30 air shot locations east of Roach Road are known as the "B-side" locations. B-side locations 5, 6, 7, 8, 9, 22, and 23 were the most used water shot locations; and B-side locations 24 and 38 were the most used air shot locations. A-side water shot location 7 is the closest to the Chicamuxen Creek and was the most used water shot location on A-side. The most used shot locations are also identified on Figure 10.2-1. A stagnant waterhole is also identified on Figure 10.2-1, and according to the 1996 VI, the stagnant waterhole was last used in 1993. An additional old shot location is identified on Figure 10.2-1 near Chicamuxen Creek, but details about this location were not provided in the VI.

The water shot locations consisted of 6- to 9-foot-deep holes, a few feet in diameter, that were filled with surface water to a depth of 4 to 5 feet. The explosive was placed between 2 and 5 feet below the water surface, and the student would work on an inert item 30 feet away from the water shot location. The air shot locations had explosives suspended on a wire approximately 2 feet above the ground, and the student would work on an inert item 75 feet away from the air shot location.

The pond at Area 8 was also used for training. Inert mines and inert torpedoes were placed at the bottom of the pond, and students were required to dive to the bottom and perform reconnaissance on the inert items. There were approximately 10 to 15 items on the bottom of the pond. There were also approximately 5 items located along the edge of the pond.

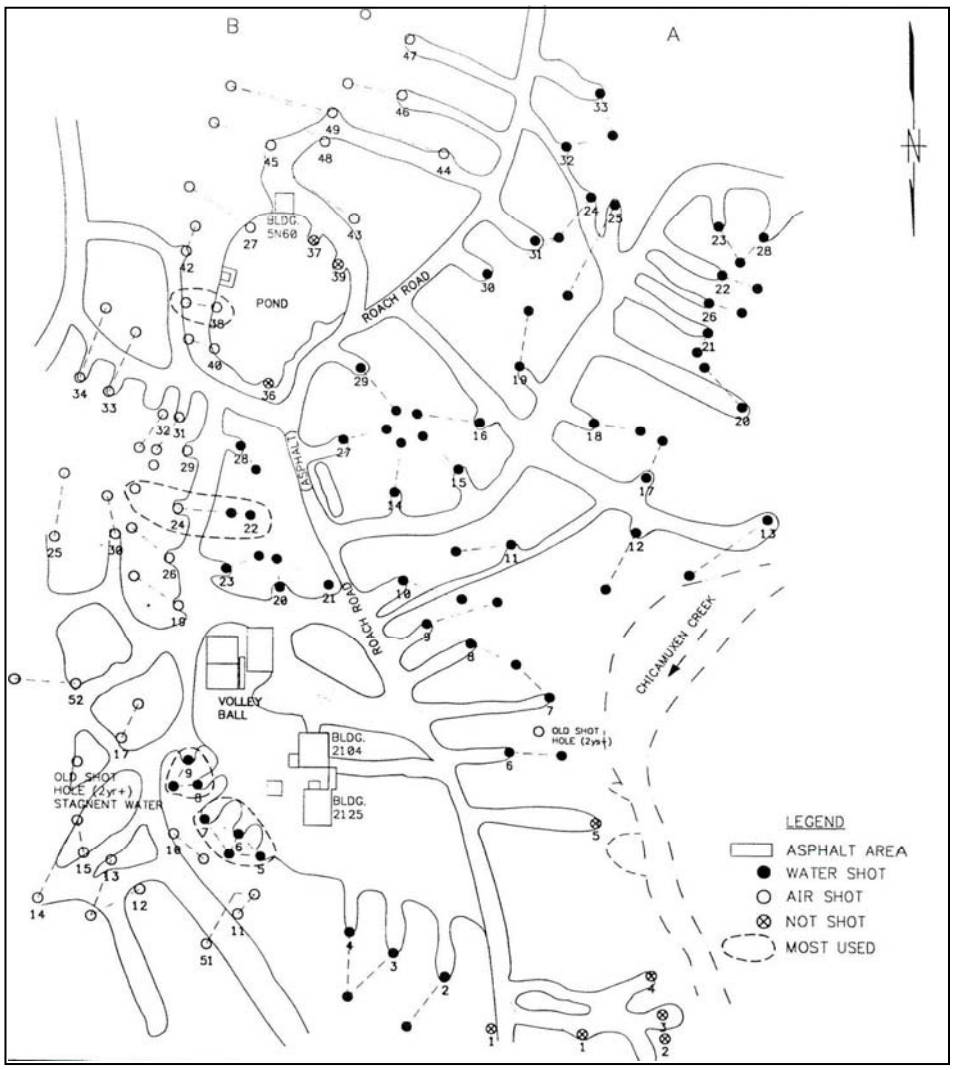


Figure 10.2-1: Water and Air Shot Locations at Area 8 from 1995 VI Work Plan

The Notice to Navigation Interests memorandum dated April 3, 1978, identifies an Underwater Demolition Training Area in the Chicamuxen Creek immediately west of Building 2104. Figure 10.2-2 shows the location of the 100-foot by 30-foot training area. The 1978 memo states that the demolition training operations were transferred to this range from the Potomac River. It also states that

> "Explosions will occur at irregular and intermittent periods during daylight hours only, approximately 350 times per year, at the training range. A warning patrol will be maintained during explosive operations, and charges will not be detonated at such times as they might endanger Marine traffic passing the area. The demolition training area will be indicated by displaying a BRAVO flag. Vessels are advised not to remain within one-eighth mile of the training range. No tests are to be conducted during the months of April and May in any year."

According to a retired Navy EOD technician, the Chicamuxen Creek was used for training associated with Area 8. In approximately 1981, a mine was half buried in the creek, and students were required to perform reconnaissance and complete a problem on the half-buried mine. The training in the creek was identical to the air and water shot training conducted in other areas Area 8, but this problem was complicated by the muddy conditions in the creek. All training, with the exception of shot training, involved inert items. The time period of training in the creek is estimated from 1978 to 1999 based on the memo random and the closure of the EOD School.

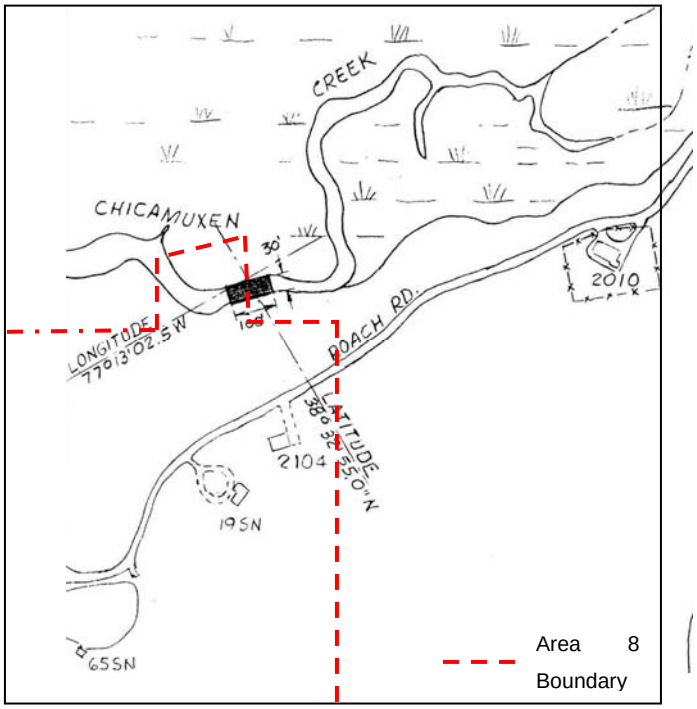


Figure 10.2-2: 1977 Map Showing EOD Training Area in Chicamuxen Creek

Topography

Section 10-3.2 of this appendix provides a general description of topography at the Stump Neck Annex. The terrain at Area 8 is very steep and slopes from the southeast to the northwest. The high point of Area 8 is located in the southern portion of the range. The southern portion of the range slopes steeply downward toward the pond, which is located in the central portion of the range. The pond is located at an elevation of approximately 35 feet above msl. The northern portion of Area 8 has a more gradual downward slope towards Chicamuxen Creek and its surrounding wetlands in the northwestern portion of the range. Two acres of wetlands border the range to the northwest. Due to the topography of the area and the complete vegetative ground cover, severe erosion is not considered to be a problem.

Geology

Section 10-3.3 of this appendix provides a geologic description for Indian Head and the Stump Neck Annex. Subsurface soil at Area 8 was classified based on data from three soil borings and three monitoring wells installed at the range during the 1996 VI. The shallow subsurface geology of the study area, as observed from the boring logs, consisted of silty sand with clay. The relative amounts of sand, silt, and clay varied somewhat at each location.

Soil and Vegetation Types

Section 10-3.4 of this appendix provides a description of the soil and vegetation types at Indian Head and the Stump Neck Annex.

Figure 10.2-3: View of Pond at Area 8 and the Surrounding Vegetation

Area 8 is within a heavily wooded hardwood forest, except for cleared areas surrounding the pond and the on-range buildings, as well as the wetland areas in the northwestern portion of the range. There is minimal undergrowth on the slopes and more undergrowth, such as ferns, closer to the creek and wetlands. The wetland area on range is classified by the installation as Palustrine forested broad-leaved deciduous wetland. Figure 10.2-3 shows the pond and surrounding vegetation, and Figure 10.2-4 shows the woodland vegetation at Area 8.

Figure 10.2-4: View of Woods Surrounding Area 8 East of Roach Road

According to the Soil Survey of Charles County, soil at Area 8 is a mixture of Aura gravelly sandy loam with 5 to 10 percent slopes, Aura gravelly sandy loam with 10 to 15 percent slopes, and steep gravely land (USDA, 1974). The majority of the range has 5 to 10 percent slopes, including the central portion and the portion of the range west of Roach Road adjacent to Chicamuxen Creek. A small portion of the southeastern corner of the range has 10 to 15 percent slopes. The soils are moderately eroded with moderately slow permeability, moderate available moisture capacity, and suitability for building and woodland. A section of steep gravely land extends on a north-to-south line along the eastern boundary of the range. The gravel content of this unit ranges from about 20 to 80 percent by volume. Most of the gravel is quartz pebbles, and slopes range from about 15 to 20 percent.

During construction of the Joint Forces EOD Equipment Magnetic Evaluation Facility in 2003, activities affecting the soil included earth movement and excavation of the top 6 feet of soil. It is not known if the excavated soil was transported off range or used as fill material on range during construction.

Hydrology

Section 10-3.5 of this appendix provides a description of hydrology at Indian Head and the Stump Neck Annex. Two acres of wetlands are located on and bordering the northwestern portion of Area 8. Chicamuxen Creek borders Area 8 to the north and northwest and is shown on Figure 10.2-5. Surface water from the range drains to these two surface water bodies, the former training pond, and drainage swales adjacent to Building 2210SN and its parking lot. The wetlands and Chicamuxen Creek drain to the Potomac River. A major portion of Area 8 is located within the 100-year floodplain.

Figure 10.2-5: View of Chicamuxen Creek Immediately West of Area 8 and Roach Road

Hydrogeology

Section 10-3.6 of this appendix provides a description of hydrogeology for Indian Head and the Stump Neck Annex. Hydrogeological conditions at Area 8 have been interpreted from data obtained during the VI, during which three monitoring wells were installed at Area 8. The range is characterized by a shallow groundwater table contained within a silty sand with clay aquifer. The water table at Area 8 ranges from the surface, at the wetlands located in the northwestern portion of the range, to 30 feet bgs. A potentiometric groundwater map created in 1995 shows groundwater flowing toward the wetlands to the northwest at a gradient of approximately 0.047. Rising-head and falling-head slug tests performed in 1995 showed the average hydraulic conductivity to be 1.47 feet per day. Using these values and an effective aquifer porosity of 30 percent, groundwater velocity was calculated to be 84 feet per year.

Cultural and Natural Resources

General cultural and natural resources for the Stump Neck Annex are provided in Section 10-3.7 of this appendix . Because the majority of the range is undeveloped, there is the potential for wildlife to exist at the range. The pond at Area 8 is also stocked for fishing. According to the 2003-2003 Stump Neck Annex Hunting Map, hunting is not permitted in Area 8. The Chicamuxen WMA is located approximately 1,000 feet downstream of Area 8.

Although the potential for cultural resources exists for the area in which the range is located, there have not been any specific archeological or cultural sites identified near the range. A total of 70 shovel tests were conducted in this area during the 1996 Phase I Cultural Resources Survey of Stump Neck Annex and Supplemental Architectural Investigations. A single isolated artifact, a fragment of quartz block/shatter, was recovered from Area 8. The survey concluded that such an isolated prehistoric artifact probably reflects nothing more than a single episode of tool curation or cobble testing. No sites were identified on the Maryland Register of Historic Places (State Register) or the National Register of Historic Places.

Endangered and Special Status Species

As discussed in Section 10-3.8 of this appendix, endangered and special status species are reported to exist at the Stump Neck Annex. No endangered or special status species are known to inhabit the Area 8. However, the reported endangered and special status species noted in Section 10-3.8 of this appendix have the potential to inhabit Area 8. Area 8 is located within an eagle protection area and in a designated species protection area.

10.2.2 Visual Survey Observations and Results

A visual survey of Area 8 was conducted on June 24, 2003. Malcolm Pirnie personnel who conducted the range visit included Mr. Dinh, Mr. Egholm, Ms. Tegtmeyer, Mr. Hains, and Mr. McManus. Ms. Morgan and Ms. Cave of the NSF Indian Head Environmental Office, accompanied the team. The range was inspected by walking around the approximate perimeter of the training areas. The team walked around the pond (Figures 10.2-7 and 10.2-6), through the woods east of Roach Road, and around Building 2210SN as shown on Map 10.2-1. The team followed trails through the woods where possible (Figure 10.2-8). Monitoring well 25MW02 was located during the visual survey. No evidence of explosives or MEC was observed during the visual survey. No evidence of the former buildings was identified during the visual survey. The area of the former volleyball courts remains undeveloped and

grass covered. At the time of the visual survey, construction of Building 2210SN was complete, and the landscaping and parking lot were being completed.

Figure 10.2-6: View of Pond and Building 60SN at Area 8

Figure 10.2-7: View of Pond Looking North from Building 60SN

Figure 10.2-8: View of Trail Walked in Woods East of Roach Road

A visual depiction of the results of range reconnaissance is provided on Map 10.2-1. Additional range/site details are illustrated on Map 10.2-2.

10.2.3 Munitions and Munitions-Related Materials Associated with the Site

This section describes the munitions and munitions-related materials known or suspected to be at the range. This includes both MEC and non-hazardous munitions-related debris (e.g., fragmentation, base plates, inert mortar fins).

Area 8 was used for testing demolition charges including: primers, detonators, fuzes, and squibs. Numerous water and air shot locations and a pond that were used to train military personnel to defuse explosive devices define Area 8. Inert ordnance items, including inert torpedoes and mines in the pond, were used for training of EOD personnel. Because no MEC were observed during the 2003 visual survey, it is probable that the training MEC were removed and transported to the new EOD School when Area 8 was closed in 1999.

In addition to the explosives used at Area 8 (TNT, PETN, and military dynamite) the following explosive devices were used at Area 8:

- Blasting caps
- Detonation cord

The fragmentation radius associated with training at Area 8 corresponds to the distance between the students and the explosives (30 feet for the water shots and 75 feet for the air shots). The water and air shots and their associated buffer areas are shown on Map 10.2-3.

Based on the information obtained during the data collection process, Area 8 is not suspected to contain CWM-filled munitions, electrically fuzed munitions, or DU-associated munitions.

10.2.4 MEC Presence

The entire range has been subdivided and categorized into one of three levels of MEC presence including known MEC areas, suspected MEC areas, and areas where no evidence exists to indicate that MEC is known or is suspected to be at the range. The categories of MEC presence at Area 8 are discussed below. Map 10.2-4 illustrates the munitions characterization of Area 8 and is provided at the end of Section 10.2 of this appendix.

Known MEC Areas

There are no known MEC areas associated with the range because the range was closed and operations were relocated in 1999.

Suspected MEC Areas

Based on historical evidence, Area 8 is identified as a range where MEC is suspected. The potential exists for MEC to be found throughout the range at the air and water shot locations and at the bottom of the pond.

Areas Not Suspected to Contain MEC

Because no MEC were identified during excavation for the Joint Forces EOD Equipment Magnetic Evaluation Facility, no MEC is suspected in the excavated area. Soil was excavated to a depth of 6 feet, and no MEC is expected below this depth based on the reported training that occurred at Area 8.

10.2.5 Ordnance Penetration Estimates

The depth to which munitions penetrate below the ground surface depends on many factors, including the type of soil, angle of impact, size of the munitions, velocity at impact, and range-specific environmental conditions.

Explosives at Area 8 were placed at 2 to 5 feet below the ground surface in holes filled with water for water shots. At the air shots locations, the explosives were suspended (on wire) approximately 2 feet above the ground surface. No penetration depths are associated with air and water shots because the explosives were either immersed in water or suspended in the air. Additionally, no penetration depths would be associated with the inert devices used in the training because they were placed on the surface by the EOD School, were not fired, and contained no projectile.

10.2.6 Munitions Constituents

Based on historical uses at Area 8, associated MC include TNT, PETN, military dynamite (75 percent RDX, 15 percent TNT, 5 percent motor oil), and metals.

It is estimated that approximately 50 to 75 pounds of ordnance (net explosive weight) were used at Area 8 every year. No more than 0.5 pound of explosives were used at air or water shot locations during

training exercises. The types of ordnance used included TNT block, PETN, military dynamite, blasting caps, detonation cord, and similar devices.

The 1990 Environmental Regulation of Ordnance and Ordnance Ranges states that the following ordnance items (and quantities) were expended annually at Area 8: M041 TNT half-pound block (1,030 each); M591 M-1 Dynamite (120 each); and M130 Electric Blasting Caps (1,090 each). There are no records of EOD responses for training at Area 8. Technical data for the associated MC are provided in Appendix D.

Sampling of soil, sediment, surface water, and groundwater were conducted in 1995 as part of the VI (Figure 10.2-9). Twenty-five of the most used water and air shot locations (including the surface water and sediment from the water shot locations and surface soil from the air shot locations) were sampled and analyzed by field test-kit screening for the presence of TNT, HMX, and RDX. The results of the field screening were used to locate the soil borings and monitoring wells. Three soil borings and three monitoring wells were installed to evaluate the potential for soil contamination. A boring (S25-SB01) was installed at the most used air shot location (24B). Borings S25-SB02 and S25-SB03 were selected based on the results of the field screenings at air shot locations 36/37B and 44/48B. Monitoring well S25-MW1 was installed adjacent to water shot location 7A, and monitoring well S25-MW02 was drilled adjacent to water shot location 7B. Monitoring well SB5-MW03 was installed upgradient of all water and air shot locations to characterize background soil and groundwater. Two soil samples were collected from each soil and well boring, one from the 0- to 2-foot interval and the other just above the water table.

Four surface water and sediment samples were collected at Area 8 using both field test-kit screening and fixed-based laboratory analysis. Sets of surface water and sediment samples were collected from: water shot location 7B, water shot location 23B, Chicamuxen Creek adjacent to water shot location 7A, and Chicamuxen Creek upstream of all water and air shot locations.

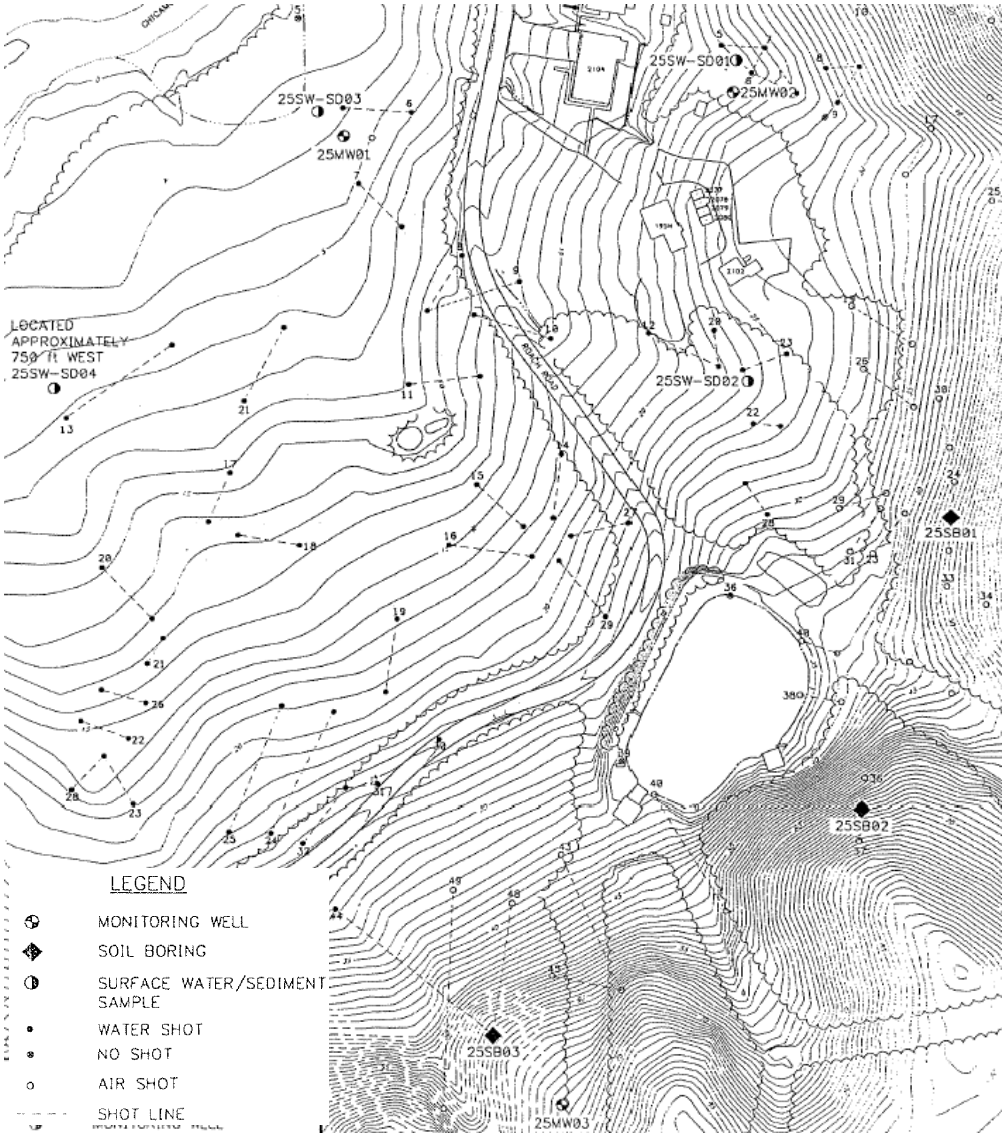


Figure 10.2-9: 1995 VI Sample Locations at Area 8

Visual observations and Photo-ionization Detector (PID) readings of soil from the borings did not identify any apparent contamination. Laboratory soil samples contained no SVOCs or energetic compounds; however, TNT and RDX were identified in surface soil field screening samples. TNT and RDX were detected in surface soil field screening samples at concentrations from less than 0.5 part per million (ppm) to 1.5 ppm. All detected concentrations were less than Region 3 RBCs for RDX and TNT. Metals were detected in soil samples at concentrations equal to or greater than two times the background concentrations. Maximum metals concentrations were generally detected in subsurface soil samples, particularly in the sample collected at the most used air shot location (SB01). Chloroform and bis(2 ethylhexyl) phthalate (BEHP) were the only target analyte organics detected in groundwater at

Area 8. No energetic compounds were detected in groundwater at the range. Metals concentrations in unfiltered groundwater samples exceeded primary federal standards. Groundwater constituent concentrations were generally greater in samples from upgradient monitoring well samples, which may indicate that groundwater at Area 8 has not been affected by range activities. BEHP, 4-amino-2,6-dinitrotoluene (an energetic compound), and metals were detected in Area 8 laboratory-analyzed surface water samples. Benzo(a)pyrene, BEHP, naphthalene, phenanthrene, and metals were detected in sediment samples at Area 8. TNT and RDX were detected in surface water and sediment field screening samples at concentrations from less than 5 parts per billion (ppb) to 15 ppb.

10.2.7 Contaminant Migration Routes

Explosives in soil could be present at Area 8 because the water shot locations had explosives between 2 and 5 feet below the water surface in 6-to 9-foot-deep holes, and the air shots were suspended above the ground surface. MC were not released into the pond during training at Area 8 because the items in the pond were connected to air shots located outside of the pond (Figure10.2-1).

Contaminants at Area 8 may potentially migrate within soil, groundwater, surface water, and sediment. Although erosion on the range is considered to be minimal, contaminants may become mobile within surface soil, particularly during extended periods of surface runoff. Stump Neck Annex has an extensive surface water hydrology system including the Potomac River, Chicamuxen and Mattawoman Creeks, and wetland areas. Portions of Area 8 are in a low-lying area containing wetlands on the northwestern edge of the range. Surface water runoff flows into these wetlands or into the pond. Contaminants migrating within surface water will follow the same paths until eventually reaching the Potomac River via Chicamuxen Creek. Sediment has the potential to migrate downstream if it is suspended in surface water flow. Based on a review of hydrogeological data, it is unlikely that MC in shallow groundwater would migrate to the deeper aquifers used as water supplies. However, shallow groundwater is still considered a potential exposure medium.

10.2.8 Receptors

Potential human receptors at Area 8 include authorized Navy personnel (military and civilian), visitors, contractors, maintenance workers, recreational users, and trespassers. Plant and animal biota are also potential receptors. Examples of ecological receptors include deer, wild turkey, waterfowl, amphibians, and fish.

Nearby Populations

Nearby populations are discussed in Section 10.1.8 of this appendix Area 8 overlaps a wildlife protection area.

Buildings Near/Within Site

The Joint Services EOD Equipment Magnetic Evaluation Facility, Building 2210SN, is located within Area 8. A storage shed, Building 60SN, and a nonmagnetic tank, Building 65 SN, are located at the pond. Figures 10.2-11 and 10.2-10 show the new Joint Forces EOD Equipment Magnetic Evaluation Facility. All other structures at the range have been demolished.

Figure 10.2-10: View of Building 2210SN Looking East from Roach Road

Figure 10.2-11: View of Parking Lot Looking East from Roach Road

When Area 8 was an active training area, Buildings 2104, 19SN, 60SN, 63SN, 65SN, 2077, 2078, 2079, 2080, and 2102 were in use. Refer to Table 10.2-1 for details on the historical and current buildings at Area 8. The information in Table 10.2-1 was obtained from historical maps and the Indian Head building database. An example of the historical maps used to identify the former buildings and range layout is included as Figure 10.2-12.

TABLE 10.2-1

AREA 8 BUILDING DESCRIPTIONS
NAVAL SUPPORT FACILITY INDIAN HEAD
INDIAN HEAD, MARYLAND

Building No.	Location	Date Built	Use	Status
2104	East of Roach Road	1972	Underwater Ordnance Applications Building	Demolished
19SN	East of current parking lot	1943	Training building	Demolished
60SN	East of pond	1943	Diver training building	---
63SN	East of current parking lot	---	Storage shed	Demolished
65SN	South of pond	1931	Nonmagnetic tank	---
2077	East of current parking lot	1966	Storage shed	Demolished
2078	East of current parking lot	1966	Storage shed	Demolished
2079	East of current parking lot	1966	Storage shed	Demolished
2080	East of current parking lot	1966	Storage shed	Demolished
2102	East of current parking lot	1972	Shelter	Demolished
2125	East of Roach Road, north of former Building 2104	1984	Training building	Demolished
2210SN	East of Roach Road, former location of Building 19SN	2003	Joint Services EOD Equipment Magnetic Evaluation Facility	---

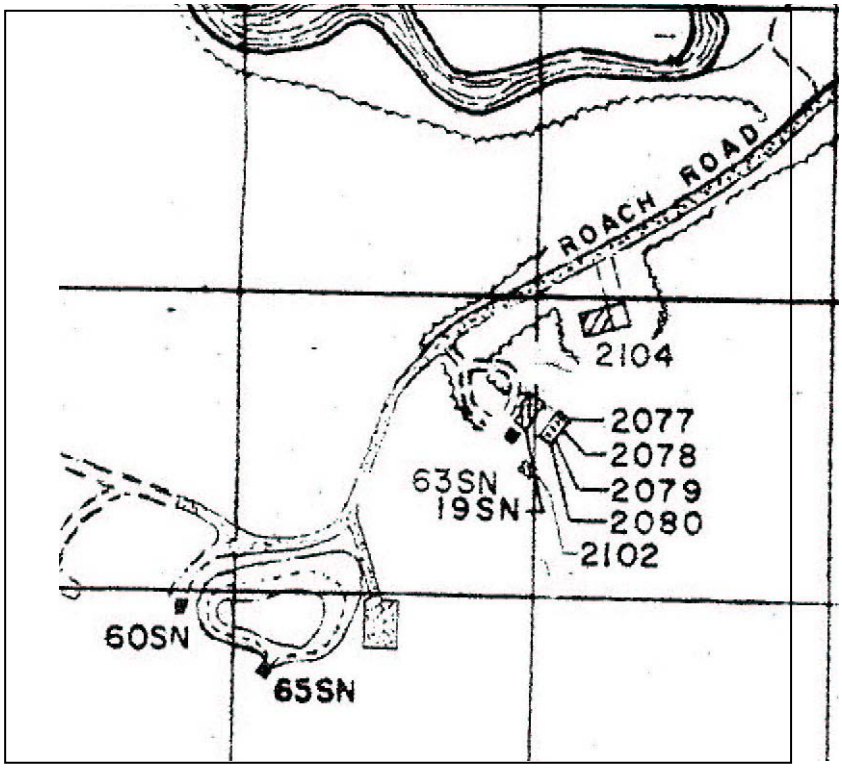


Figure 10.2-12: Former Buildings as Shown on 1983 Map of Reservation, Stump Neck Area

Utilities On/Near Site

The Joint Services EOD Equipment Magnetic Evaluation Facility at Area 8 is serviced by electricity, potable water, and sanitary sewer. The training building (60SN) is also serviced by electricity.

10.2.9 Land Use

There is no readily available information on land use at the site prior to 1957, but based on historical maps, it is assumed that this area was undeveloped. From 1957 until 1999, the range was maintained as an underwater demolition training area for the EOD School. After the school relocated, the buildings were demolished to make way for the Joint Services EOD Equipment Magnetic Evaluation Facility, which was built in 2003. Navy personnel use the pond at Area 8 for recreational fishing and picnicking. The wooded area surrounding the pond and existing building is unused. According to the installation, there are no planned changes to activities at Area 8.

10.2.10 Access Controls/Restrictions

Access to the Stump Neck Annex is limited by gated entrances, a security patrol, and a perimeter fence. Only Navy personnel and authorized contractors/visitors are allowed on the installation. A fence partially surrounds Area 8. A gate is located at the intersection of Roach Road and Archer Avenue. Forests surround the area on the eastern, southern, and western sides. Wetlands and Chicamuxen Creek border the northwestern edge. Access from the water is not controlled. According to the 2003-2004 Stump Neck Annex Hunting Map, hunting is not permitted within Area 8.

The wetlands located on the northwestern edge of the range are protected under Executive Order 11990, which prohibits construction in a wetland area unless there is no practicable alternative and all possible measures are taken to minimize the environmental impacts. Wetlands are also protected under Section 404 of the Clean Water Act, which requires a permit to be obtained from the United States Army Corps of Engineers (USACE) before any work in a wetland can commence. The wetlands at Area 8 are under the category of Palustrine forested broad-leaved deciduous wetland.

The 100-year floodplains that cover a major portion of Area 8 are protected under Executive Order 11988, which restricts development within the 100-year floodplain to water-dependent activities. Any construction within the floodplain must be in accordance with regulations promulgated by the Federal Insurance Administration pursuant to the National Flood Insurance Act of 1968. Permits for construction within the 100-year floodplain are also required and are administered by the Waterway Permits Division of the Maryland Department of Natural Resources.

According to the Master Plan Update, many of the soil types on Stump Neck and Indian Head have load-bearing capacity limitations as a result of high water tables and extreme erodability conditions. Based on this information, the installation has limited construction and the use of septic systems in specific areas of concern. Area 8 is located in an area with a seasonal high water table and overlaps an area containing hydric soil. The range also overlaps a restricted area in which septic systems are prohibited.

10.2.11 Conceptual Site Model

As seen on Figure 10.2-13, the MEC Exposure Pathway Analysis, the potential exists for MEC at the surface of the range. Based on this potential, the figure identifies the exposure pathways through which range receptors could come in contact with or be impacted by MEC. Potentially complete pathways exist for human and ecological receptors for MEC in surface soil. This includes receptors for hand/tread underfoot contact and surface intrusive work that may be conducted at Area 8. These activities include, but are not limited to, excavation, plowing, tilling, construction, and environmental sampling for human

receptors. Ecological receptors may come in contact with MEC through burrowing, nesting, or feeding activities that disturb surface soil. Trespassers are anticipated to be exposed via non-intrusive surface soil activities at the range, but it is unlikely they would be exposed to subsurface soil through intrusive activities. MEC are not anticipated in subsurface soil at the range because the items were placed on the surface, so this is not included as a potential pathway in Figure 10.2-13.

As illustrated in the MC Exposure Pathways Analysis (Figure 10.2-14), soil and surface water/sediment impacted by MC represent a primary source medium. Potential receptors include both human and ecological receptors that may disturb, unbury, or remove the source medium from the range. Potentially complete exposure pathways exists for surface soil through ingestion, dermal contact, and inhalation for human and ecological receptors. Runoff, discharges, and/or erosion may transport MC from surface soil to surface water/sediment, so potentially complete pathways also exist for all human and ecological receptors of surface water/sediment. Soil also represents an exposure medium when considering plant/animal uptake for biota (including game such as deer) and human receptors consuming the affected biota (e.g., fishing and hunting). Although hunting is not permitted at Area 8, hunters may wander into the range or consume game that came in contact with MC at the range. Explosives in soil could be present because the water shot locations had explosives between 2 and 5 feet below ground surface in the 6- to 9-foot-deep water shot locations; however, samples from the VI do not support this. There is potential for the MC present in the water to infiltrate to subsurface soil or surficial groundwater. Thus, potentially complete exposure pathways exist for MC in subsurface soil for all human and ecological receptors with the exception of trespassers. It is not anticipated that trespassers would come in contact with subsurface soil. Although confining layers are expected to prevent the migration of MC to the lower aquifers used for water supplies, potentially complete pathways exist for MC in shallow groundwater for human receptors. A graphical illustration of the CSM is presented in Figure 10.2-15.

Figure 10.2-13: MEC Exposure Pathway Analysis

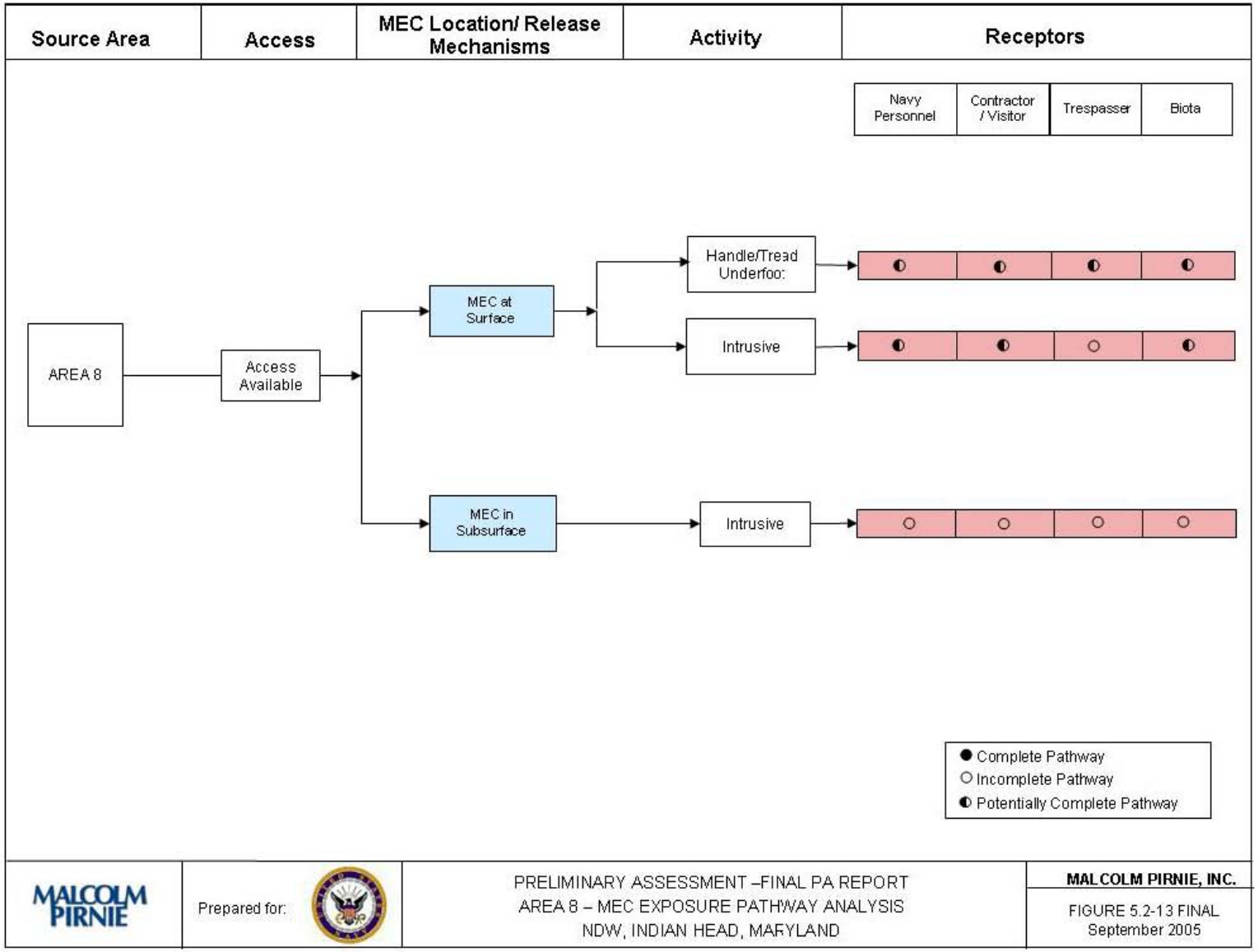


Figure 10.2-14: MC Exposure Pathway Analysis

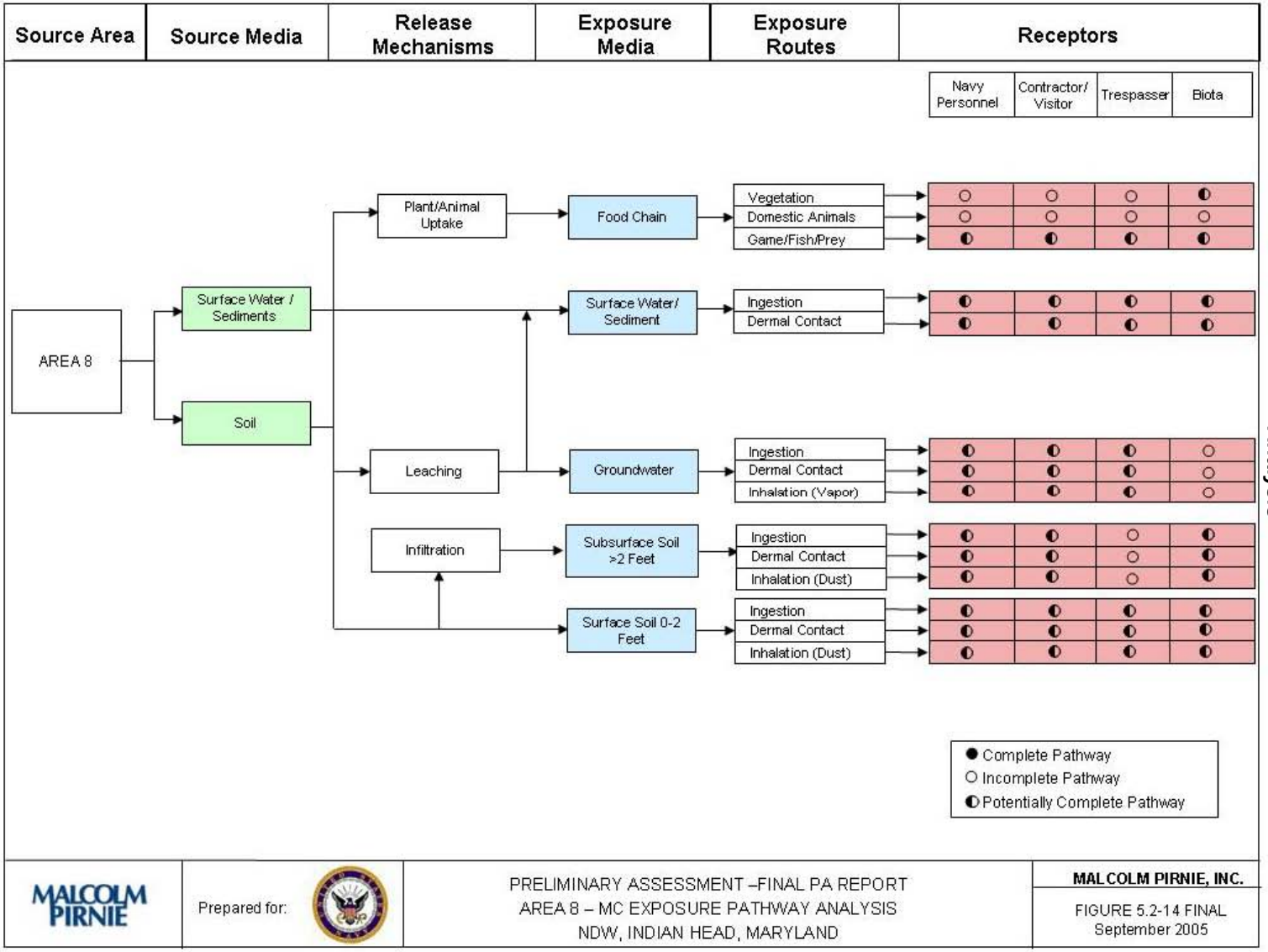
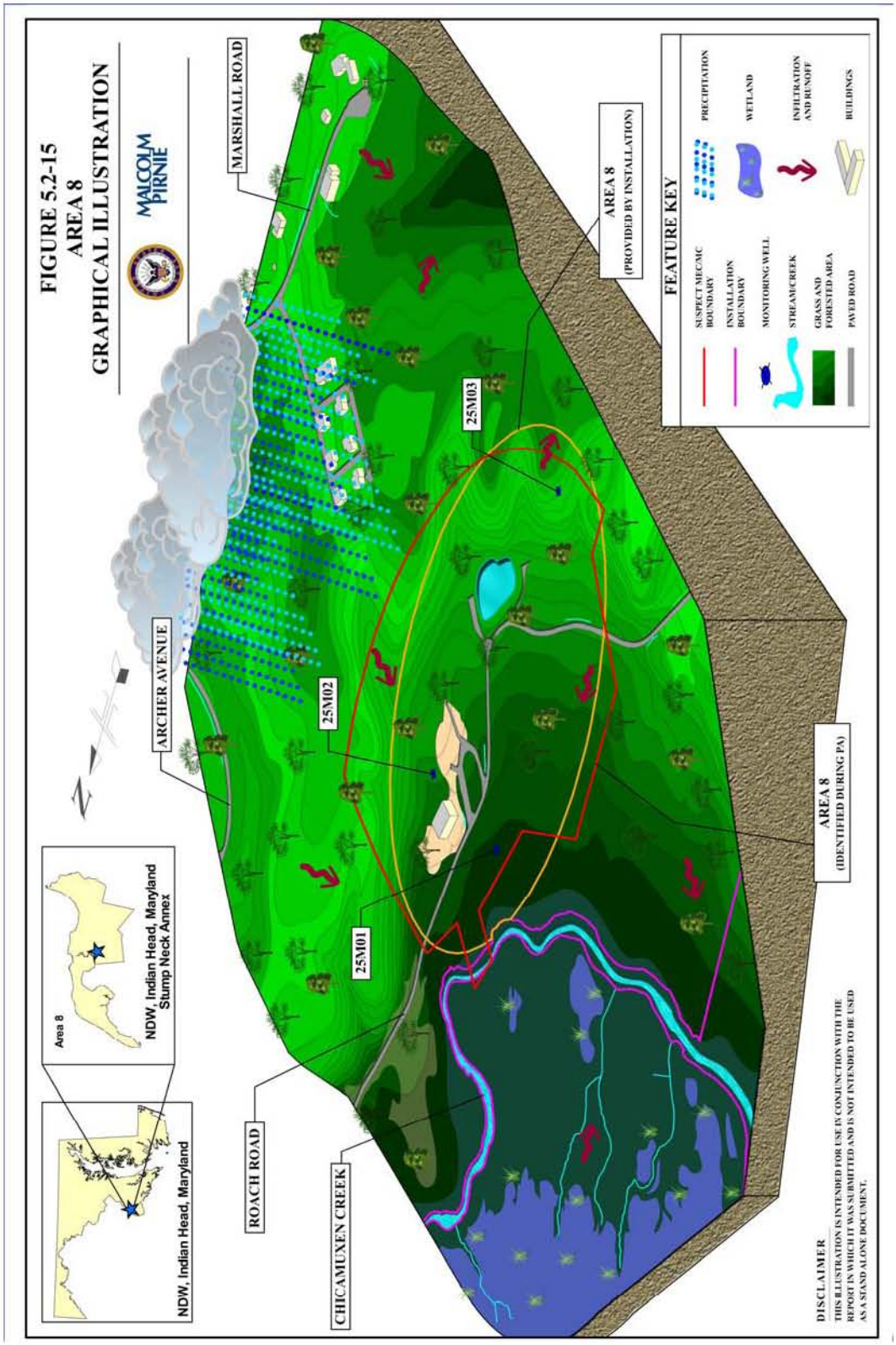


Figure 10.2-15: Area 8 Graphical Illustration



10.2.12 Problem Definition Summary

Area 8 occupies 22.61 acres in the central portion of NSF Indian Head, Stump Neck Annex. The area was used from 1957 to 1999 for testing demolition charges including primers, detonators, fuzes, and squibs. Numerous water and air shot locations and a pond were used at Area 8 to train military personnel to defuse explosive devices. Area 8 is the location of the current Joint Services EOD Equipment Magnetic Evaluation Facility. Navy personnel use the pond at Area 8 for recreational fishing. The wooded area is unused, and the land use of Area 8 is not proposed to change. Area 8 is considered a suspect MEC area, and MC associated with Area 8 include TNT, PETN, and military dynamite. Historical documentation and NSF Indian Head personnel indicated that no other explosives or munitions were used at the range, and that the range was not used for any other purposes. Sampling of soil, sediment, surface water, and groundwater were conducted in 1995. Laboratory analysis of collected soil samples detected no SVOCs or energetic compounds; however, TNT and RDX were identified in surface soil field screening samples. No energetic compounds were detected in groundwater at the range. Metals concentrations in unfiltered groundwater samples exceeded primary federal standards, and metals were detected in Area 8 surface water. Groundwater constituent concentrations were generally greater in samples from upgradient monitoring wells, indicating that groundwater at Area 8 has not been affected by range activities.

Munitions Types

Inert ordnance items were used at Area 8 for the training of EOD personnel. Approximately 12 classes each year from 1957 to 1999 used the render-safe training locations in Area 8. Half-pound TNT explosive charges were placed at 6 to 9 feet below the ground surface in holes (a few feet in diameter) that were filled with surface water to a depth of 4 to 5 feet for the water shots. The explosive charge was placed in the hole between 2 and 5 feet below the water surface. EOD students would work on the inert training item at safe a distance of about 30 feet from the water shot explosive charge location.

Similar charges were used for the air shots, which had the explosive charges suspended on a wire approximately 2 feet above the ground surface. Students would work on a connected but inert training item at a distance of 75 feet from the air shot explosive charge location.

The pond at Area 8 contained only inert torpedoes and mines for student training in performing diving and reconnaissance operations. No live munitions or explosives were used in the pond.

The following explosive devices were used at Area 8:

- TNT block
- PETN (pentaerythritol tetranitrate)
- Military Dynamite - 75 percent RDX, 15 percent TNT, 5 percent motor oil, and 5 percent cornstarch
- Blasting caps
- Detonation cord
- Other similar devices

It has been estimated that 50 to 75 pounds of ordnance (net explosive weight) were used at this training facility annually from 1957 to 1999.

Maximum Probable Penetration Depth

No penetration depths are associated with the air and water shots performed in Area 8 because the explosive charges were either immersed in water or suspended in air. Additionally, no penetration depths would be associated with the inert training devices because they were placed on the surface by the EOD School, were not fired, and did not contain projectiles.

MEC Density

The potential for MEC is suspected in the vicinity of the Area 8 water explosive shot locations and air explosive shot locations used in conjunction with the EOD School inert ordnance training items. The potential exists for MEC to be found throughout the Area 8 range at the air and water shot locations and at the bottom of the pond.

The Joint Forces EOD Equipment Magnetic Evaluation Building was constructed in the spring of 2003. During the construction activities, 6 feet of soil was excavated for the foundation. No MEC were noted during this excavation.

MEC Scrap/Fragments

The entire Area 8 area except the excavated areas for the EOD Equipment Magnetic Evaluation Building is suspected to contain MEC. However, no MEC have been found in Area 8, and no MEC were observed during the visual survey of Area 8 in June 2003. Explosive soil may be present because the water shot locations had explosives between 2 and 5 feet bgs in the 6- to 9-foot-deep water shot locations, although the samples from the VI do not support the presence of explosive soil.

Associated Munitions Constituents

Historically identified MC in Area 8 include:

- TNT block
- PETN

- Military dynamite
- Metals

The 1995 VI included the sampling of soil, sediment, surface water, and groundwater. Twenty-five of the most used water and air shot locations (surface water and sediment from the water shot locations and surface soil from the air shot locations) were sampled and analyzed by field test-kit screening for the presence of TNT, HMX, and RDX. The results of the field screening analyses were used to guide the locations of the soil boring and monitoring wells. Three soil borings and three monitoring wells were installed to evaluate the potential for soil contamination. Two soil samples were collected from each soil and well boring for laboratory analysis, one from the 0 to 2 feet and one from just above the water table. A set of four surface water and sediment samples were collected for field test-kit screening and laboratory analysis.

The laboratory-analyzed soil samples contained no SVOCs or energetic compounds, although TNT and RDX were identified in surface soil field screening samples (at 0.5 to 1.5 ppm). Metals were detected in soil samples at levels equal to or greater than two times background concentrations. The maximum metals concentrations were detected in subsurface soil samples, particularly in the samples collected at the most used air shot locations (SB01). Chloroform and BEHP were the only target analyte organics detected in groundwater at Area 8. No energetic compounds were detected in groundwater at Area 8. Metals concentrations in unfiltered groundwater samples exceeded primary federal standards. BEHP, 4-amino-2,6-dinitrotoluene (an energetic compound), and metals were detected at Area 8 surface water. Benzo(a)pyrene, BEHP, naphthalene, phenanthrene, and metals were detected in sediment samples at Area 8. TNT and RDX were detected in surface water and sediment field screening samples at concentrations from less than 5 to 15 ppb.

Migration Routes/Release Mechanisms

Contaminants at Area 8 may potentially migrate within soil, groundwater, surface water, and sediment. There is the possibility for MC present in water to infiltrate to subsurface soil or surficial groundwater. Therefore, potentially complete exposure pathways exist for MC in subsurface soil (direct contact, ingestion, and inhalation) during intrusive soil activities (construction/excavation) for human and ecological receptors.

Potential human receptors that may contact MC in subsurface soil include Navy personnel, visitors, contractors, range maintenance workers, recreational users, and trespassers. Plant and animal biota are potential receptors that may contact MC directly through surface water/soil or indirectly through the food chain (bioaccumulated in plants and animals). Examples of ecological receptors at Area 8 include deer, wild turkey, waterfowl, amphibians, and fish.

Relationship of MEC/MC Sources to Habitat and Potential Receptors

Receptors may contact MEC in subsurface soil. Receptors may have contact with MC directly through surface water/soil or indirectly through the food chain (bioaccumulated in plants and animals).

Problem Definition/Conceptual Site Model for EOD School Demolition Area (UXO 28)

10.3 EOD SCHOOL DEMOLITION AREA

10.3.1 History and Site Description

The EOD School Demolition Area occupies approximately 5 acres on Stump Neck Annex within the boundaries of the Marine Rifle Range and partially within the boundaries of the Torpedo Burial Site. The EOD School Demolition Area consists of an open field and wooded areas (see Figure 10.3-1). The EOD School Demolition Area is mentioned in a report written by a former bomb disposal officer who was employed at Stump Neck Annex from September 1944 to November 1945. The report describes a "large field" on the left side of the road, immediately past the former entrance gate, where he and his colleague would introduce graduating students to live explosives. They would demonstrate "the use of blocks of TNT, Tetryl packs, caps, primer cord, safety fuse and shape charges." The report further states that "students took their turns using the cap blaster, blasting blocks of TNT, shearing rails and trees, creating blow holes in the ground and splitting live bombs in situ by using shape charges." The clearing described in this report is visible on a map showing conditions at Stump Neck on June 30, 1945 (see Figure 10.3-2).

Figure 10.3-1: Current Site Conditions of the EOD School Demolition Area

As shown on Figure 10.3-2, the entrance gate (Bldg. 10-SN) in 1945 was located east of the causeway, just before the intersection of Roach Road and Archer Avenue. Heading west on Archer Ave. and past the causeway, the clearing is visible on the map immediately south of Archer Ave., as described in the former bomb disposal officer's report. This clearing appears unchanged in later maps, until a June 30, 1949, map shows a Ballistic Mortar Shed (Bldg. 2075) on the eastern side of the clearing (see Figure 10.3-3).

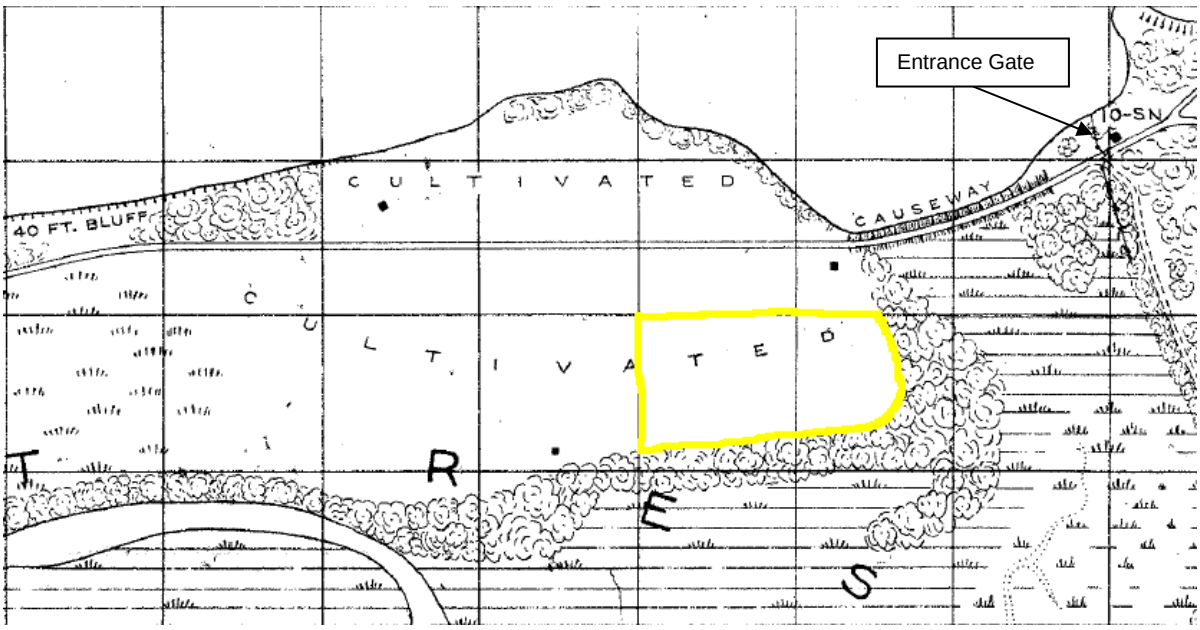


Figure 10.3-2: 1945 Map Showing EOD Demolition Area

Therefore, it is assumed that this EOD School Demolition Area was used from September 1944 until approximately June 1949 when the building was built on the clearing, preventing its use as a demolition area. The EOD Demolition Area is located within the estimated firing fan of The Valley located at NSF Indian Head, Main Installation. Information on the Valley is also provided in Section 10.8 of this appendx, the Valley Impact Area.

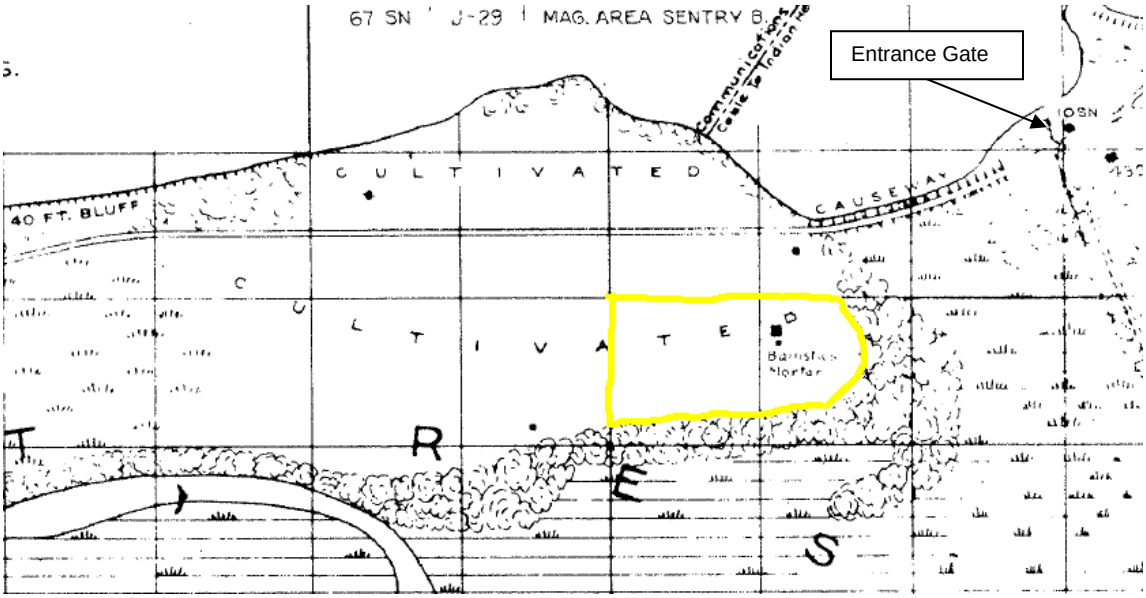


Figure 10.3-3: 1949 Map Showing EOD Demolition Area

Topography

Section 10-3.2 of this appendix provides a general description of topography at the Stump Neck Annex. At the EOD School Demolition Area, the topography is relatively flat. Elevations at the EOD School Demolition Area range from 5 to 10 feet above msl.

Geology

Section 10-3.3 of this appendix provides a geologic description for the Stump Neck Annex. This general description is applicable to the EOD School Demolition Area.

Soil and Vegetation Types

Section 10-3.4 of this appendix provides a description of soil and vegetation types at the Stump Neck Annex. The EOD School Demolition Area is located in a hardwood forest area, with wetland areas to the south and east. According to the Soil Survey of Charles County (USDA, 1974), the soil at the EOD School Demolition Area is classified as Mattapex silt loam with 0 to 2 percent slopes.

Hydrology

Section 10-3.5 of this appendix provides a description of hydrology at the Stump Neck Annex. The EOD School Demolition Area is bounded by Archer Avenue, wooded areas, and wetlands. Surface runoff is in the direction of Chicamuxen Creek.

Hydrogeology

Section 10-3.6 of this appendix provides a description of hydrogeology for the Main Installation. This information is applicable to the EOD School Demolition Area.

Cultural and Natural Resources

General cultural and natural resources for Stump Neck Annex are described in Section 10-3.7 of this appendix. The 1996 Phase I Cultural Resources Survey of Stump Neck Annex and Supplemental Architectural Investigations identified one site within the EOD School Demolition Area. The site and associated locations of prehistoric and historic findings are identified on Figure 10.3-4.

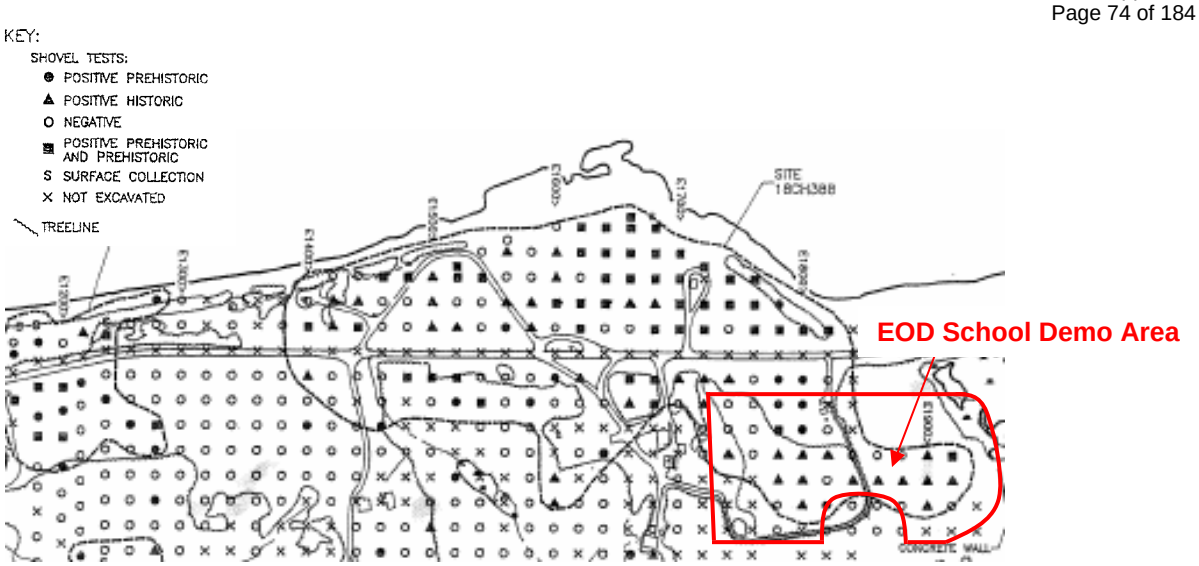


Figure 10.3-4: Cultural Resources Identified in Shovel Test Pits

Endangered and Special Status Species

As discussed in Section 10-3.8 of this appendix, endangered and special status species are reported to exist at Stump Neck Annex and thus have the potential to inhabit the EOD School Demolition Area.

10.3.2 Visual Survey Observations and Results

A visual survey of the EOD School Demolition Area was conducted on June 2, 2004, by Malcolm Pirnie personnel. Ms. Heidi Morgan, NSF Environmental Office, accompanied the team. However, the visual survey was conducted at an area adjacent to the EOD School Demolition Area, which was believed to be the location of the site at the time. Because the EOD School Demolition Area is located within the Marine Rifle Range, the area was visually surveyed during the initial site visit on June 26, 2003. No MEC was observed within the EOD School Demolition Area during the June 2003 site visit.

A visual depiction of the site reconnaissance route as well as additional range/site detail are provided on Map 10.3-1.

10.3.3 Munitions and Munitions-Related Materials Associated with the Site

This section describes the munitions and munitions-related materials known or suspected to be at the range, including the types and estimated maximum penetration depths. This includes both MEC and non-hazardous munitions-related debris (e.g., fragmentation, base plates, inert mortar fins). Potential

ordnance concentration areas are presented along with a discussion on the presence of any special consideration ordnance.

Based on historical documents and information obtained during the data collection process, it is expected that TNT, Tetryl packs, shape charges, caps, primer cords, safety fuses, 100-pound bombs, and other live bombs were used at the EOD School Demolition Area.

The EOD School Demolition Area is overlapped by the firing fan from the Valley located at the Main Installation. Thus, there is a potential for munitions associated with the Valley to be present at the EOD School Demolition Area. Refer to Section 10.8 of this appendix for information on the Valley Impact Area.

Based on the information obtained during the data collection process, the EOD School Demolition Area is not suspected to contain CWM-filled munitions, electrically fuzed munitions, or DU-associated munitions

10.3.4 MEC Presence

The EOD School Demolition Area has been assessed based on the likelihood of MEC contamination and assigned to one of three categories: (1) Known MEC Area; (2) Suspect MEC Area; or (3) Area Where No MEC Evidence Exists. The EOD School Demolition Area is overlapped by the firing fan from the Valley located at the Main Installation. Thus, there is a potential for munitions associated with the Valley to be present at the EOD School Demolition Area. Refer to Section 10.8 of this appendix for information on the Valley Impact Area. Only MEC presence specifically related to the EOD School Demolition Area is considered. Map 10.3-2 illustrates the munitions characterization of the EOD School Demolition Area and is provided at the end of Section 10.3 of this appendix.

Known MEC Areas

Based on historical documents and information obtained during the data collection process, there are no areas at the EOD School Demolition Area known to contain MEC.

Suspected MEC Areas

Based on its reported use, the entire EOD School Demolition Area is a suspected MEC area.

Areas Not Suspected to Contain MEC

There are no areas of the EOD School Demolition Area not suspected to contain MEC.

10.3.5 Ordnance Penetration Estimates

The depth to which munitions penetrate below the ground surface depends on many factors, including the type of soil, angle of impact, size of the munitions, velocity at impact, and site-specific environmental conditions.

There is no ordnance penetration depth associated with the EOD School Demolition Area. Explosives were used on the surface for demonstration purposes; no firing of munitions took place at this site. The EOD School Demolition Area is overlapped by the firing fan from the Valley located at the Main Installation. Thus, there is a potential for munitions associated with the Valley to be present at the EOD School Demolition Area. The ordnance penetration depths associated with munitions fired from the Valley are provided in Section 10.8 of this appendix, the Valley Impact Area.

10.3.6 Munitions Constituents

Munitions constituents potentially present at the EOD School Demolition Area include metals, TNT, explosive residuals, and Tetryl. The EOD School Demolition Area is overlapped by the firing fan from the Valley at the Main Installation. Thus, there is a potential for munitions associated with the Valley to be present at the EOD School Demolition Area. Refer to Section 10.8 of this appendix for information on the Valley. Only the munitions constituents that specifically relate to the EOD School Demolition Area are considered.

10.3.7 Contaminant Migration Routes

Environmental media through which MC may migrate from the EOD School Demolition Area include soil, groundwater, surface water, and sediment. Direct human or biota contact with surficial and subsurface soil is possible if the soil is disturbed. The proximity of the EOD School Demolition Area to Chicamuxen Creek provides possible migration routes to surface water. The majority of the area is sloped toward the creek, and storm water discharges to surface water via overland flow. Groundwater flow in the shallow water table aquifer also likely flows towards Chicamuxen Creek; therefore, MC leaching from soil into shallow groundwater may migrate to surface water. Based on a review of hydrogeological data, it is unlikely that MC in shallow groundwater would migrate to the deeper aquifers that are used as water supplies. However, shallow groundwater is still considered a potential exposure medium. Sediments can act as contaminant repositories, and sediment mixing and dredging can act as a migration route for contaminants to surface water. MC in surface soil and sediments may migrate via plant/animal uptake.

10.3.8 Receptors

Potential human receptors at the EOD School Demolition Area include authorized Navy personnel (military and civilian), visitors, contractors, maintenance workers, hunters, and trespassers. Plant and animal biota are also potential receptors. Examples of ecological receptors at the site include deer, wild turkey, and water fowl.

Nearby Populations

Nearby populations are as discussed in Section 10.1 of this appendix The Chicamuxen WMA is located approximately 245 feet downstream of the EOD School Demolition Area, and it is used by recreational hikers, hunters, and fishers. Residential properties are located 2 miles south of the range.

Buildings Near/Within Site

A number of buildings, including Buildings 2019 (Influence Mine Test), 2075 (Ballistic Motor Shed), 2101 (Vehicle Shelter), 2156, and D-21CSN, are located within the EOD School Demolition Area. Buildings 2012 and 2174 are located across from Archer Avenue, to the north and northwest of the EOD School Demolition Area, respectively.

Utilities On/Near Site

Utilities within the EOD School Demolition Area include potable water on the western side and sanitary sewer toward the center of the range. Electric utilities are located outside the northwestern corner of the range.

10.3.9 Land Use

During its use as the EOD School Demolition Area, the range was an open field. Buildings 2075 (Ballistic Mortar Shed), 2019 (Influence Mine Test), 2101 (Vehicle Shelter), 2156, and D-21CSN are located on this site. The rest of the site consists of unused wooded or mowed grass areas. The EOD School Demolition Area is located within an upland hunting area according to the 2003-2004 Stump Neck Annex Hunting Map.

10.3.10 Access Controls/Restrictions

No public access is authorized at NSF Indian Head. Signs, partial fencing, locked/secured gates, login book/office check-in, and vehicle security patrol control the entire facility. There are no access control

features specific to the EOD School Demolition Area. Access from the water is not controlled. There are no known land use/development restrictions for the range.

10.3.11 Conceptual Site Model

The following CSM exposure pathways analysis focuses only on the EOD School Demolition Area and does not consider impacts from the Valley firing fan. For exposure pathway analysis for the Valley, refer to Section 10.8 of this appendix.

The nature of the activities that presumably occurred at the EOD School Demolition Area suggests that MEC may be present. Therefore, potentially complete pathways exist for human and ecological receptors for MEC in surface soil. This includes receptors for hand/tread underfoot contact as well as intrusive work that may be conducted at the EOD School Demolition Area. Trespassers are anticipated to be exposed via non-intrusive surface soil activities at the range, but it is unlikely they would be exposed to subsurface soil through intrusive activities. MEC is not anticipated in the subsurface because explosives were only used on the surface at this site. An Exposure Pathway Analysis for MEC at the EOD School Demolition Area is presented as Figure 10.3-5.

As illustrated on Figure 10.3-6, the MC Exposure Pathway Analysis, soil impacted by MC represents a primary source medium. Exposures to surface soil, subsurface soil, and surface water/sediment containing MC may present potentially complete pathways for human and ecological receptors. All human and ecological receptors have potentially complete exposure pathways for direct contact with MC in surface soil, which includes dermal contact, ingestion, and inhalation (dust). Runoff and/or erosion may transport the MC from surface soil to surface water/sediment, so a potentially complete pathway also exists for all human and ecological receptors of surface water/sediment. Precipitation infiltration may provide for contaminant mobility into the subsurface soil and into the shallow surficial groundwater aquifer, which is assumed to be connected to nearby surface water bodies. Potentially complete exposure pathways exist for MC in subsurface soil (direct contact, ingestion and inhalation during intrusive work activities). The food chain is also a potentially complete pathway because hunting is permitted within much of the site. Although confining layers are expected to prevent the migration of MC to the lower aquifers used for water supplies, potentially complete pathways exist for MC in shallow groundwater for human receptors.

Figure 10.3-5: MEC Exposure Pathway Analysis

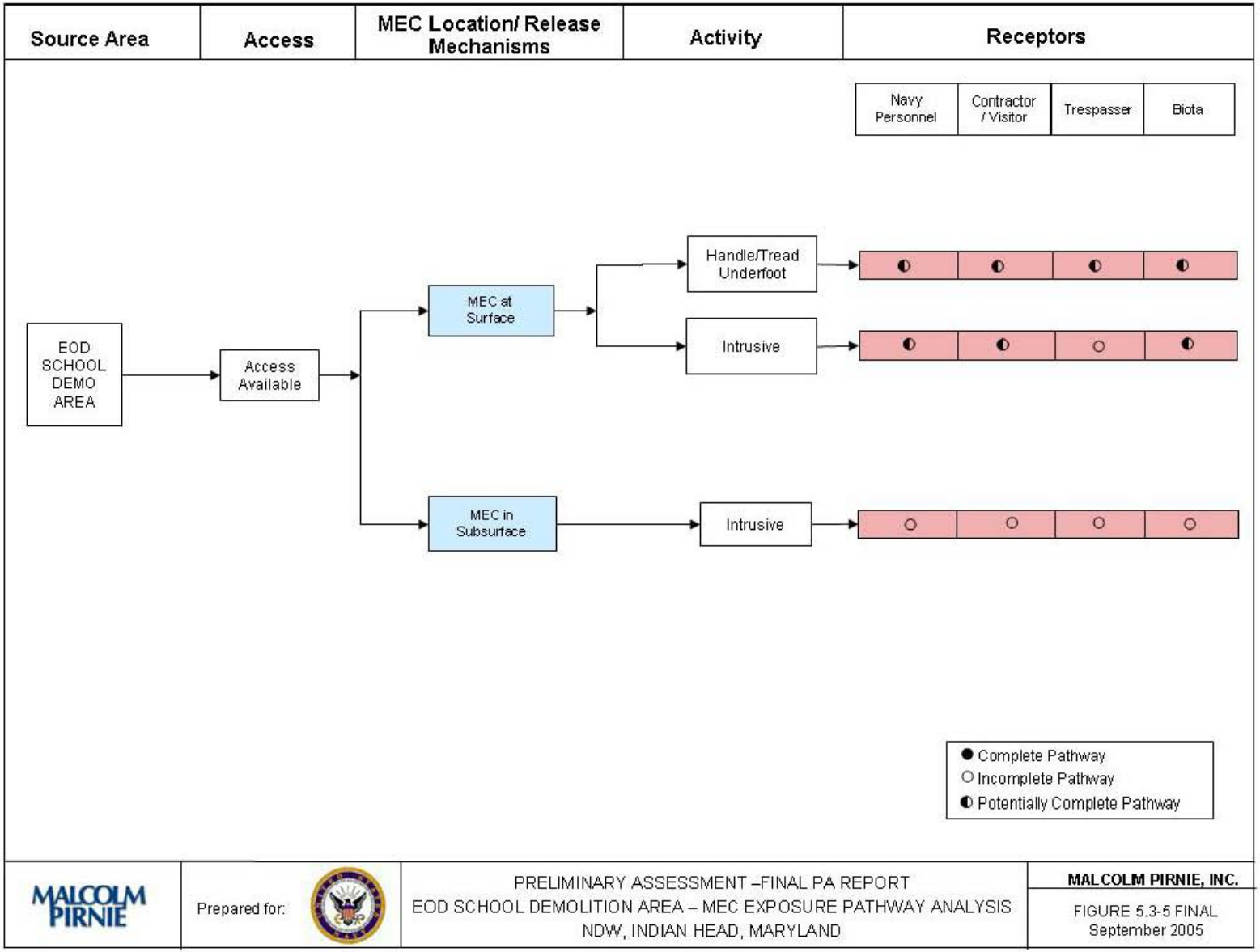
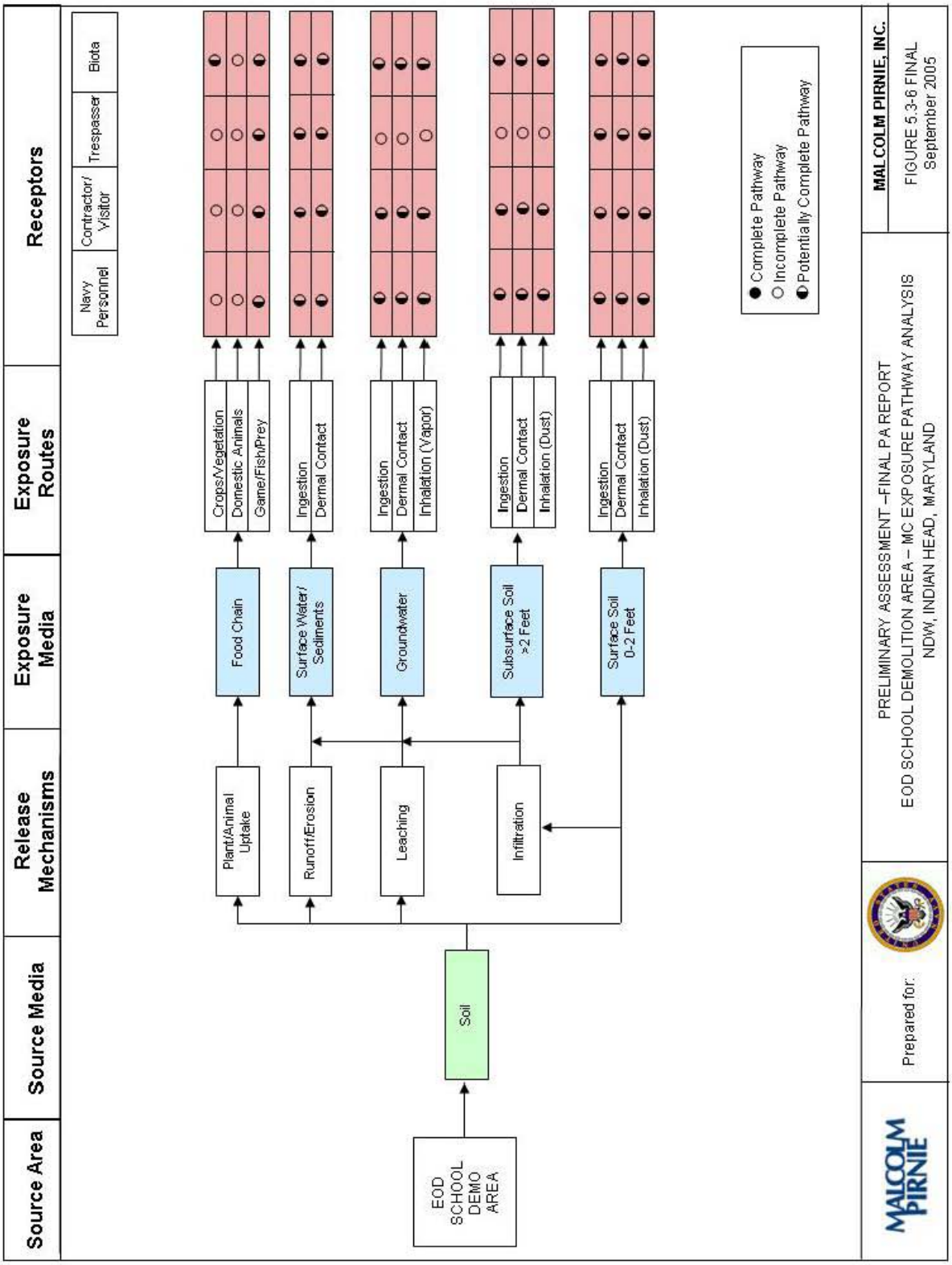


Figure 10.3-6: MC Exposure Pathway Analysis



10.3.12 Problem Definition Summary

Based on information gathered during the PA, the EOD School Demolition Area was used from 1944 to 1949 as a training area to introduce graduating students to live explosives. The site is located on Stump Neck Annex, within the boundaries of the Marine Rifle Range and the Torpedo Burial Site. Both MEC and MC are expected to be present at the EOD School Demolition Area. Potential MEC include TNT, Tetryl packs, shape charges, caps, primer cords, safety fuses, 100-pound bombs, and other live bombs. The primary MC of concern are metals, explosive residuals, TNT, and Tetryl.

MEC Density

The EOD School Demolition Area is overlapped by the firing fan from the Valley Impact Area, thus there is potential for munitions associated with the Valley to be present at the EOD School Demolition Area.

Munitions Types

TNT, Tetryl packs, shape charges, caps, primer cords, safety fuses, 100-pound bombs, and other live bombs were used in the EOD School Demonstration Area.

Maximum Probable Penetration Depth

There is no associated penetration depth for this area based on the training activities reported for the EOD School Demolition Area because munitions were not fired at the site.

MEC Density

The anticipated MEC density at the EOD School Demolition Area is low due to the development at that location over the past 50 years.

Because the EOD School Demolition Area is within the estimated firing fan of the Valley Impact Area, there is the potential for MEC from that area to be within the subsurface at this site. There was no evidence of MEC/MC observed within the Valley Impact Area during the 2003 visual surveys attributed the former usage of the Valley Impact Fan. However, based on historical documents obtained during the data collection process, MEC is suspected for the Valley Impact Area (including the EOD School Demolition Area). Therefore the entire 5 acres of wooded and grassed fields of the EOD School Demolition Area are suspected to contain MEC.

MEC Scrap/Fragments

None anticipated.

Associated Munitions Constituents

Potential MC related to the EOD School Demolition Area activities include metals, TNT, explosive residuals, and Tetryl.

Migration Routes/Release Mechanisms

Soil surface runoff; soil leaching; groundwater discharge; site maintenance; construction; excavation.

Relationship of MEC/MC Sources to Habitat and Potential Receptors

Receptors may have direct or indirect contact with MEC/MC that exist in the environment or have been incorporated into the food chain.

Problem Definition/Conceptual Site Model For IED Practical Training Area (Basic IED Area) (UXO 04)

10.4 IED PRACTICAL TRAINING AREA (BASIC IED AREA)

10.4.1 History and Site Description

The Basic IED Area was originally identified as the IED Area during the Navy's Range Inventory. The name was changed as a result of information obtained during the research conducted to prepare this SAP. The Basic IED Area is a 3.79-acre range located on the western-central portion of Stump Neck Annex, south of Archer Avenue. The range is accessed by an unnamed dirt road extending from Archer Avenue through the middle of the range and into the southern portion of the range. The range is overgrown with open grassy fields and shrub/wooded areas.

The Basic IED Area was used from November 1957 until approximately 1996 for the testing and demonstration of various explosive devices. Based on historical documentation and maps available for review, the Basic IED Area was formerly part of the EOD School at NSF Indian Head. The EOD School was divided into Divisions I through V, and Division II was further divided into Areas 1A and 1B. The Basic IED Area corresponds to Division II Area 1B. At this area, students were trained in making and dismantling IEDs. It is assumed that the entire area was closed by 1996 when a VI was performed. One portion of the area was used until 1991 to demonstrate the explosive potential of common household chemical mixtures.

Basic IED Area included Building 2158 (bleachers), Building 2118 (mixing with French drain), Building 2063 (observation area), two unnamed storage buildings, the Incendiary Demonstration Area, and the Detonation Demonstration Area. In Building 2118, containers used to measure IED chemicals were rinsed in a sink that discharged to a French drain and then directly to the ground. The storage buildings were used to store IED chemicals for approximately 20 years. The other sites of interest were used for a variety of demonstration purposes. The bleachers were used when demonstrating to students the effects of mixing household chemicals. Specific information about the types of munitions used at each of these areas is not available. The layout of these designated areas is illustrated on Figure 10.4-1. Only Building 2087, formerly used for instructor office space, remains. Former building 42SN was used as a classroom and a workshop.

In 1996, a VI Report was submitted on the Naval School EOD sites. Investigations were performed at four SWMU sites, including the Basic IED Area (SWMU #26, IR Site #64). Soil and groundwater samples

were collected and analyzed to determine the nature and extent of contamination. Seven soil borings were drilled at the range, and two samples were collected from each boring. Three of the borings were then converted to monitoring wells 26MW01, 26MW02, and 26MW03. The VI concluded that no further action was needed at the Basic IED Area; however, USEPA disagreed and decided that the range needed further investigation. The results of the VI are discussed in more detail in Section 5.4.6 of the PA. The Basic IED Area is located within the estimated firing fan from the Valley. Information on the Valley is provided in Section 10.8 of this appendix, the Valley Impact Area.

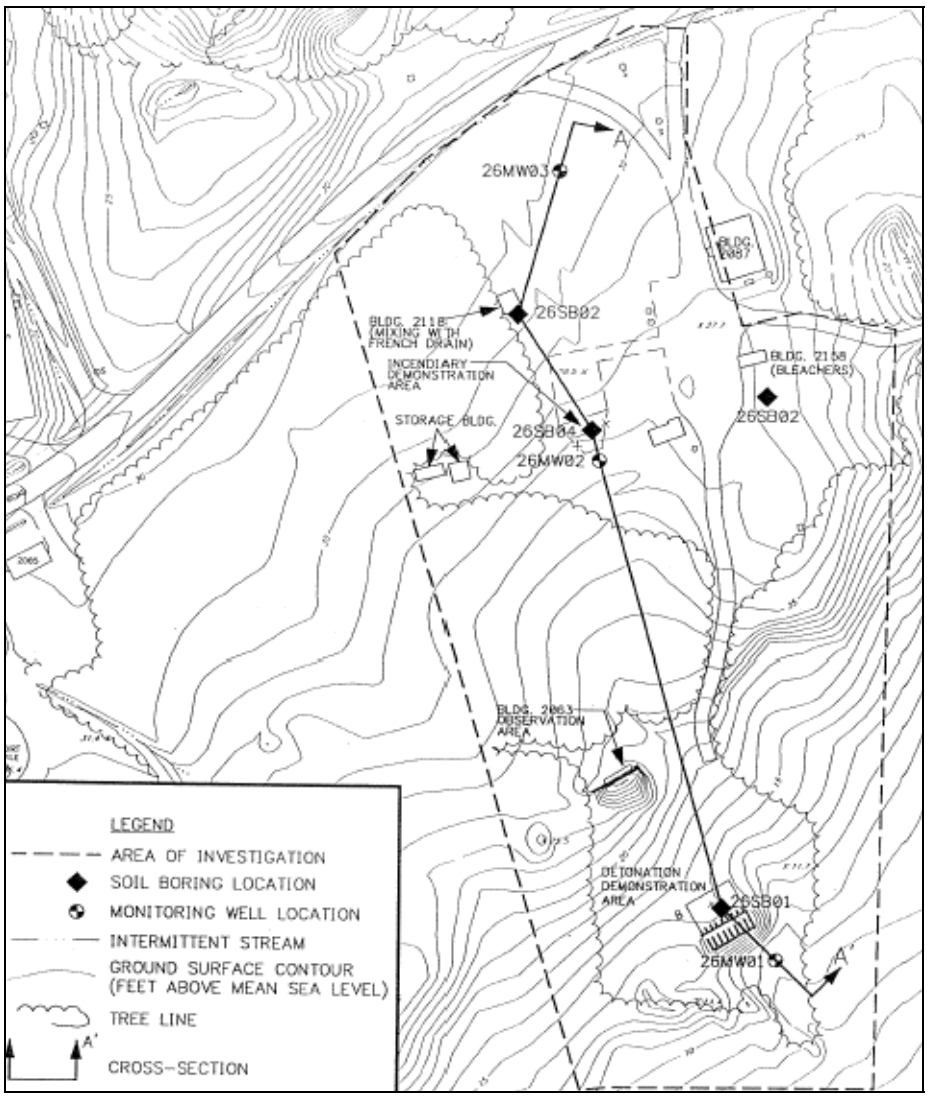


Figure 10.4-1: Former Training Areas and Sampling Locations at the Basic IED Area

Topography

Section 10-3.2 of this appendix provides a general description of topography for the Stump Neck Annex. Elevations at the Basic IED Area range from approximately 5 to 30 feet above msl. The topography is flat to gently sloping in the northern portion of the range and steeply sloping in the south-southeastern portion of the range. The overall topography of the Basic IED Area is downward sloping from northwest to southeast. Erosion is generally most severe in the southern portion of the range where the slopes are the steepest. Downward slopes continue to a wetland located 50 feet south of the range.

Geology

Range-specific geology is based on boring and geophysical logs prepared by Brown & Root Environmental during the VI in 1996. The geology at the range consists of silty sand and gravel fill material from approximately 0 to 2 feet bgs; the fill is underlain by silty sand with some clay. The relative amounts of sand, silt, and clay vary across the range. A clay lens was observed at approximately 5 to 7 feet bgs in boring 26SB-03 near the French drain area of Building 2118. The deepest boring on range was 22 feet bgs; bedrock was not encountered in this boring. Based on the regional geology of Stump Neck Annex, it is expected that bedrock occurs at approximately 600 to 700 feet below msl.

Soil and Vegetation Types

Section 10-3.4 of this appendix provides a description of the soil and vegetation types at Indian Head and the Stump Neck Annex. According to the Soil Survey of Charles County, soils at the Basic IED Area are classified as Keyport silt loams with 2 to 5 percent slopes over the northern portion and 5 to 12 percent slopes over the southern portion (USDA, 2974). These soils are considered moderately eroded with only a thin layer of surface soil remaining. In some cases the subsoil is exposed. The soils are moderately drained with a high moisture capacity and low permeability. These soils are at risk for severe erosion.

Vegetation at the Basic IED Area is characterized by large wooded areas and open grassy areas. The vegetation on range is illustrated on Figure 10.4-2. A wetland area is located south of the range.

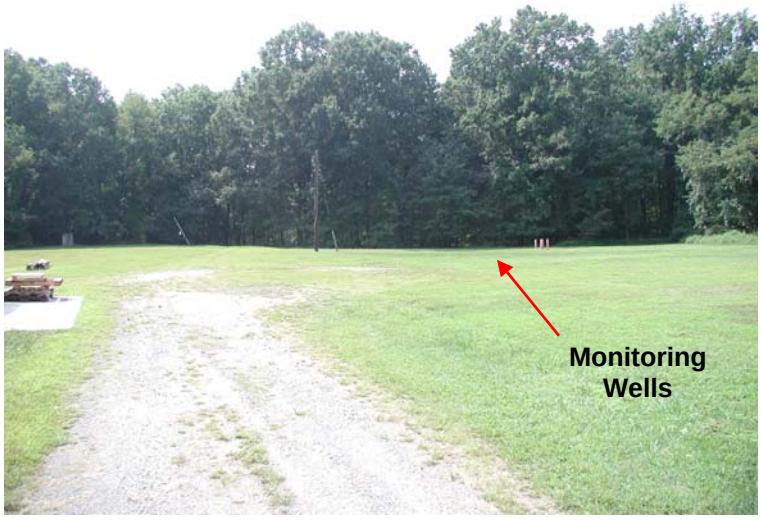


Figure 10.4-2: Access Road and Vegetation Across the Basic IED Area

Hydrology

Section 10-3.5 of this appendix provides a description of hydrology at Indian Head and the Stump Neck Annex. There are no surface water bodies within the boundaries of the Basic IED Area. Surface water runoff drains to marsh and wetland areas south of the site and then into Chicamuxen Creek. There are wetlands located approximately 200 feet south of the range. Drainage follows the local topography in the south-southeasterly direction.

Hydrogeology

Section 10-3.6 of this appendix provides a description of hydrogeology for Indian Head and the Stump Neck Annex. Three monitoring wells were installed at the range during the 1996 VI. These three wells, 26MW01, 26MW02, and 26MW03, have total depths of 15 to 20 feet bgs. Shallow groundwater at the range is typically encountered at 8 to 12 feet bgs. Based on data from slug testing, the groundwater gradient is approximately 0.034, and the average velocity is calculated to be 35 feet per year. The groundwater flow direction is southeasterly across the range. The average hydraulic conductivity of the aquifer is approximately 0.85 feet per day.

Cultural and Natural Resources

General cultural and natural resources for the Stump Neck Annex are provided in Section 10-3.7 of this appendix. According to the 1996 Phase I Cultural Resources Survey of Stump Neck Annex, there are no

archeological/cultural sites within the Basic IED Area. Several shovel test pits were excavated within the site boundaries, and all were negative for artifacts.

Endangered and Special Status Species

As discussed in Section 10-4.8 of this appendix, endangered and special status species are reported to exist at the Stump Neck Annex. According to the Navy Inventory, the Basic IED Area is located within a wildlife protection area that does not contain eagle nesting sites. No endangered or special status species are known to exist at the range.

Visual Survey Observations and Results

A visual survey of the Basic IED Area was conducted on June 25, 2003, by Malcolm Pirnie personnel. Ms. Morgan, NSF Indian Head Environmental Office, accompanied the team. During the visual survey, Malcolm Pirnie personnel walked the perimeter of the range and then walked several transects through the range. The Basic IED Area consists of large wooded and grass areas and one building (Building 2087). Building 2087 is shown on Figure 10.4-3. There was no ordnance observed during the visual survey. A visual depiction of the range reconnaissance is provided on Map 10.4-1 located at the end of Section 10.4 of this appendix. Additional range details, including the locations of monitoring wells and Building 2087, are illustrated on Map 10.4-2 also located at the end of Section 10.4 of this appendix.

Figure 10.4-3: Looking South at Building 2087 Located in the Northern Portion of Basic IED Area

10.4.3 Munitions and Munitions-Related Materials Associated with the Site

This section describes the munitions and munitions-related materials known or suspected to be at the range, including the types and estimated maximum penetration depths. This includes both MEC and non-hazardous munitions-related debris (e.g., fragmentation, base plates, inert mortar fins).

The Basic IED Area was used for demonstration and testing purposes on a variety of explosive devices and chemicals. Munitions used on range include small arms, bulk high explosives, demolition charges, primers, detonators, fuzes, and squibs. According to the 1996 VI report, the area was used for approximately 40 years at a rate of 10 pounds of ordnance (net explosive weight) per year.

According to William Penn, former head of the IED Department, the Basic IED Area was used for a variety of training and testing purposes in the mid-1970s. Law enforcement officers were trained here to disarm explosive devices. Foreign explosives were brought to the range for anti-terrorism training. Newly developed ordnance was also tested and evaluated here by the EOD technicians before being used by the Navy. Practical exercises were set up using letters, parcels, and pipe bombs with chlorates and thorates as part of the EOD School. Also, there were simulated real-life situations in which EOD technicians would be required to disarm explosive devices set up within car carcasses, helicopters, and other structures. Fragment-producing devices with TNT were used in such exercises. Mr. Penn recalls that metallic sodium and potassium chlorate, which are explosive and incendiary chemicals, were frequently used at the range. Ammonia nitrol fuel oil, brake fluid, and industrial/household products were also frequently used on range. Explosives used at the range included electric and non-electric blasting caps, DETA sheets (a rubber-like explosive), military grade (without nitroglycerine [NG]) and civilian (with NG) dynamite, C-4, C-3, astro-pac (a binary liquid explosive), and military thermite and thermate. Black powder was made on range using sulfur, charcoal, and salt peter.

According to EOD technicians interviewed about the Basic IED Area, real explosives were not used in the practical exercises with students. Explosives were primarily used for testing or demonstration purposes. Training exercises would normally consist of simulated bombs, on which students would practice disarming. The students would be instructed to first x-ray the item and then devise the best approach to render it safe. The only explosive used in this process was smokeless powder within 50-caliber rounds that were sometimes used to disarm the devices.

A 1970 memo discussing Division II of the EOD School references a simulated Viet Cong trail that opened at the Basic IED Area in May 1969 and was then enlarged in April 1970. This trail was used to simulate actual situations that students could encounter in Vietnam. The location of the trail within the Basic IED Area is unknown.

The Basic IED Area is overlapped by the firing fan from the Valley located at NSF Indian Head, Main Installation. Thus, there is a potential for munitions associated with the Valley to be present at the Basic IED Area. Information on the Valley is provided in Section 10.8 of this appendix, the Valley Impact Area.

Based on the information obtained during the data collection process, the Basic IED Area is not suspected to contain CWM-filled munitions or DU-associated munitions.

10.4.4 MEC Presence

The entire range has been subdivided and categorized into one of three levels of MEC presence including known MEC areas, suspected MEC areas, and areas where no evidence exists to indicate that MEC is known or is suspected to be at the range. The categories of MEC presence at the Basic IED Area are discussed below. The Basic IED Area is overlapped by the firing fan from the Valley located at the Main Installation. Thus, there is a potential for munitions associated with the Valley to be present at the Basic IED Area. Refer to Section 10.8 of this appendix for information on the Valley. For the purpose of the PA, only MEC presence specifically related to the Basic IED Area is considered. Map 10.4-3 illustrates the munitions characterization of the Basic IED Area and is provided at the end of Section 10.4 of this appendix.

Known MEC Areas

There are no known MEC areas at the range.

Suspected MEC Areas

As illustrated in Map 10.4-3, there are six sites of interest within the Basic IED Area, which are also suspected MEC areas: (1) Building 2158 (bleachers); (2) Building 2118 (mixing with French drain); (3) Building 2063 (observation area); (4) two unnamed storage buildings; (5) the Incendiary Demonstration Area; and (6) the Detonation Demonstration Area. A thorough survey of the range, including a geophysical investigation, would be required to confirm the absence or presence of MEC.

Areas Not Suspected to Contain MEC

The remaining Basic IED Area, outside of the six sites of interest, is not suspected to contain MEC.

10.4.5 Ordnance Penetration Estimates

According to the EOD technicians interviewed about this range, there is no ordnance penetration depth associated with the Basic IED Area. All ordnance used in this area was for testing or demonstration purposes and was only used on the surface. The Basic IED Area is overlapped by the firing fan from the Valley located at the Main Installation. Thus, there is a potential for munitions associated with the Valley to be present at the Basic IED Area. The ordnance penetration depth associated with munitions fired from the Valley is provided in Section 10.8 of this appendix for the Valley Impact Area.

10.4.6 Munitions Constituents

The Basic IED Area was used for testing and demonstrating the effects of IEDs, as well as various chemical mixtures. During the demonstrations, small amounts of chemicals or residual waste were discarded on the ground. The following chemical/explosives are known to have been used at the range:

- Sulfuric acid
- Potassium chloride
- Potassium permanganate
- Sodium chloride
- Gasoline
- Aluminum powder
- Nitric acid
- Glycerin
- Detonation cord
- Iron oxide
- TNT
- Black powder
- Red phosphorous
- Sodium peroxide
- Hydrogen peroxide
- Magnesium powder
- Calcium hypochlorite
- Potassium nitrate
- Ammonium nitrate
- Ferrous oxide
- Potassium hypochlorate

During the 1996 VI study, groundwater and soil samples were collected to determine the extent of the contamination at four sites of interest on the Basic IED Area: the Incendiary Demonstration Area; Detonation Demonstration Area; French drain system in the vicinity of Building 2118; and area in front of the bleachers. These areas and associated sampling locations are presented on Figure 10.4-1. Soil and groundwater samples were analyzed for VOCs, SVOCs, polychlorinated biphenyls (PCBs), energetics, and inorganics. Over 100 target analytes were evaluated using USEPA national and Region 3 guidelines.

No organic compounds were detected in surface or subsurface soil samples collected from the French drain area near Building 2118. Soil samples collected from the Detonation Demonstration Area contained low levels of toluene, carbon disulfide, chloroform, and methylene chloride. At the Incendiary

Demonstration Area, chloroform and BEHP were detected in soil samples. Methylene chloride was detected in soil samples from the area in front of the bleachers. Concentrations of organics at each of these areas did not vary significantly with depth. PCBs and energetics were not detected in any of the soil samples at the Basic IED Area.

Several inorganics were detected in soil samples at concentrations at least two times greater than in background samples. Silver and arsenic were detected at concentrations five times greater than background levels in the Incendiary Demonstration Area. Ammonium nitrate, total organic carbon (TOC), and total petroleum hydrocarbons (TPH) were also detected at levels greater than background in this area. Inorganics were detected at greater concentrations at the downgradient location than the source location. At the Detonation Demonstration Area, calcium and copper were detected at concentrations 10 times background levels, and nickel was detected at concentrations five times the background level. In this area, concentrations of inorganics were slightly greater in the source area than the downgradient location. At Building 2118, lead, sodium, and zinc were the only inorganics detected, and they were detected at greater concentrations in the shallow soil samples. Antimony and sodium were the only inorganics detected in the area in front of the bleachers. Ammonia and TPH were also detected in this area at concentrations greater than background levels.

VOCs, SVOCs, and energetics were not detected in any of the groundwater samples collected from on-range monitoring wells. Metals detected in groundwater included arsenic, barium, calcium, cobalt, iron, magnesium, manganese, and sodium. Only iron and manganese were detected at concentrations greater than five times background levels. Concentrations of inorganics detected in Basic IED Area groundwater samples did not exceed federal primary Maximum Concentration Levels (MCLs). Aluminum, iron, and manganese concentrations did exceed federal secondary MCLs.

The Basic IED Area is overlapped by the firing fan from the Valley located at the Main Installation. Thus, there is a potential for munitions associated with the Valley to be present at the Basic IED Area. Refer to Section 10.8 of this appendix for information on the Valley. Only munitions constituents that specifically relate to the Basic IED Area are considered.

10.4.7 Contaminant Migration Routes

Contaminants at the Basic IED Area may potentially migrate within the soil, groundwater, and surface water runoff. Human activities that may disturb MEC include construction, excavation, plowing or tilling, and surface soil or vegetation removal. Based on the soil types found on-range, erosion is considered a potential problem. Due to the topography and slope of the land, surface water runoff is expected to flow in a southeasterly direction. Adjacent to the southern edge of the Basic IED Area is a large wetland that

drains into Chicamuxen Creek. Precipitation infiltration may provide for contaminant mobility through the subsurface to the shallow surficial groundwater aquifer, which is assumed to be connected to nearby surface water bodies. Surface water runoff could potentially erode the soil on range and transport contaminants off range to the wetland. Based on a review of hydrogeological data, it is unlikely that MC in shallow groundwater would migrate to the deeper aquifers that are used as water supplies. However, shallow groundwater is still considered a potential exposure medium.

10.4.8 Receptors

Potential human receptors include authorized Navy personnel (military and civilian), visitors, contractors, maintenance workers, recreational users, and trespassers. Plant and animal biota are also potential receptors. Examples of ecological receptors include deer, wild turkey, and waterfowl.

Nearby Populations

Nearby populations are as discussed in Section 10.1.8 of Section 10.1 of this appendix.

Buildings Near/Within Site

Building 2087 is the only building remaining at the range. This building was constructed in 1967 and was used for offices. There were additional buildings/structures on range while the Basic IED Area was in use, all of which have now been demolished. Table 10.4-1 provides known information on the buildings/structures formerly located on range.

TABLE 10.4-1

**SUMMARY OF FORMER BUILDINGS/STRUCTURES LOCATED AT THE BASIC IED AREA.
NAVAL SUPPORT FACILITY INDIAN HEAD
INDIAN HEAD, MARYLAND**

Building/Structure Number	Former Use
42-SN	Classroom/workshop
2012	Chlorinator house
2063	Observation area
2090	Training building
2118	Mixing chemicals/storage
2119	Storage
2120	Storage
2158	Bleachers

According to the installation's 2003 Utilities Data Map, there are potable water, sewer, and utility lines to Building 2087 at the Basic IED Area. The electric lines were noted during the 2003 visual survey.

Utilities On/Near Site

10.4.9 Land Use

As mentioned in previous sections, land use at the Basic IED Area included operations and training for Navy personnel from 1957 to the late 1990s. There is no readily available information on the land use prior to 1957. The Basic IED Area is presently closed and unused by the installation. No future land use changes are planned for the range.

10.4.10 Access Controls/Restrictions

Access to the Stump Neck Annex is limited by gated entrances, a security patrol, and a perimeter fence. Only Navy personnel and authorized contractors/visitors are allowed on the installation. The Basic IED Area is accessed by an unpaved, unnamed road off of Archer Avenue. Access to the Basic IED Area is not specifically controlled. Forests surround the Basic IED Area on the eastern, western, and southern sides. The southern side of the range is adjacent to a wetland area. The range is located within a wildlife protection area.

According to the Soil Survey of Charles County, many of the soil types on Stump Neck and Indian Head have load-bearing capacity limitations as a result of high water tables and extreme erodability conditions (USDA, 1974). This includes the soils found at the Basic IED Area. Based on this information, the installation has limited the construction and use of septic systems in specific areas of concern. The Basic IED Area is located in a region that has a seasonally high water table and, therefore, a waiver is required for all septic systems.

10.4.11 Conceptual Site Model

The following CSM exposure pathways analysis focuses only on the Basic IED Area and does not consider impacts from the Valley firing fan. For exposure pathway analysis for the Valley Impact Area, refer to Section 10.8.11 of this appendix

Historical evidence indicates that MEC may be present at the range; therefore, an Exposure Pathway Analysis for MEC was created (Figure 10.4-4). Based on available information, MEC are considered

suspect over the six sites of interest at the Basic IED Area in surface soil. Therefore, potentially complete pathways exist for human and ecological receptors for MEC in surface soil. This includes receptors for hand/tread underfoot contact and surface intrusive work that may be conducted at the Basic IED Area. These activities include, but are not limited to, excavation, plowing, tilling, construction, and environmental sampling for human receptors. Ecological receptors may come in contact with MEC through burrowing, nesting, or feeding activities that disturb surface soil. Trespassers are anticipated to be exposed via non-intrusive surface soil activities at the range, but it is unlikely they would be exposed to surface soil through intrusive activities.

There are also potentially complete pathways for MC as illustrated on the Exposure Pathway Analysis for MC, Figure 10.4-5. The primary source medium for exposure is soil. Exposures to surface soil, subsurface soil, and surface water runoff containing MC may present potentially complete pathways for human and ecological receptors. All human and ecological receptors have potentially complete exposure pathways for direct contact with MC in surface soil, which includes dermal contact, ingestion, and inhalation (dust). Although there are no surface water bodies within the Basic IED Area, there is a large wetland area located directly south of the range. Surface water runoff at the Basic IED Area drains into this wetland area. Thus, potentially complete pathways exist for all human and ecological receptors of surface water/sediment in this wetland. The food chain also becomes a potential pathway because hunting is allowed near the Basic IED Area. Human receptors have the potential to accumulate MC from game animals collected at or near the range. Precipitation infiltration may provide for contaminant mobility into the subsurface soil and into the shallow surficial aquifer, which is assumed to be connected to nearby surface water bodies. MC within subsurface soil are only likely to affect Navy personnel and/or contractors on range through intrusive activities such as construction or sampling. It is not anticipated that trespassers would come in contact with subsurface soil. Although confining layers are expected to prevent the migration of MC to the deeper aquifers used for water supplies, potentially complete pathways exist for MC in shallow groundwater for human receptors. A graphical illustration of the Basic IED Area is presented as Figure 10.4-6.

Figure 10.4-4 MEC Exposure Pathway Analysis

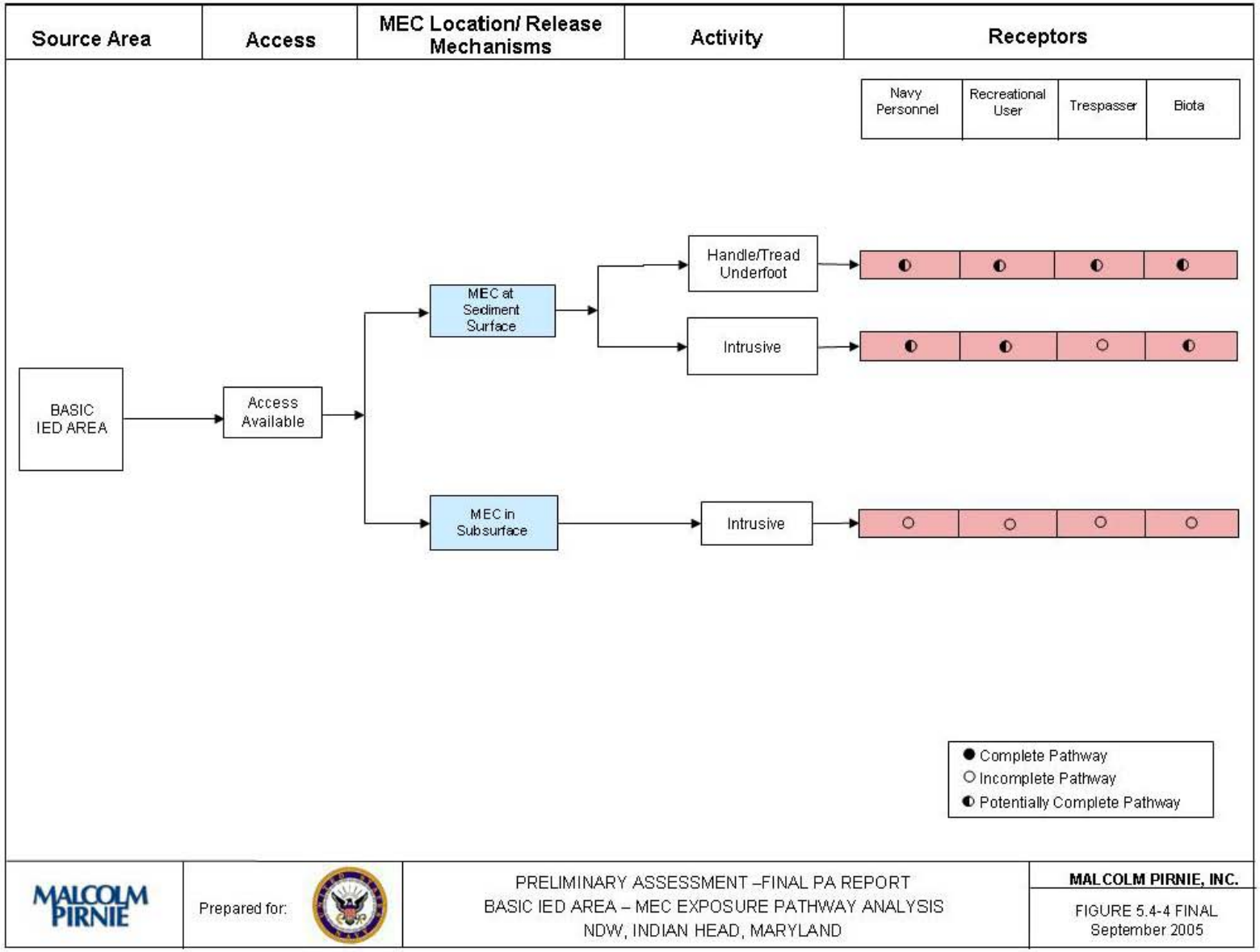


Figure 10.4-5 MC Exposure Pathway Analysis

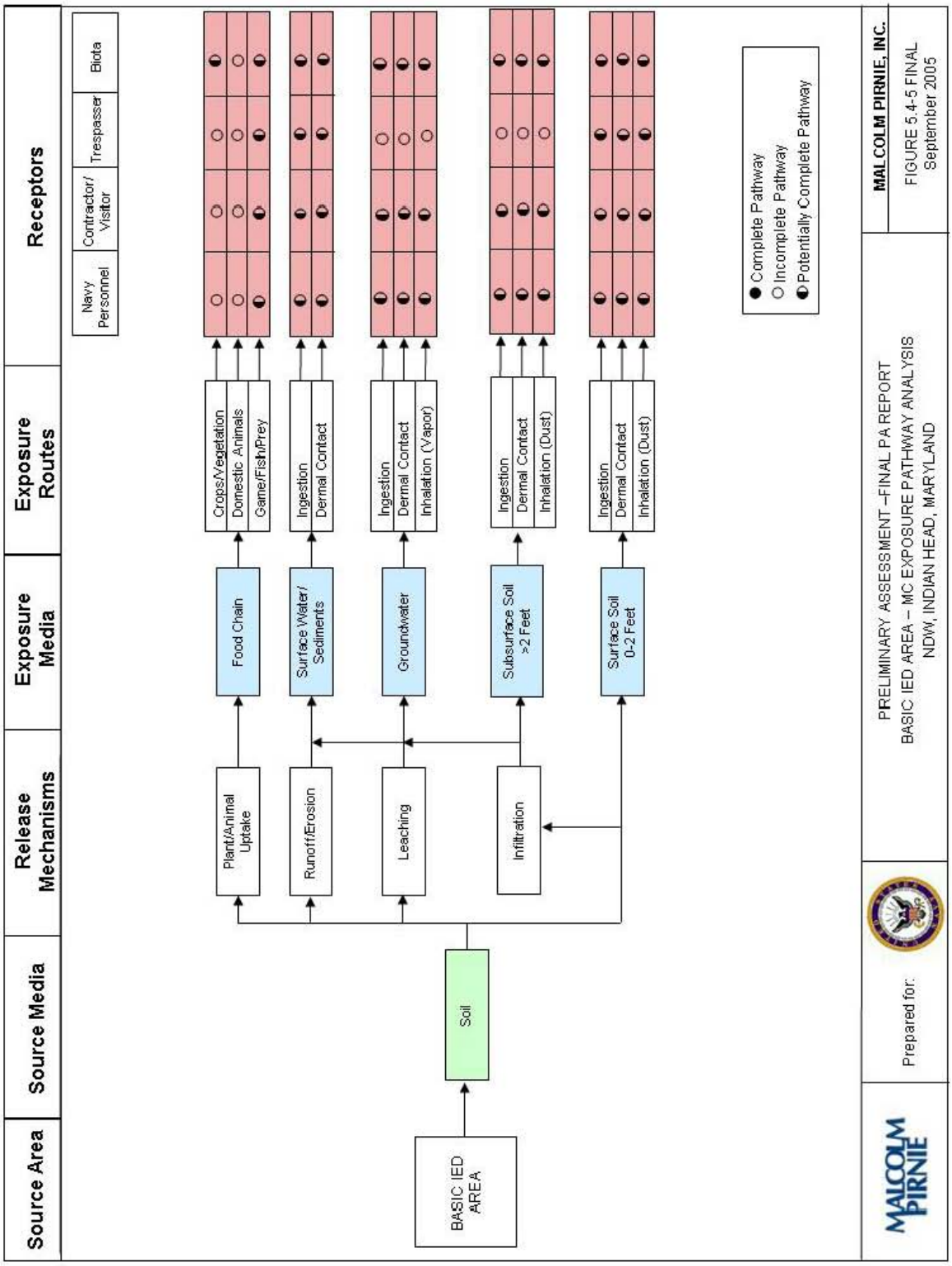
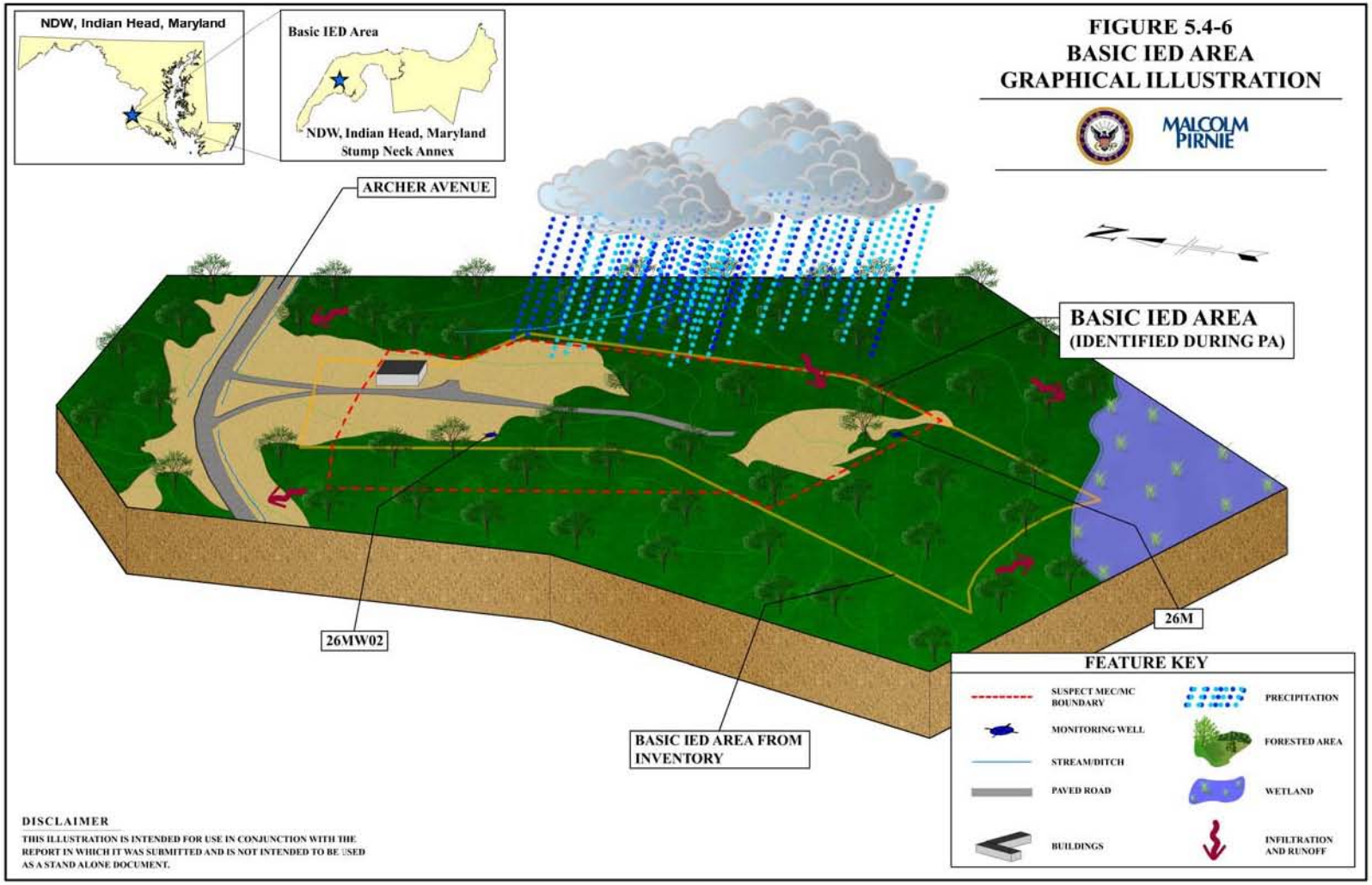


Figure 10.4-6: Basic IED Area Graphical Illustration



10.4.12 Problem Definition Summary

The Basic IED Area was used for testing and demonstration of various explosive devices including mixtures of household and industrial chemicals. It was first used in November 1957 as an active demonstration area for the EOD School. Although an exact date could not be determined, the range was closed prior to 1996. The range originally contained six areas of concern: Building 2158 (the bleachers), Building 2118 (French drain for mixing of chemicals), Building 2063 (observation area), two unnamed storage buildings, the Incendiary Demonstration Area, and the Detonation Demonstration Area. These structures have since been removed. Only Building 2087, formerly used for offices, remains on the former range.

Although no evidence of MEC/MC was observed during the 2003 visual survey at the range, there is historical and physical evidence to suggest that residual MC may exist based on sampling performed during the 1996 VI. Without further sampling, the presence of MEC cannot be confirmed. The six sites of interest are suspect for MEC. In the 1996 VI, samples were collected from seven soil borings and three monitoring wells installed at the range to investigate potential contamination. During this investigation, no MEC were encountered. As detailed in Section 10.4.6, several inorganics and organics were detected in excess of background levels in soil and groundwater samples; however, no explosives were detected.

Munitions Types

The types of munitions used on the range are as follows: small arms, bulk high explosives, demolition charges, primers, detonators, fuzes, and squibs. Chemicals/explosives used include ammonium nitrate, sulfuric acid, potassium chloride, sodium chloride, gasoline, aluminum powder, nitric acid, glycerin, black powder, red phosphorous, sodium peroxide, hydrogen peroxide, magnesium powder, calcium hypochlorite, potassium nitrate, ferrous oxide, and explosive D.

Maximum Probable Penetration Depth

There is no penetration depth at the Basic IED Area; demonstrations were only on the surface, and no firing of munitions took place related to the standard IED training activities.

MEC Density

The MEC density on range is unknown.

MEC Scrap/Fragments

No debris or fragments of MEC were identified during the 2003 visual survey or identified by range personnel.

Associated Munitions Constituents

Associated MC include ammonium nitrate, sulfuric acid, potassium chloride, sodium chloride, gasoline, aluminum powder, nitric acid, glycerin, black powder, red phosphorous, sodium peroxide, hydrogen peroxide, magnesium powder, calcium hypochlorite, potassium nitrate, ferrous oxide, and explosive D.

Some organics and inorganics were detected in soil and groundwater samples collected in 1996. No energetics or PCBs were detected.

Migration Routes/Release Mechanisms

Soil surface runoff; groundwater discharge; range maintenance; construction; excavation.

Relationship of MEC/MC Sources to Habitat and Potential Receptors

Receptors may have direct or indirect contact with MEC and MC that exist in the environment or have been incorporated into the food chain at the Basic IED Area.

Problem Definition/Conceptual Site Model for Advanced IED Range (UXO 05)

10.5 ADVANCED IED AREA

10.5.1 History and Site Description

The Advanced IED Area, initially identified as the Inert Ordnance Devices (IOD) Area from the Navy's Range Inventory, is a 10.07-acre range located in the western-central portion of Stump Neck Annex, adjacent to Archer Avenue. Parker Road bisects the Advanced IED Area. The name and boundaries of the range was changed after reviewing several memoranda and maps identifying the area.

Based on historical documentation and maps available for review, the Advanced IED Area was formerly part of the EOD School at NSF Indian Head, established by the Secretary of the Navy in 1947. According to a memorandum from the Commanding Officer of the EOD School to the Chief of Naval Operations dated 1970, the EOD School began using the property associated with the Advanced IED Area in 1968. The EOD School was divided into Divisions I through V. Division II was further broken down into Areas 1A and 1B. The Advanced IED Area corresponds to Division II, Area 1 A. The Advanced IED Area is shown as Area 1 A on Figure 10.5-1.

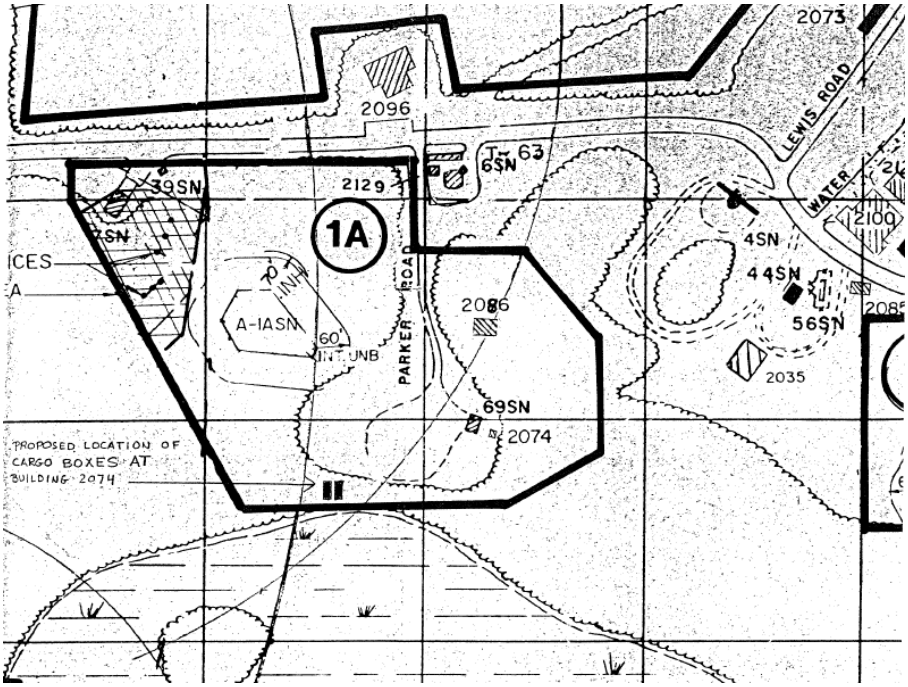


Figure 10.5-1: Map Displaying Location of Advanced IED Area.

Division II began using the Advanced IED Area for practical training in dropped/projected munitions and clandestine devices in 1968. Training that occurred in Area 1A was described as dropped munitions, fuze stripping, tools and methods, explosive analysis, baltograph (polaroid), accidents/incidents related to dropped munitions, and new developments.

The 1996 VI report, completed for the Naval School EOD Sites at Stump Neck Annex, included SWMU #27 (now IR Site #65). The Advanced IED Area overlaps SWMU #27. According to information in the VI report, the EOD School likely used the SWMU #27 area for training and to dispose of inert ordnance items and training aids. Based on the results of the VI, a no further action recommendation was assigned to SWMU #27. Because SWMU #27 is located in the southeast portion of the Advanced IED Area (as depicted on Figure10.5-2) and was used by the EOD School, the potential MEC associated with SWMU #27 is being considered as part of this PA for the Advanced IED Area.

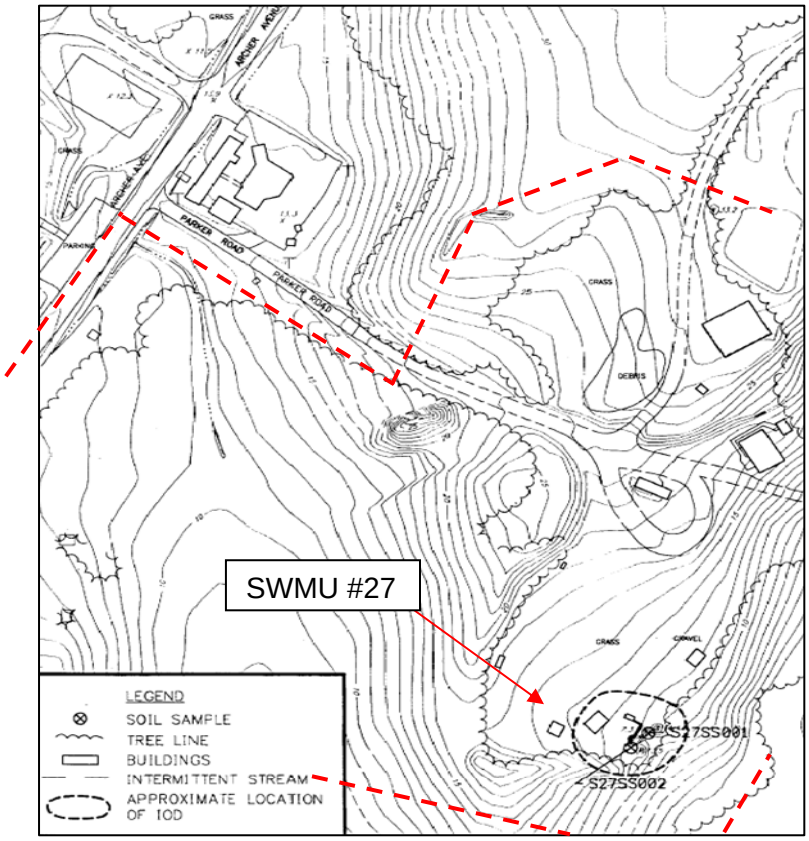


Figure 10.5-2: Location of SWMU #27 on Map from 1996 VI Report

What is believed to be a concrete bunker (approximately 18 feet by 12 feet), built into the side of a gently sloping grass-covered hill, is located on SWMU #27, within the boundaries of the Advanced IED Area. The bunker reportedly had two manhole-type openings through what is assumed to be the roof. The

manhole-type openings were filled with concrete sometime during the 1980s. According to correspondence regarding the range, the concrete layer also covered the discarded ordnance items that were assumed to be inert ordnance items and training aids used by the EOD School; however, during the visual survey ordnance items were observed inside the concrete bunker (see Section 10.5.2 of this appendix).

An aircraft fuselage, used for training exercises (simulating the deactivation of UXO aboard an aircraft), was also once reportedly located on the range. This is consistent with information obtained during an interview with Mr. Earl Scroggins. Mr. Scroggins referred to this area as the Air Practical Area where the EOD School used TNT (quarter- to half-pound) and detonator cord as training aids between 1967 and 1970.

The EOD School was in operation from 1947 until 1995 when the school was moved to Eglin Air Force Base. As mentioned previously, the EOD School began using the area associated with SWMU #27 and the Advanced IED Area in 1968. However, based on the fact that building 69SN was constructed in 1953 and the EOD School was established in 1947, it is possible that this area was actually used from 1953 through 1995. The buildings associated with the EOD School were located north of the range and have all been demolished. The current conditions at the Advanced IED Area are shown on Figures 10.5-3 and 10.5-4.

Figure 10.5-3: View of Northern Side of Advanced IED Area

The Advanced IED Area is located within the estimated firing fan from the Valley. Information for the Valley is provided in Section 10.8 of this appendix, the Valley Impact Area**.**

Figure 10.5-4: View of Southern Side of Advanced IED Area

Topography

Section 10-3.2 of this appendix provides a general description of topography for Stump Neck Annex. Elevations across the Advanced IED Area range from 5 to 15 feet above msl, gently sloping from the northwest to the southeast toward a wetland area (not discussed yet).

Geology

Section 10-3.3 of this appendix provides a geologic description for Indian Head and Stump Neck Annex, which is applicable to the Advanced IED Area. No range-specific geology information is available for the Advanced IED Area.

Soil and Vegetation Types

Section 10-3.4 of this appendix provides a description of the soil and vegetation types at Indian Head and Stump Neck Annex. According to the Soil Survey of Charles County, the predominant soil type associated with the Advanced IED Area is Keyport Silt Loam, moderately eroded, with 2 to 5 percent slopes (USDA, 1974). These soils are characterized by a thin silt loam surface layer or potentially exposed subsoil. These soils have high available moisture content and low permeability. The Advanced IED Area is a grass-covered area and is surrounded by a mixture of coniferous and deciduous trees. A large wetland lies within approximately 200 feet of the eastern, western, and southern boundaries of the Advanced IED Area.

Hydrology

Section 10-3.5 of this appendix provides a description of hydrology at Indian Head and Stump Neck Annex. Drainage from the Advanced IED Area drains either directly into the wetland areas surrounding the site and then into Chicamuxen Creek, or directly into the creek.

Hydrogeology

Section 10-3.6 of this appendix provides a description of hydrogeology for Indian Head and Stump Neck Annex, which is applicable to the Advanced IED Area.

Cultural and Natural Resources

General cultural and natural resources for NSF Indian Head are provided in Section 10.3-7 of this appendix. According to the 1996 Phase I Cultural Resources Survey of Stump Neck Annex, there are no archeological/cultural sites within the Advanced IED Area. Several shovel test pits were excavated within the site boundaries, and all were negative for historic artifacts.

Endangered and Special Status Species

As discussed in Section 10-3.8 of this appendix, endangered species are reported to exist at Stump Neck Annex. According to the 2003-2004 Stump Neck Annex Hunting Map, the Advanced IED Area lies within an eagle protection area and access is restricted from December 15 through June 15. Although their presence has not been confirmed, the endangered and special status species, is expected to inhabit the Advanced IED Area.

10.5.2 Visual Survey Observations and Results

The Advanced IED Area visual survey was conducted on June 23, 2003. Malcolm Pirnie personnel who conducted the range visit included Mr. Dinh, Mr. Engholm, Ms. Tegtmeyer, Mr. Dan Hains, and Mr. McManus. Ms. Morgan, NSF Indian Head Environmental Office, accompanied the team. During the visual survey, a perimeter walk was conducted around range, followed by a north-to-south transect across the parcel within the site. Site coverage was estimated at 40 percent walked, with 100 percent of the range visually observed.

Various types of munitions debris items were observed within the area covered by SWMU #27 both on the ground and within the concrete bunker. These items included submunitions (cluster bombs), practice rockets, snake eye fin tubes, smoke canisters, bomb fuzes, and random munitions debris. According to

installation personnel and on-site EOD personnel, these ordnance items were inert. A visual depiction of the range reconnaissance route is provided on Map 10.5-1, provided at the end of Section #10.5 of this appendix.

10.5.3 Munitions and Munitions-Related Materials Associated with the Site

This section describes the munitions and munitions-related materials known or suspected to be at the range, including the types and estimated maximum penetration depths. This includes both MEC and non-hazardous munitions-related debris (e.g., fragmentation, base plates, inert mortar fins). Potential ordnance concentration areas are presented along with a discussion of the presence of any special consideration ordnance.

As mentioned previously, the EOD School's Division II Area 1A began using the property adjacent to and associated with the Advanced IED Area in 1968. The types of training that occurred at Area 1A included the following:

- Dropped munitions
- Fuze stripping
- Tools and methods
- Explosive analysis
- Baltograph (polaroid)
- Accidents/incidents related to dropped munitions
- New developments

According to Ms. Heidi Morgan, red flags were posted along the northern and western boundaries of the Advanced IED Area that stated "active explosive operations in progress." Reportedly, during nearby groundwater sampling in 1997 and 1998, Ms. Morgan heard "fire in the hole" followed by loud explosions. This further confirms the use of this area by the EOD School for training activities.

Based on information obtained from the VI report, the concrete bunker and surrounding area identified as SWMU #27, located within the boundaries of the Advanced IED Area, were used for both training and disposal of inert ordnance items and training aids once used by the EOD School. The following inert ordnance and munitions debris items were observed on or near the concrete bunker during the visual survey conducted in June 2003:

- Submunitions (cluster bombs)

- Practice rockets
- Snake eye fin tubes
- Smoke canisters
- Bomb fuzes
- Random munitions debris

The Advanced IED Area is overlapped by the firing fans from the Valley located at the Main Installation. Thus, there is a potential for munitions associated with the Valley to be present at the Advanced IED Area. Information on the Valley is provided in Section 10.8 of this appendix, the Valley Impact Area.

Based on the information obtained during the data collection process, no CWM-filled munitions, or DU-associated munitions were found or are expected to be found at the Advanced IED Area.

10.5.4 MEC Presence

The entire range has been subdivided into one of three levels of MEC presence including known MEC areas, suspected MEC areas, and areas where no evidence exists to indicate that MEC are known or are suspected to be at the range. The categories of MEC presence at the Advanced IED Area are discussed below. The Advanced IED Area is overlapped by the firing fan from the Valley located at the Main Installation. Thus, there is a potential for munitions associated with the Valley to be present at the Advanced IED Area. Only MEC presence specifically related to the Advanced IED Area is considered. Map 10.5-3 illustrates the munitions characterization of the Advanced IED Area and is provided at the end of Section 10.5 of this appendix.

Known MEC Areas

During the visual survey, various inert ordnance and munitions debris were observed within the concrete bunker located on the Advanced IED Area. Because no live MEC were observed at the site, there are no known MEC areas at the Advanced IED Area.

Suspected MEC Areas

According to historical documents and information obtained during the data collection process, there is evidence of prior MEC use at the Advanced IED Area. Inert ordnance and munitions debris were also observed during the visual survey. Therefore, the entire Advanced IED Area is considered a suspect MEC area. Map 10.5-3 illustrates the munitions characterization of the Advanced IED Area and is provided at the end of Section 10.5 of this appendix.

Areas Not Suspected to Contain MEC

According to historical documents and information obtained during the data collection process, there is no evidence of the absence of MEC at the Advanced IED Area. Therefore, there are no portions of the Advanced IED Area that are not expected to contain MEC.

10.5.5 Ordnance Penetration Estimates

The Advanced IED Area was used for training and potentially disposal. Based on the fact that the Advanced IED Area was used by the EOD School, the types of training that may have occurred did not involve firing projectile-type ordnance items. Therefore, there is no estimated ordnance penetration depth for this range. The Advanced IED Area is overlapped by the firing fan from the Valley located at the Main Installation. Thus, there is a potential for munitions associated with the Valley to be present at the Advanced IED Area. The ordnance penetration depth associated with munitions fired from the Valley is provided in Section 10.8 of this appendix.

10.5.6 Munitions Constituents

During the VI conducted in 1996, two subsurface soil samples (0 to 2 feet bgs) were collected approximately 25 feet south and east of the concrete bunker. The sample locations are provided on Figure 10.5-5 and Map 10.5-2. These samples were analyzed for the following:

- VOCs
- Target Analyte List metals
- Cyanide
- Nitrate and nitrite
- NG
- Nitroguanidine
- Method 8330 explosives (including TNT, HMX, and RDX)
- SVOCs
- Tin
- TOC
- Ammonia
- Nitrocellulose
- PETN

No energetics or SVOCs were detected in the samples collected. Elevated levels of methylene chloride, toluene, and several inorganics were detected in soil samples. The inorganics with elevated concentrations (two to five times background levels at the nearby Basic Inert Explosive Devices site) include the following:

- Antimony
- Cadmium
- Calcium
- Copper
- Magnesium
- Tin
- Zinc

Both a human health risk assessment and an ecological risk assessment were conducted for SWMU #27. These risk assessments only considered chemical constituents and not explosives. Based on the results, contaminants detected at SWMU #27 were unlikely to pose a risk to human health or the environment under current and anticipated future land use scenarios. Therefore, a no further action recommendation was made for SWMU #27.

Although the source(s) of methylene chloride and toluene is unknown, they are not likely related to MEC. The elevated metals concentrations may be related to MEC and MEC debris in and around the concrete bunker. Based on the results of these samples collected from SWMU #27, the MC suspected to be present in this area may include inorganics. The concentrations of the inorganics present are not known.

The Advanced IED Area is overlapped by the firing fan from the Valley located at the Main Installation. Thus, there is a potential for munitions associated with the Valley to be present at the Advanced IED Area. Refer to Section 10.8 of this appendix for information on the Valley. Only the munitions constituents that specifically relate to the Advanced IED Area are considered.

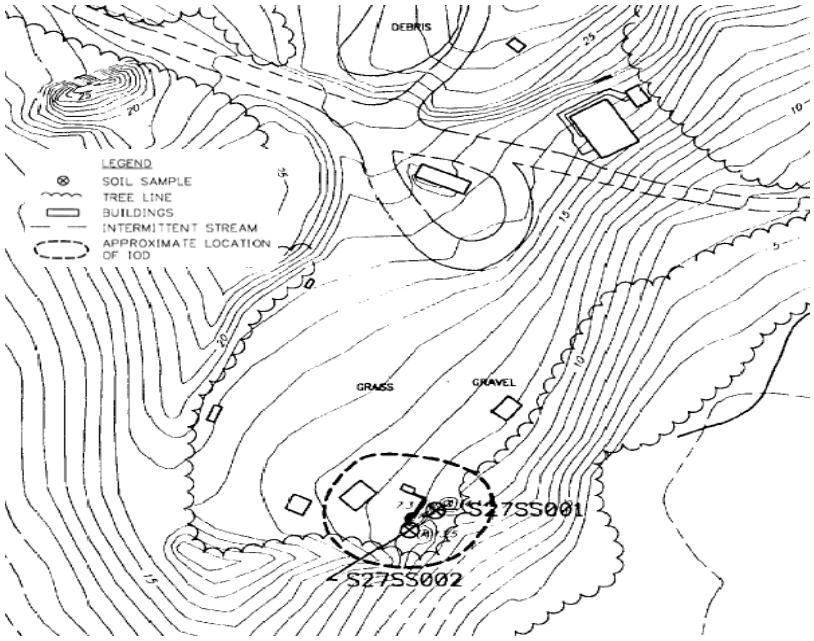


Figure 10.5-5: SWMU #27 Sample Locations from 1996 VI Report

10.5.7 Contaminant Migration Routes

Contaminants at the Advanced IED Area may potentially migrate within soil, groundwater, and surface water runoff. Because the Advanced IED Area is grass covered and is only gently sloping, erosion would likely only occur during a major storm event involving a torrential downpour, or as a result of construction/demolition or other intrusive activities. Surface water runoff is expected to drain to the wetlands south of the range. MC in soil could potentially migrate into shallow groundwater through infiltration. Based on a review of hydrogeological data, it is unlikely that MC in shallow groundwater would migrate to the deeper aquifers that are used as water supplies. However, shallow groundwater is still considered a potential exposure medium.

10.5.8 Receptors

Potential human receptors include authorized Navy personnel (military and civilian), visitors, contractors, maintenance workers, recreational users, and trespassers. Plant and animal biota are also potential receptors. Examples of ecological receptors include deer, wild turkey, and waterfowl.

Nearby Populations

Nearby populations are as discussed in Section 10.1 of this appendix. There are no residential properties located on Stump Neck Annex.

Buildings Near/Within Site

There are no buildings located on the Advanced IED Area. Several buildings were located just north of the Advanced IED Area before, during, and after its use by the EOD School, all of which have since been demolished. The following buildings were identified as being part of the EOD School's Division II Area 1A, including:

- Building 2086SN (used as office/storage/class room space)
- Building 69SN (used as a work shop/publication storage/student coffee mess)
- Building 6SN (used for fuze stripping procedures)
- Building 7SN [used for baltograph (Polaroid)].

All of the buildings have since been demolished. Building 6SN was identified in the October 1970 memorandum as part of Division II Area 1A; however, the corresponding map (Figure 10.5-1) shows Building 6SN outside the range boundaries.

Utilities On/Near Site

The Utilities Data Map of the Main Installation indicates that no utilities are present within the boundaries of the Advanced IED Area. Potable water, sewage, and electrical lines run parallel to the northern side of Parker Road but do not occur within the boundaries of the Advanced IED Area.

10.5.9 Land Use

As mentioned previously, the Advanced IED Area was used by the EOD School for training, and potentially for the disposal of inert ordnance items and training aids. The area is currently undeveloped and unused. However, the grass covering the Advanced IED Area is mowed regularly. According to the 2003-2004 Stump Neck Annex Hunting Map, hunting is permitted within the Advanced IED Area. Although no changes to the current land use are planned, it is assumed that the Advanced IED Area could potentially be redeveloped in the future.

10.5.10 Access Controls / Restrictions

Access to Stump Neck Annex is limited by gated entrances, a security patrol, and a perimeter fence. There are no access control features specific to the Advanced IED Area. Access to the Advanced IED Area is gained via Parker Road, which extends from the eastern side of Archer Avenue. The Advanced IED Area is surrounded to the east, west, and south by a mixture of conifer and deciduous trees. A large wetland lies within approximately 200 feet of the eastern, western, and southern boundaries of the Advanced IED Area. According to the 2003-2004 Stump Neck Hunting Map, the Advanced IED Area is located within an eagle protection area and access is restricted from December 14 through June 15.

According to the Soil Survey of Charles County, many of the soil types on Stump Neck Annex have load-bearing capacity limitations as a result of high water tables and extreme erodability conditions (USDA, 1974). This includes the soils found at the Advanced IED Area. Based on this information, the installation has limited the construction and use of septic systems in specific Areas of Concern (AOCs). The Advanced IED Area is located in a region that has a seasonally high water table, and therefore a waiver is required for all septic systems.

10.5.11 Conceptual Site Model

The following CSM exposure pathways analysis focuses only on the Advanced IED Area and does not consider impacts from the Valley firing fan. For exposure pathway analysis for the Valley Impact Area, refer to Section 10.8.11 of this appendix.

The MEC Exposure Pathway Analysis (Figure 10.5-6) illustrates that potentially complete pathways exist for human and ecological receptors for MEC in surface soil at the Advanced IED Area. This includes receptors for hand/tread underfoot contact and surface intrusive work that may be conducted at the site. These activities include, but are not limited to, excavation, plowing, tilling, construction, and environmental sampling for human receptors. Ecological receptors may come in contact with MEC through burrowing, nesting, or feeding activities that disturb surface soil. Trespassers are anticipated to be exposed via non-intrusive surface soil activities at the range, but it is unlikely they would be exposed to subsurface soil through intrusive activities. MEC are not expected in the subsurface.

As illustrated in the MC Exposure Pathway Analysis, Figure 10.5-7, soil impacted by MC represents a primary source medium. Exposures to surface soil, subsurface soil, and surface water runoff containing MC may present potentially complete pathways for human and ecological receptors. All human and ecological receptors have potentially complete exposure pathways for direct contact with MC in surface soil, which includes dermal contact, ingestion, and inhalation (dust). Although there are no surface water

bodies within the Advanced IED Area, a large wetland lies within approximately 200 feet of the eastern, western, and southern boundaries of the range, providing an exposure medium for receptors. Thus, surface water runoff is a potentially complete exposure pathway for all receptors (human and ecological) at the Advanced IED Area. Because the range is located in an upland hunting area, human and ecological receptors have a potentially complete pathway by ingesting game/prey that previously consumed contaminated vegetation or prey. Precipitation infiltration may provide for MC mobility to subsurface soil and the shallow surficial aquifer, which is assumed to be connected to nearby surface water bodies. Potentially complete exposure pathways exist for MC in subsurface soil (direct contact, ingestion and inhalation during intrusive work activities) for all human and ecological receptors with the exception of trespassers. It is not anticipated that trespassers would come in contact with subsurface soil. Surficial groundwater in the area is not used, and confining layers are expected to prevent the migration of MC to the lower aquifers used for water supply. Therefore, exposure to human receptors and biota are incomplete pathways for groundwater. A graphical illustration of the Advanced IED Area is presented as Figure 10.5-8.

Figure 10.5-6: MEC Exposure Pathway Analysis

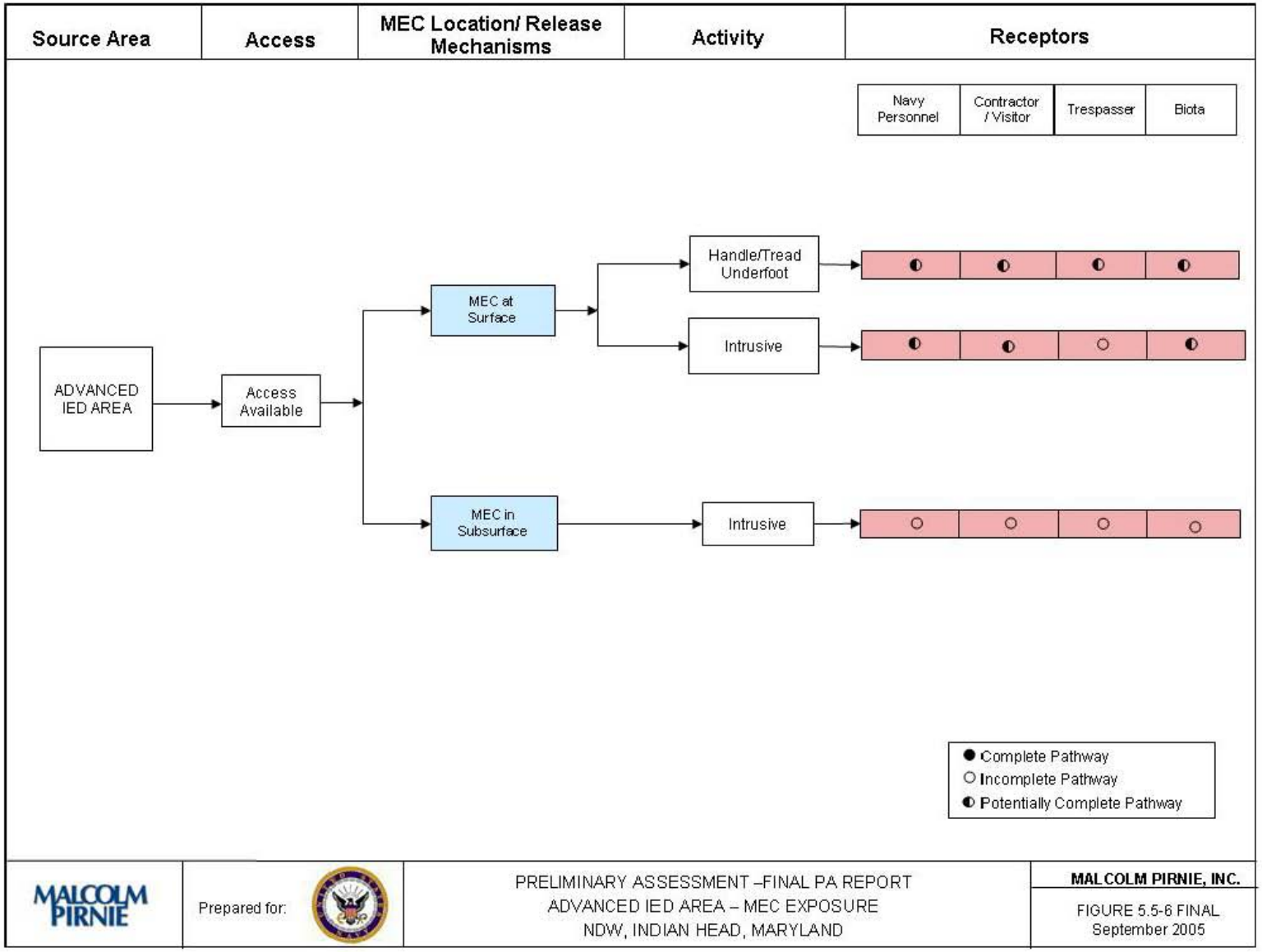


Figure 10.5-7: MC Exposure Pathway Analysis

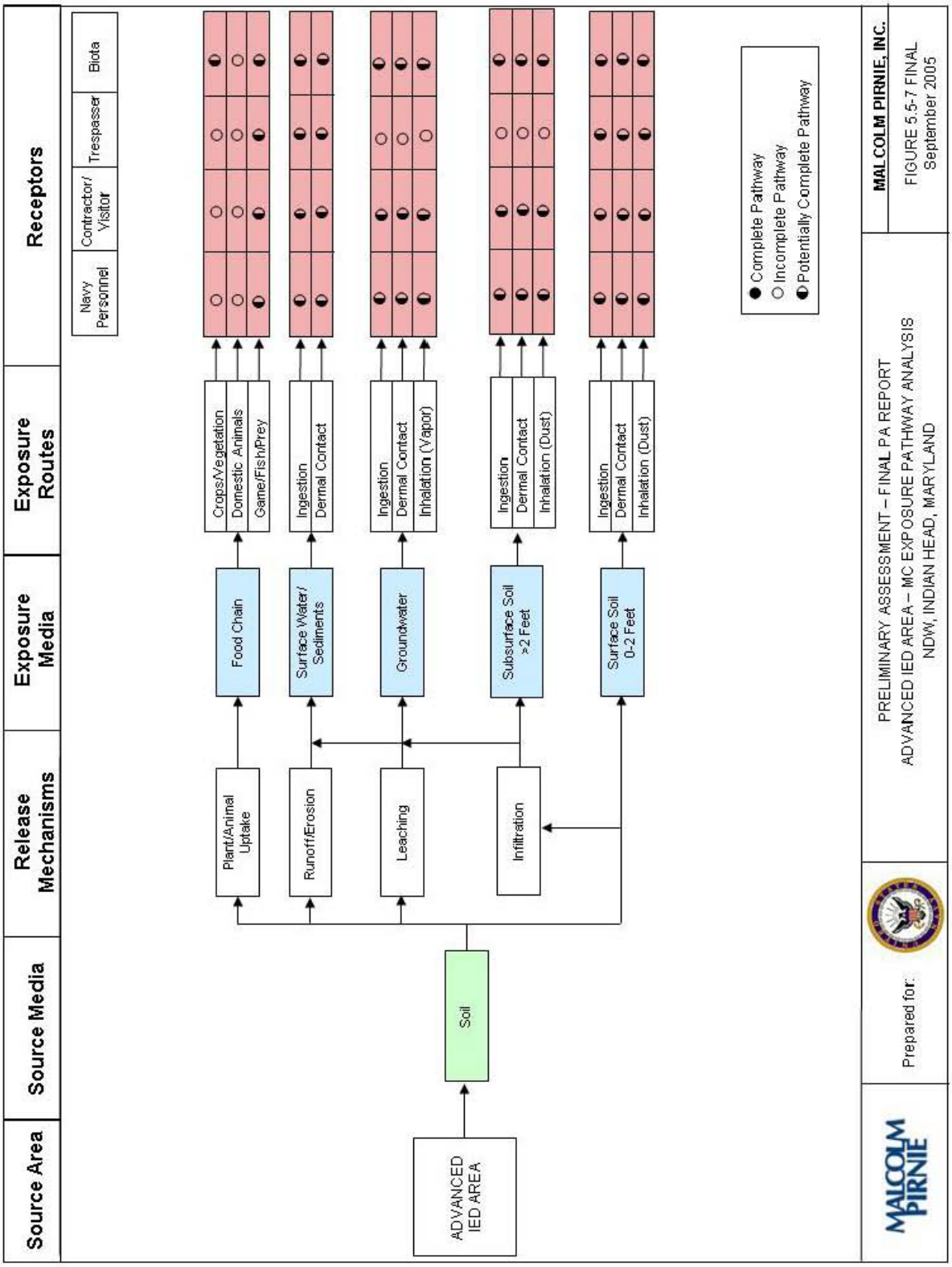
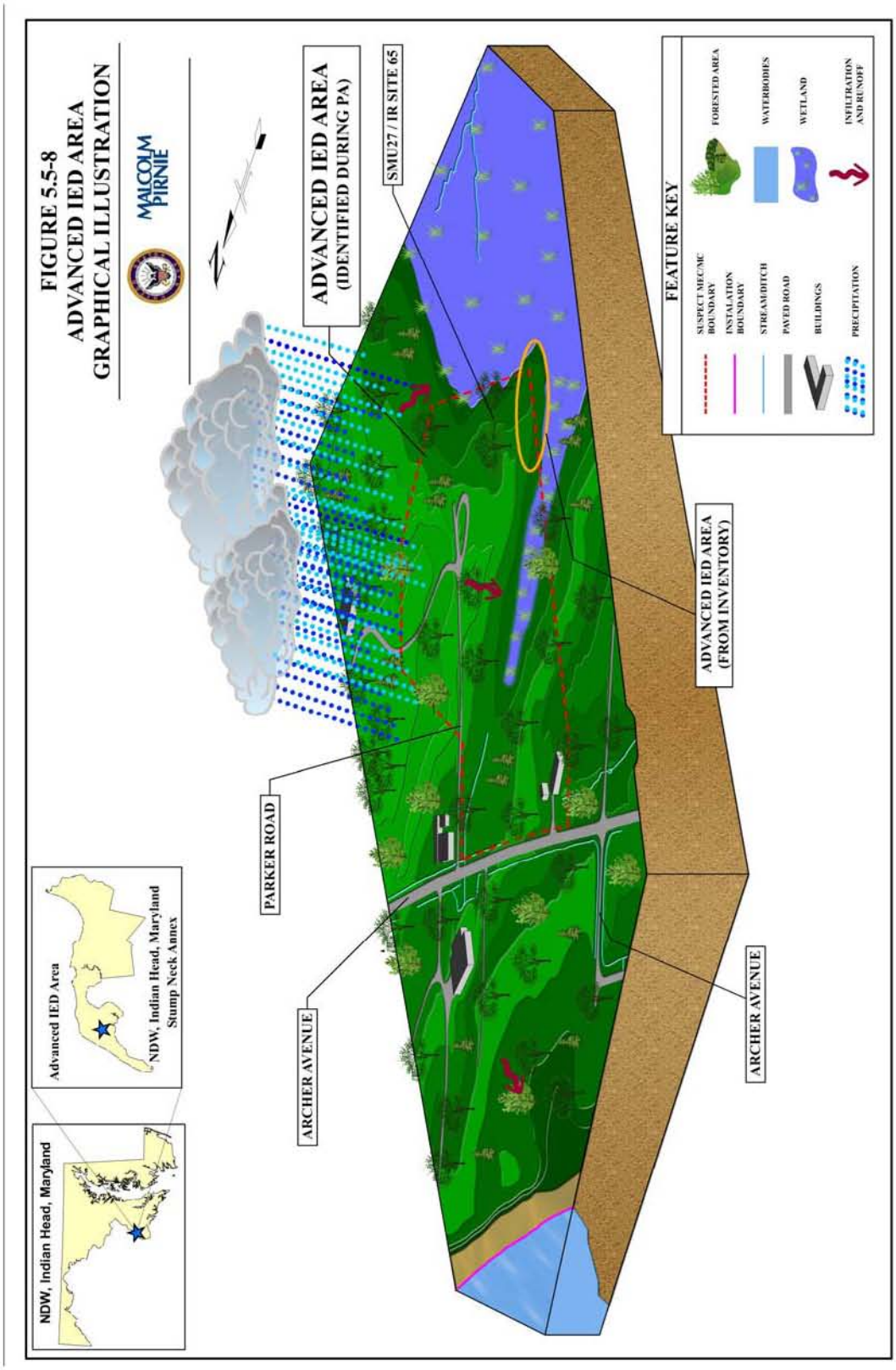


Figure 10.5-8: Advanced IED Area Graphical Illustration



10.5.12 Problem Definition Summary

The Advanced IED Area is a 7.98-acre site located in the western-central portion of Stump Neck Annex. The boundaries of the range, originally identified during the Navy's Range Inventory, were adjusted based on several maps found identifying the location of the Advanced IED Area. Based on information reviewed, the Advanced IED Area was part of the EOD School's Division II Area 1A. Division II Area 1A was responsible for practical training in dropped/projected munitions and clandestine devices beginning in 1968.

Based on historical documents of Division II Area 1A training activities, there is evidence of prior MEC use at the Advanced IED Area. Additionally, inert ordnance and munition debris were noted both on the ground and within the concrete bunker during the 2003 visual survey. This included submunitions (cluster bombs), practice rockets, snake eye fin tube, smoke canisters, bomb fuzes, and random Ordnance and Explosives (OE) debris. Therefore, the Advanced IED Area is considered a suspect MEC area, and the bunker is considered a known MEC area.

During the VI conducted in 1996, elevated concentrations of several inorganics were detected in two subsurface (0 to 2 feet bgs) soil samples collected approximately 25 feet south and east of the concrete bunker. Based on these results, the MC suspected to be present in this area include inorganics.

Munitions Types

Inert submunitions (cluster bombs), practice rockets, snake eye fin tubes, smoke canisters, bomb fuzes, and random munitions debris.

An aircraft fuselage was reportedly located in the area for training exercises to simulate the deactivation of UXO aboard aircraft.

The Advanced IED Area includes SWMU # 27, which was used by the EOD School for training and to dispose of inert ordnance items and training aids. SWMU #27 includes a subgrade concrete bunker that contained a variety of submunitions, practice rockets, snake eye fin tubes, smoke canisters, bomb fuzes, and random munitions debris, all reported to be inert. As a result of the VI, a recommendation of no further action was assigned to SWMU #27. Buildings in SWMU #27 were constructed as early as 1953, so it is possible that the general Advanced IED Area was active from 1953 through 1995, when the school was moved to Eglin AFB.

Maximum Probable Penetration Depth

Penetration depth estimates are not applicable to Advanced IED Area activities or operations. The training that occurred in that area did not involve firing projectile-type ordnance items. Potential ordnance penetration at the Advanced IED Area related to munitions impacts at the Valley Impact Area will be addressed during the SI of the Valley Impact Area.

MEC Density

The presence or density of MEC at the Advanced IED Area is unknown, although during the 2003 visual site survey, no live MEC were observed or reported at the site.

MEC Scrap/Fragments

The presence of MEC scrap/fragments is unknown for the Advanced IED Area. The presence of elevated MC concentrations in soil samples collected during the limited soil sampling near the concrete bunker may be indicative of MEC scrap/fragments in subsurface soil in that area. Potential MEC scrap and fragments in the Advanced IED Area related to munitions fired into the Valley Impact Area will be addressed during the SI of the Valley Impact Area.

Associated Munitions Constituents

The primary associated MCs for the Advanced IED Area are metals. The 1996 VI report included the Advanced IED Area, and two surface soil samples (0 to 2 feet bgs) were collected approximately 25 feet south and east of the concrete bunker. The samples were analyzed for VOCs, SVOCs, energetics and Method 8330 explosives, and other parameters. The soil samples had elevated concentrations of methylene chloride, toluene, and several inorganics (antimony, cadmium, calcium, copper, magnesium, tin, and zinc) with respect to background soil levels. The potentially affected medium is soil, and it is believed that the inorganic constituents are derived from the MC debris in and around the concrete bunker.

Migration Routes/Release Mechanisms

Soil surface runoff; groundwater discharge; range maintenance; construction; excavation.

Relationship of MEC/MC Sources to Habitat and Potential Receptors

Receptors may contact MEC in subsurface soil at the site. Receptors may contact MC directly through surface water/soil or indirectly through the food chain (bioaccumulated in plants and animals).

Problem Definition/Conceptual Site Model for Stump Neck Impact Area (UXO 10)

10.6 STUMP NECK IMPACT AREA

10.6.1 History and Site Description

The Stump Neck Impact Area is a 32.88-acre range located in the central portion of Stump Neck Annex. The range was initially identified as SWMU #23 in the 1983 IAS and in a 1990 draft RCRA Facility Assessment (RFA). The range has since been identified as IR Site #30. Sources indicate the area was once a target/impact area for several firing activities. The Navy Range Inventory database states that Naval gun testing fire originating from the Valley, now known as Indian Head Main Installation, occurred from January 24, 1891, to July 21, 1921. The firing point was located on the northern side of the Valley, where long-range guns (1-inch to 16-inch) were fired south toward primary impact areas at Stump Neck Annex and the Potomac River. By 1924, Headquarters United States Marine Corps (HQMC) tried to secure permission to fire 75-mm guns from Quantico across the Potomac to Stump Neck Annex. The status of the request is unknown. In 1931, another request was made and permission granted to fire 75-mm guns and howitzers at Stump Neck from a firing point in the vicinity of Rum Point. This arrangement lasted until about 1934. Another request was made and approved that same year to fire 75-mm pack howitzers, 75-mm guns, 155-mm guns, and the 37-mm or Naval one-pounder, and the sub caliber for the 6-inch Navy gun. It is unknown when this arrangement expired. Aerial photography, such as that shown in Figure 10.6-1 depicting several impact craters in what is believed to be the impact area, corroborates such firing activities. It is unclear which activities in particular created the craters. Other

Figure 10.6-1: Crater Formations Appear as Dots in the Impact Area on This Aerial Photograph

sources indicate that rockets may have also been fired into the impact area until about 1947, but the duration of this activity and the location of the firing point are not known. Furthermore, based on discussions with retired NSF Indian Head EOD personnel (Mr. Miller) and historical correspondence provided by a Navy Historian (Mr. Dolph), it is believed that a variety of other training activities, including land surface demolition testing and underwater testing (prior to construction of the Area 8 Pond), may have occurred in what is believed to be the impact area. However, no physical or historical evidence has been discovered to support those assertions.

Topography

Section 10-3.2 of this appendix provides a general description of topography for Stump Neck Annex. The impact area is a wetland comprised of scattered vegetation, tidal pools, and marsh. Surrounding hydrologic features and drainage patterns suggest a slight slope from north to south.

Geology

Section 10-3.3 of this appendix provides a geologic description for Indian Head and Stump Neck Annex. This general description is applicable to the Stump Neck Impact Area.

Soil and Vegetation Types

Section 10-3.4 of this appendix provides a description of the soil and vegetation types at Indian Head and Stump Neck Annex. According to the Soil Survey of Charles County, the soil at the Stump Neck Impact Area is classified as tidal marsh (USDA, 1974). The vegetation at the Stump Neck Impact Area is characterized by heavy shrubs and small trees. This range is classified by the installation as Palustrine emergent/broad-leaved deciduous scrub-shrub wetland. Hardwood forests surround the range. Figure 10.6-2 illustrates the vegetation at the Stump Neck Impact Area.

Figure 10.6-2: Vegetation at the Stump Neck Impact Area (Looking West from Roach Road)

Hydrology

Section 10-3.5 of this appendix provides a description of hydrology at Stump Neck Annex. Chicamuxen Creek surrounds the Stump Neck Impact Area. The area is dotted with small pools of standing water and small streams that weave through the marsh (Figure 10.6-3). The percentage of surface water coverage and level of ground saturation varies with the tidal flow, seasonal climates, and rainfall. Water that does not percolate to groundwater will drain into Chicamuxen Creek and eventually reach the Potomac River.

Figure 10.6-3: Wetlands at the Stump Neck Impact Area

Hydrogeology

Section 10-3.6 of this appendix provides a description of hydrogeology for Indian Head and Stump Neck Annex. This information is applicable to the Stump Neck Impact Area.

Cultural and Natural Resources

General cultural and natural resources for NSF Indian Head are provided in Section 10-3.7 of this appendix. The Stump Neck Impact Area is within an eagle protection area and a wildlife protection area. According to the 1996 Phase I Cultural Resources Survey of Stump Neck Annex, there are no archeological/cultural sites within the Stump Neck Impact Area.

Endangered and Special Status Species

As discussed in Section 10-3.8 of this appendix, endangered species are reported to exist at Stump Neck Annex. The reported endangered and special status species have the potential to inhabit the Stump Neck Impact Area.

10.6.2 Visual Survey Observations and Results

A visual survey of the Stump Neck Impact Area was conducted on June 24, 2003, by Malcolm Pirnie personnel. Mr. Jorgensen and Ms. Morgan NSF Indian Head Environmental Office, accompanied the team. The visual survey was conducted from peripheral locations north and east of the impact area. The

survey team was unable to conduct a full visual survey due to the water barriers and protected status of the wetland. The visual survey covered approximately 25 percent of the site. Heavy shrubs covered the marshy ground (Figure 10.6-4). No evidence of MEC/MC was observed during the survey, nor are there any reported sightings in the historical record. No geophysical inspection of the range has been completed to date.

Additional range details are provided on Map 10.6-1 located at the end of Section 10.6 of this appendix.

Figure 10.6-4: Heavy Shrubs Observed from the Periphery of the Impact Area

10.6.3 Munitions and Munitions-Related Materials Associated with the Site

This section describes the munitions and munitions-related materials known or suspected to be at the range. This includes both MEC and non-hazardous munitions-related debris (e.g., fragmentation, base plates, inert mortar fins). Historical documentation indicates that rockets and various calibers of guns (1-inch through 16-inch) were proved at the Valley, and that several other projectiles ranging from 75-mm to 155-mm were fired from Quantico. These projectiles contained different types of high explosives and explosive fillers including black powder, smokeless powder, brown prismatic powder, emmensite, joveite, wet gun cotton, and randite. No physical evidence of MEC/MC was observed in this area. Based on the information obtained during the data collection process, the Stump Neck Impact Area is not suspected to contain CWM-filled munitions, electrically fuzed munitions, or DU-associated munitions.

Information on the Valley is in Section 10.8 of this appendix, the Valley Impact Area.

10.6.4 MEC Presence

The entire range has been subdivided into one of three levels of MEC presence including known MEC areas, suspected MEC areas, and areas where no evidence exists to indicate that MEC are known or are suspected to be at the range. The MEC presence is discussed below.

Map 10.6-2 illustrates the munitions characterization of the Stump Neck Impact Area and is provided at the end of Section 10.6 of this appendix.

Known MEC Areas

According to historical documents and information obtained during the data collection process, there are no known MEC areas at the Stump Neck Impact Area.

Suspected MEC Areas

The entire Stump Neck Impact Area is considered a suspect MEC area; however, the potential relative concentration or density of MEC is not known.

Areas Not Suspected to Contain MEC

According to historical documents and information obtained during the data collection process, there is evidence of the presence of MEC at the Stump Neck Impact Area. Therefore, there are no areas at the Stump Neck Impact Area that are not suspected to contain MEC.

10.6.5 Ordnance Penetration Estimates

The depth to which munitions penetrate below the ground surface depends on many factors, including the type of soil, angle of impact, size of the munitions, velocity at impact, and range-specific environmental conditions. Estimated penetration depths for the munitions believed fired into the impact area range from 4 to 12 feet.

The Stump Neck Impact Area is overlapped by the firing fan from the Valley located at the Main Installation. Thus, there is a potential for munitions associated with the Valley to be present at the range. The ordnance penetration depth associated with munitions fired from the Valley is provided in Section 10.8.5 of this appendix.

10.6.6 Munitions Constituents

No surface or subsurface sampling has been conducted at the Stump Neck Impact Area to determine what specific MC may be present. Potential MC could include metals, various explosives, and various chemicals associated with pyrotechnics, such as perchlorate and propellants. A partial list of known explosives tested in the Valley was documented and is as follows:

- 1894 Annual Report - Powder expended during testing: 56,981 pounds
- 1897 Annual Report - Powder expended during testing: 50,000 pounds, including:
  - Wet gun cotton: 47 pounds
  - Shell powder: 220.25 pounds
  - Randite: 4 pounds and 3.2 ounces
  - Joveite: 10.75 pounds
  - Picric acid: 2 pounds
- 1901 Annual Report - Powder: 46 pounds
- 1901 Annual Report - Powder: 350 pounds
- 1919 Annual Report - Smokeless powder: 831, 033 pounds
- 1920 Annual Report - Smokeless powder: 419,607 pounds

MC commonly found in 75-mm, 37-mm, and 155-mm ammunition include the following:

- TNT
- HMX
- Composition B
- Composition D
- Perchlorate

The relative concentrations of these MC are not known but is not anticipated to exceed 10 percent in soil. No MC were observed during the visual survey.

10.6.7 Contaminant Migration Routes

Contaminants at the Stump Neck Impact Area may potentially migrate within soil, groundwater, surface water, and sediment. Due to the high erodability of the soils at the Stump Neck Area, contaminants may become mobile within the surface soil, particularly during extended periods of rainfall and during high tide. MC in surface water may eventually reach the Potomac River. Contaminants on range can potentially

migrate to shallow groundwater through infiltration. The water table is at or just below the land surface within the Stump Neck Impact Area. Based on a review of hydrogeological data, it is unlikely that MC in shallow groundwater would migrate to the deeper aquifers that are used as water supplies. However, shallow groundwater is still considered a potential exposure medium.

10.6.8 Receptors

Potential human receptors include authorized Navy personnel (military and civilian), visitors, contractors, maintenance workers, recreational users, and trespassers. Plant and animal biota are also potential receptors. Examples of ecological receptors include deer, wild turkey, and waterfowl.

Nearby Populations

Nearby populations are as discussed in Section 10.1.8 of this appendix. The Stump Neck Impact Area overlaps a wildlife protection area.

Buildings Near/Within Site

There are no buildings in close proximity to the Stump Neck Impact Area. There is no evidence of any former structures at the range.

Utilities On/Near Site

There is no evidence of utilities in use in the Stump Neck Impact Area**.**

10.6.9 Land Use

There is no additional information about this range's land use other than as an impact area and munitions testing area. According to the installation, there are no planned future activities at the range.

10.6.10 Access Controls / Restrictions

No public access to the Stump Neck Annex is authorized. Signs, partial fencing, locked/secured gates, login book/office check-in, and vehicle security patrols are used to control the entire facility. There are no access control features specific to the Stump Neck Impact Area. Access from the water is not controlled.

The wetlands are protected under Executive Order 11990, which prohibits construction in a wetland area unless there is no practicable alternative and all possible measures are taken to minimize the

environmental impacts. Wetlands are also protected under Section 404 of the Clean Water Act, which requires a permit to be obtained from USACE before any work in a wetland can commence. The wetland associated with this range is categorized as a Palustrine emergent/broad-leaved deciduous scrub-shrub wetland. Hunting is permitted within this region by permission only after December 15.

According to the Soil Survey of Charles County, many of the soil types on Stump Neck and Indian Head have load-bearing capacity limitations as a result of high water tables and extreme erodability conditions (USDA, 1974). Based on this information, the installation has limited the construction and use of septic systems in specific areas of concern. The Stump Neck Impact Area is located in a region that contains hydric soils where septic systems are prohibited.

10.6.11 Conceptual Site Model

The following CSM exposure pathways analysis focuses only on the Stump Neck Impact Area and does not consider impacts from the Valley firing fan. For exposure pathway analysis for the Valley Impact Area, refer to Section 10.8.11 of this appendix.

Historical evidence indicates that MEC may be present at the range. As such, an Exposure Pathway Analysis for MEC was created and is shown on Figure 10.6-5. A potentially complete pathway exists for all human and ecological receptors for hand/tread underfoot contact at the Stump Neck Impact Area. Wetland areas are protected against intrusive activities such as digging, excavation, and construction; therefore, there are no potentially complete pathways to MEC for intrusive work in the surface and subsurface for human receptors. Ecological receptors may come in contact with MEC through burrowing, nesting, or feeding activities that disturb surface soil. Trespassers are anticipated to be exposed via non-intrusive surface soil activities at the range, but it is unlikely they would be exposed to subsurface soil through intrusive activities.

Soil and surface water/sediment impacted by MC represents a primary potential source medium, as illustrated in the Exposure Pathway Analysis Figure for MC, Figure 10.6-6. Exposures to surface soil, subsurface soil, and surface water/sediment containing MC may present potentially complete pathways for human and ecological receptors. All human and ecological receptors have potentially complete exposure pathways for direct contact with MC in surface soil, which includes dermal contact, ingestion, and inhalation (dust). Recreational fishing occurs in this area. Therefore, human and ecological receptors have potentially complete pathways by ingesting fish that have previously consumed contaminated vegetation or prey. Runoff, discharges, and/or erosion may transport MC from surface soil to surface water/sediment. The Stump Neck Impact Area is a wetland area, so potentially complete pathways also exist for all human and ecological receptors of surface water/sediment. There is also the

potential for the MC present in surface water and soil to infiltrate to the subsurface. Because construction or excavation is prohibited within the wetland areas, potentially complete exposure pathways do not exist for MC in subsurface soil for any human receptors. Although confining layers are expected to prevent the migration of MC to the lower aquifers used for water supplies, potentially complete pathways exist for MC in shallow groundwater for human receptors. A graphical illustration of the Stump Neck Impact Area is provided as Figure 10.6-7.

Figure 10.6-5: MEC Exposure Pathway Analysis

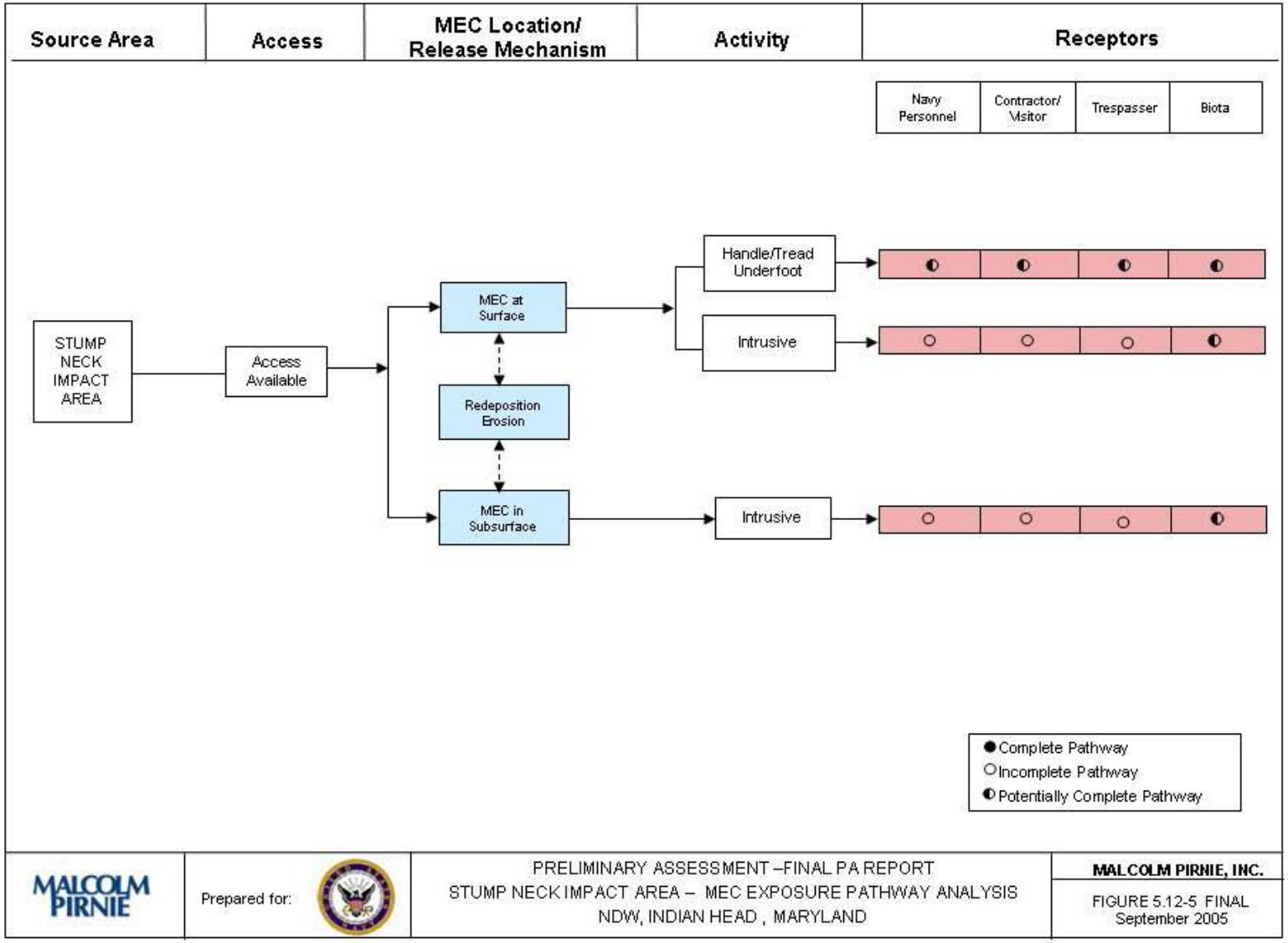


Figure 10.6-6: MC Exposure Pathway Analysis

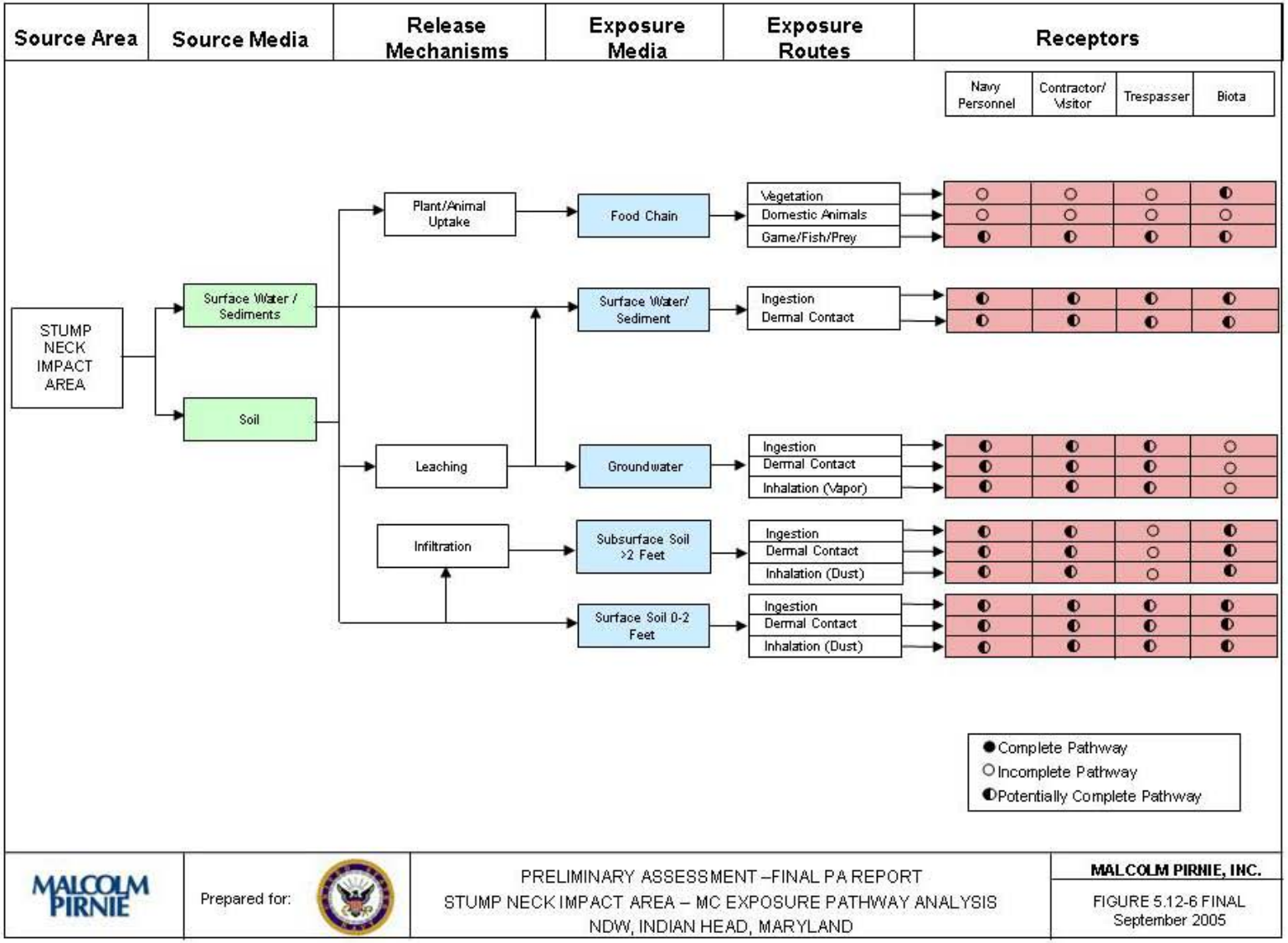
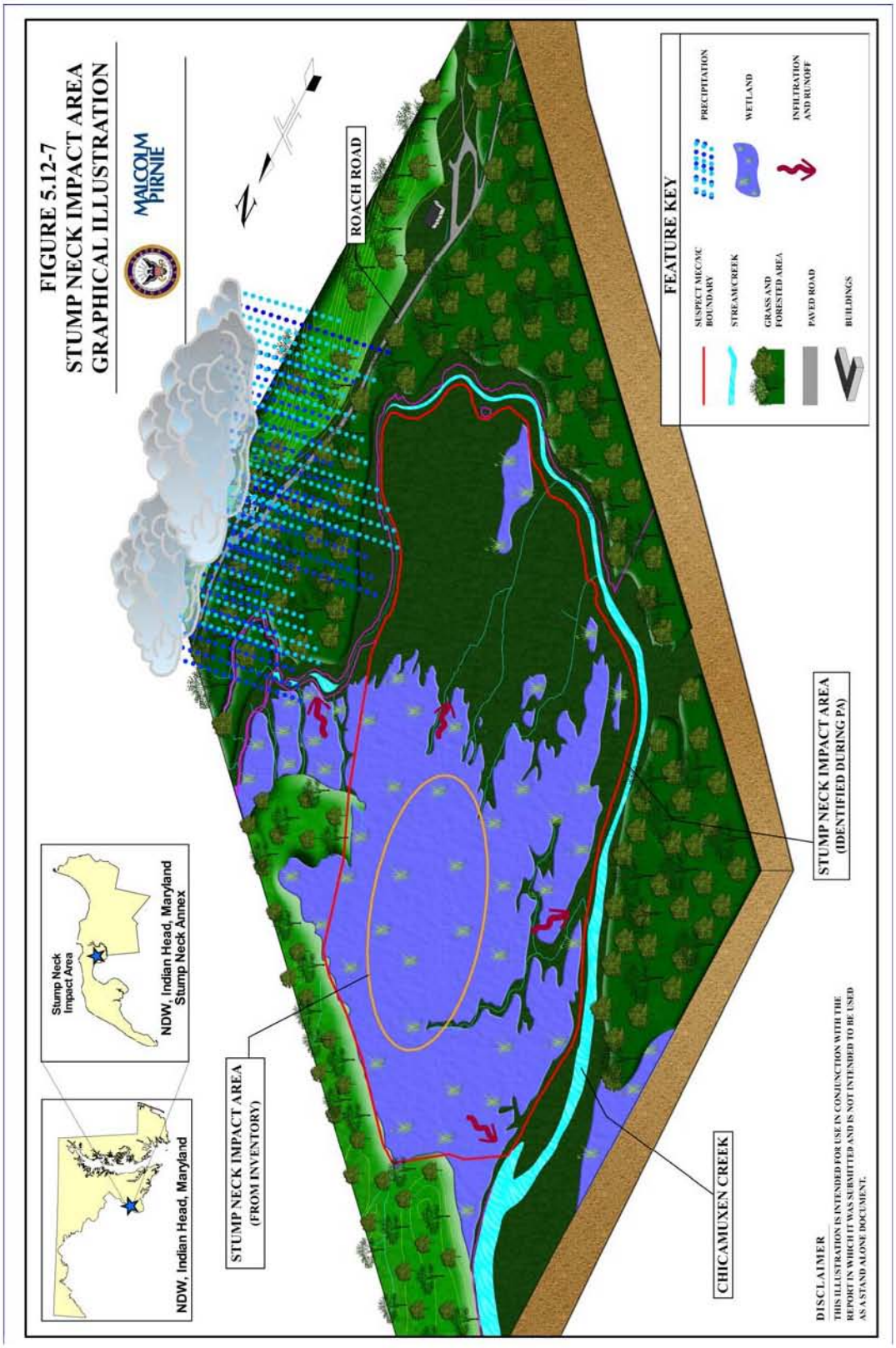


Figure 10.6-7: Stump Neck Impact Area Graphical Illustration



10.6.12 Problem Definition Summary

The 32.88-acre Stump Neck Impact Area is located in the central region of Stump Neck Annex. The range is situated in the wetlands south of Archer Avenue, bordered by Chicamuxen Creek on the southern, eastern, and western sides. The northern side is bordered by hardwood forest. The range was first identified in a 1983 IAS conducted when USEPA was preparing to issue a RCRA permit to the Navy for its facility on Stump Neck, and again during a 1990 RFA. Under a Federal Facility Agreement (FFA) between USEPA and the Navy, the range (also known as IR Site #30) was proposed to undergo a Site Screening Process to determine if a Remedial Investigation, Feasibility Study, or no further action would be required. The results of the Site Screening Process are unknown. Sources indicate that this area was used as an impact area for Naval gun testing from the early 1890s to the early 1920s, an impact area for artillery and Naval gun testing from MCB Quantico, and as a land and underwater demolitions testing area. Aerial photography depicting what are believed to be impact craters in the Stump Neck Impact Area supports the reported use of the range.

Munitions Types

A variety of munitions and projectiles have been fired during proving ground tests at Stump Neck Annex. The Stump Neck Impact Area covers 32.88 acres in the central portion of Stump Neck Annex. Approved training requests for the Stump Neck Impact Range (during 1931 through at least 1934) include authorizations for the firing of 75-mm pack howitzers, 75-mm guns, 155-mm guns, and the 37-mm or Naval one-pounder, and the sub caliber for the 6-inch Navy gun. The Stump Neck Impact Area may have received ordnance from a firing range set up by units from the Quantico Marine Corps Base (on Stump Neck Annex near Rum Point—the exact location is unknown) for 75-mm guns and howitzers. Historical documentation also indicated that Marine Corps Base Quantico was also permitted to fire large artillery at Stump Neck Annex for several years until 1934.

Sources indicate that rockets may have been fired into the Stump Neck Impact Area through 1947; however, the duration of this activity and the location of the firing point are not known. Information provided by a Navy historian indicates that the Stump Neck Impact Area may have been used to support a variety of other training activities, including suspected land surface demolitions testing and underwater demolitions testing (prior to the construction of the Area 8 pond in the late 1950s). However, there is no physical or historical evidence to support those assertions.

Maximum Probable Penetration Depth

Historical documents indicated that additional long-range firing activities at MCB Quantico were authorized to impact Stump Neck Annex, and a 5,500-yard range for 75-mm howitzer training was located

on Rum Point, with firing toward the far side of Stump Neck Annex from 1931 to 1934. The PA report indicates the estimated penetration depths for munitions believed fired into the Stump Neck Impact Range is between 4 and 12 feet.

MEC Density

No MEC have been found or reported in the Stump Neck Impact Area, although 75-mm and howitzer firing points were established at an unknown marine training range on Rum Point in the easternmost portion of Stump Neck Annex facility from 1931 to 1934. This historical information indicates that projectiles were fired into the Stump Neck Impact Area, and therefore it is suspected to contain expended/fired projectiles.

MEC Scrap/Fragments

No MEC have been found or reported in the Stump Neck Impact Area.

Associated Munitions Constituents

The potential MC released by projectiles and munitions fired into the Stump Neck Impact Area include multiple metals, explosive constituents, and various chemical associated with pyrotechnics, such as perchlorate and propellants. Those MC commonly included in 75-mm, 37-mm, and 155-mm ammunition are as follows:

- TNT
- HMX
- Composition B
- Composition D
- Perchlorate

No surface or subsurface sampling has been conducted at the Stump Neck Impact Area. Potential MC include TNT, HMX, Composition B and D, and perchlorate.

Migration Routes/Release Mechanisms

Soil surface runoff; groundwater discharge; range maintenance; construction; excavation.

Relationship of MEC/MC Sources to Habitat and Potential Receptors

Receptors may contact MEC in subsurface soil. Receptors may have contact with MC directly through surface water/soil or indirectly through surface water/soil or indirectly through the food chain (bioaccumulated in plants and animals).

Problem Definition/Conceptual Site Model for Test Area 1 (UXO 21)

10.7 TEST AREA 1

10.7.1 History and Site Description

Test Area 1, which comprises approximately 4.52 acres, is located near the center of the Stump Neck Annex peninsula. In the 1950s, the Naval Research Laboratory constructed a 220-foot by 263-foot "hole-in-the-ground" antenna at the range that was used in pioneer moon relay communication experiments. Figures 10.7-1 and 10.7-2 show current conditions at Test Area 1. During the 1960s and 1970s, Test Area 1 was used for AA&D training (such as booby traps and trip wires). In the 1980s, Test Area 1 was used for IED and IND training. All training items were inert; however, the devices were connected to working components that would set off small charges (a quarter-pound block of TNT) located a short distance from the training item. The charges were sized for total consumption; however, it is possible that small amounts of residue may remain. From the 1990s to the present, Test Area 1 has been used primarily as an area for robotics testing.

Figure 10.7-2: Antenna Dish Partially Overgrown by Vegetation

Figure 10.7-1: Test Area 1 is Currently a Wooden, Overgrown Area

Topography

Section 10-3.2 of this appendix provides a general description of topography for Stump Neck Annex. The antenna located at Test Area 1 is located within a man-made depression. The outer rim of the antenna is at a higher elevation (approximately 125 feet above msl) than the surrounding area and was likely built up with soil excavated during the antenna construction. The southern side of Test Area 1 is naturally at higher elevations than the northern side of the site.

Geology

Section 10-3.3 of this appendix provides a geologic description for Indian Head and Stump Neck Annex, which is applicable to Test Area 1. No range-specific geology for Test Area 1.

Soil and Vegetation Types

Section 10-3.4 of this appendix provides a description of the soil and vegetation types at Indian Head and Stump Neck Annex. According to the Soil Survey of Charles County, the predominant soil type associated with Test Area 1 is moderately eroded, Beltsville silt loam with 2 to 5 percent slopes (USDA, 1974). Test Area 1 is located within a hardwood forest area.

Hydrology

Section 10-3.5 of this appendix provides a description of hydrology at Indian Head and Stump Neck Annex. Test Area 1 is located near the center of the Stump Neck peninsula. The closest water body is Mattawoman Creek, approximately 2,000 feet to the north. Surface water runoff likely follows topography at Test Area 1; however, because Test Area 1 is on a local topographic high, it is not known in which direction surface water would flow. There are no known wetlands at Test Area 1.

Hydrogeology

Section 10-3.6 of this appendix provides a description of hydrogeology for Indian Head and Stump Neck Annex, which includes the Small Arms Range. It is assumed that shallow groundwater flow from Test Area 1 follows topography and is connected to the area's dominant surface water bodies (Mattawoman Creek and Potomac River). However, because Test Area 1 is on a local topographic high, it is not known in which direction groundwater would flow.

Cultural and Natural Resources

General cultural and natural resources for NSF Indian Head are provided in Section 10.3-7 of this appendix. According to the 1996 Phase I Cultural Resources Survey of Stump Neck Annex, there are no archeological/cultural sites within Test Area 1. Several shovel test pits were excavated on the site, and all were negative for artifacts.

Endangered and Special Status Species

As discussed in Section 10-3.8 of this appendix, endangered species are reported to exist at Stump Neck Annex. The reported endangered and special status species have the potential to inhabit Test Area 1.

10.7.2 Visual Survey Observations and Results

A visual reconnaissance of Test Area 1 was conducted on June 25, 2003. Personnel conducting the visual survey included Mr. Rice, Mr. Wiley and Mr. McManus. Mr. Jorgensen accompanied the team. Test Area 1 was inspected by walking along the perimeter of the area. The majority of Test Area 1 is comprised of a “hole-in-the-ground” antenna that has been overgrown by vegetation. Several small wooden structures used for the current robotics testing are located north of the antenna. There were no physical indications of MEC observed during the inspection of Test Area 1.

A visual depiction of the range reconnaissance is provided on Map 10.7-1 located at the end of Section 10.7 of this appendix.

10.7.3 Munitions and Munitions-Related Materials Associated with the Site

This section describes the munitions and munitions-related materials known or suspected to be at Test Area 1, including the types and estimated maximum penetration depths. This includes both MEC and non-hazardous munitions-related debris (e.g., fragmentation, base plates, inert mortar fins). Potential ordnance concentration areas are presented along with a discussion on the presence of any special consideration ordnance.

Based on interviews with range personnel regarding Test Area 1, TNT was used at the range. Test Area 1 was formerly used for IED and IND training. All training items were inert; however, the devices were connected to working components that would set off a small charge (a quarter-pound block of TNT) located a short distance from the training item. The exact locations of these small charges are not known. The charges were sized for total consumption; however, it is possible that small amounts of residue may remain.

Based on the information obtained during the data collection process, Test Area 1 is not suspected to contain CWM-filled munitions, electrically fuzed munitions, or DU-associated munitions.

10.7.4 MEC Presence

The entire range has been subdivided and categorized into one of three levels of MEC presence including known MEC areas, suspected MEC areas, and areas where no evidence exists to indicate that MEC are known or are suspected to be at the range. The MEC presence is discussed below.

Map 10.7-2 illustrates the munitions characterization of Test Area 1 and is provided at the end of Section 10.7 of this appendix.

Known MEC Areas

There are no known MEC areas associated with Test Area 1.

Suspected MEC Areas

Based on historical use of the range for IED and IND training, all of Test Area 1 is a suspected area for MEC.

Areas Not Suspected to Contain MEC

There are no areas of Test Area 1 that are not suspected to contain MEC.

10.7.5 Ordnance Penetration Estimates

The depth to which munitions penetrate below the ground surface depends on many factors, including the type of soil, angle of impact, size of the munition, velocity at impact, and range-specific environmental conditions. Over the years, DoD has studied and modeled munitions penetration depths and has issued various guidance and technical documents on the subject. Maximum probable penetration depths are estimated following guidance listed in the latest draft (July 2002) of the DoD Directive on Explosives Safety issued by the DoD Explosives Safety Board [DoD Directive 6055.9 (DoD Ammunition and Explosives Safety Standards)]. The directive refers to TM 5.855.1 and NAVFAC P-1080.

TNT charges used at the site as described to the audit team do not penetrate the ground; residue would be expected to be found on the ground surface or within the immediate soil horizon.

10.7.6 Munitions Constituents

MC include TNT and TNT breakdown products (2-amino-4,6-dinitrotoluene, 4-amino-2,6-dinitrotoluene, 1,3,5-trinitobenzene, 2,4-dinitrotoluene, and p-dinitrobenzene).

10.7.7 Contaminant Migration Routes

Contaminants at Test Area 1 may potentially migrate in soil, groundwater or surface water runoff. Direct human or biota contact with surficial soil is considered the most likely exposure scenario. Precipitation infiltration may provide for contaminant mobility through the subsurface to the shallow surficial groundwater aquifer, which is assumed to be connected to nearby surface water bodies. Based on a review of hydrogeological data, it is unlikely that MC in shallow groundwater would migrate to the deeper aquifers that are used as water supplies. However, shallow groundwater is still considered a potential exposure medium.

10.7.8 Receptors

Potential human receptors include authorized Navy personnel (military and civilian), visitors, contractors, maintenance workers, recreational users, and trespassers. Plant and animal biota are also potential receptors. Examples of ecological receptors include deer, wild turkey, and waterfowl.

Nearby Populations

Nearby populations are as discussed in Section 10.1.8 of this appendix.

Buildings Near/Within Site

Buildings 2191 and 2192, which are used for equipment storage, are located within the boundaries of Test Area 1. Several other small structures, which are currently used for the robotics training, and two towers, which were formerly used in operating the antenna, are also at Test Area 1. Building 2172 is located approximately 150 meters east of Test Area 1.

Utilities On/Near Site

As shown on Stump Neck Geographic Information System (GIS) utilities map, a potable water line is located in the eastern portion of Test Area 1. Although not shown on this map, electrical power lines, which were installed in 1995, also run to Test Area 1.

10.7.9 Land Use

Figure 10.7-3: Current Structures at Test Area 1 Used in the Robotics Testing

The majority of Test Area 1 is occupied by a former moon relay communication antenna, a reflector formed by a parabolically shaped depression in the ground, with lip-to-lip dimensions of 220 feet by 263 feet, coupled with a collector suspended above the reflector by a boom. To the north of this "hole-in-the-ground" antenna, are a storage building and several small structures used for the current robotics testing at Test Area 1 (see Figure 10.7-3). The anticipated and potential future activities at the range/site include continued training and operations, and construction, maintenance, and operations related to any future development.

10.7.10 Access Controls/Restrictions

No public access is authorized at NSF Indian Head. Signs, partial fencing, locked/secured gates, login book/office check-in, and vehicle security patrols are used to control the entire facility. There are no access control features specific to Test Area 1. There are no known land use/development restrictions for Test Area 1.

10.7.11 Conceptual Site Model

At Test Area 1, historical evidence indicates that MEC may be present. The Exposure Pathway Analysis for MEC is provided as Figure 10.7-4. As illustrated in the figure, potentially complete pathways exist for human and ecological receptors for MEC in surface soil. This includes receptors for hand/tread underfoot contact and surface intrusive work that may be conducted at Test Area 1. These activities include, but are not limited to, excavation, plowing, tilling, construction, and environmental sampling for human receptors. Ecological receptors may come in contact with MEC through burrowing, nesting, or feeding activities that disturb surface soil. Trespassers are anticipated to be exposed via non-intrusive surface soil activities at the range, but it is unlikely they would be exposed to subsurface soil through intrusive activities. MEC are not expected in the subsurface.

Residual TNT and breakdown constituents may be present in soil as a result of IED and IND training conducted at Test Area 1 in the 1980s. The Exposure Pathway Analysis for MC (Figure 10.7-5) illustrates several potentially complete exposure pathways. Soil represents the primary potential source medium.

All human and ecological receptors have potentially complete exposure pathways for direct contact with MC in surface soil, which includes dermal contact, ingestion, and inhalation (dust). Plants may accumulate MC as well. Because Test Area 1 is located within an upland hunting area, MC entering the food chain may provide migration pathways for human and ecological receptors. There are no surface water bodies on Test Area 1; however, surface water runoff may transport MC in surface soil to off-range water bodies. Potentially complete pathways exist for all human and ecological receptors of surface water runoff. There is also a potential for MC present in surface soil to infiltrate to the subsurface. Potentially complete exposure pathways exist for MC in subsurface soils (direct contact, ingestion, and inhalation during intrusive work activities) for all human and ecological receptors with the exception of trespassers. It is not anticipated that trespassers would come in contact with subsurface soil. Although confining layers are expected to prevent the migration of MC to the lower aquifers used for water supplies, potentially complete pathways exist for MC in shallow groundwater for human receptors.

Figure 10.7-4: MEC Exposure Pathway Analysis

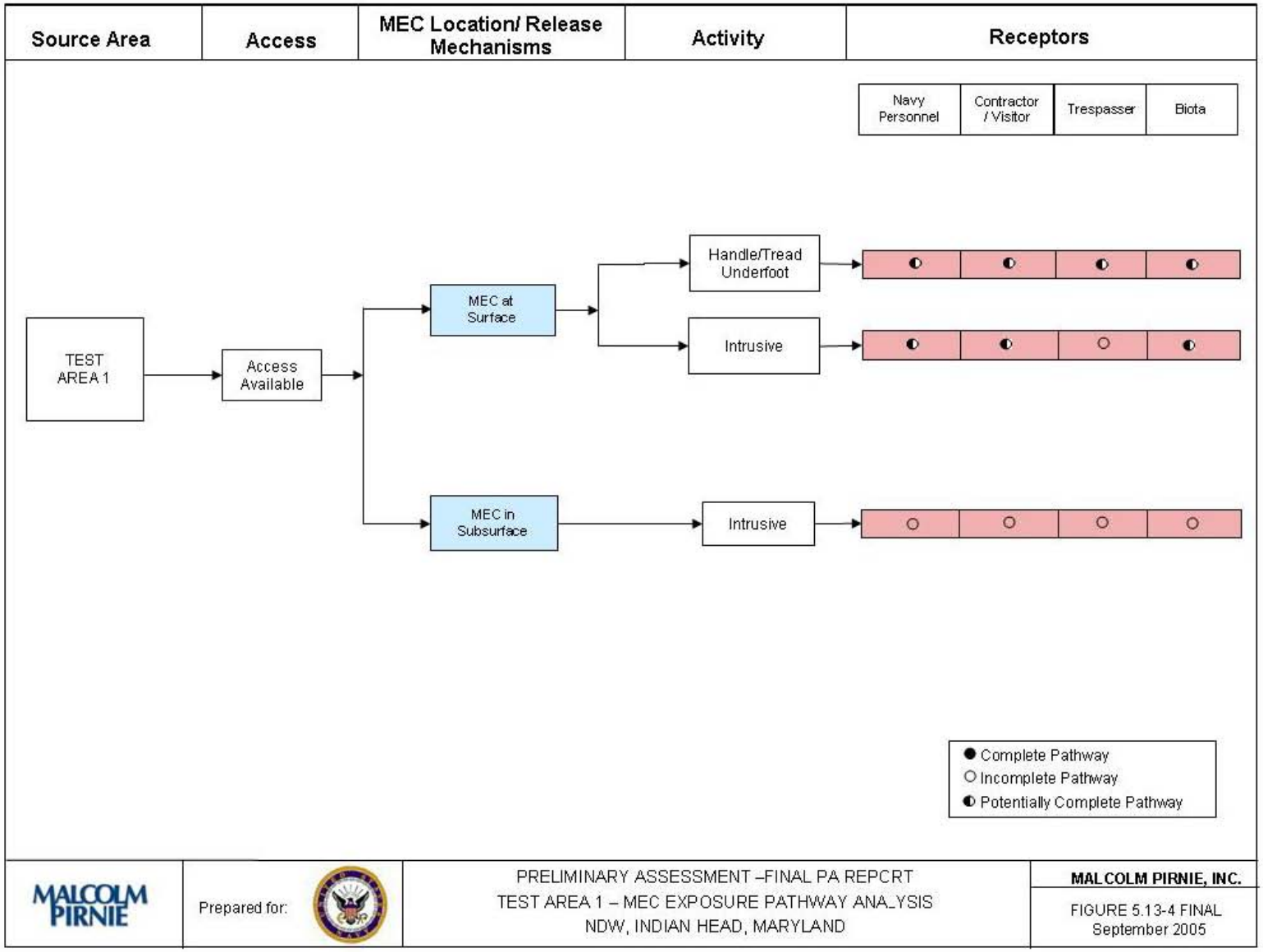
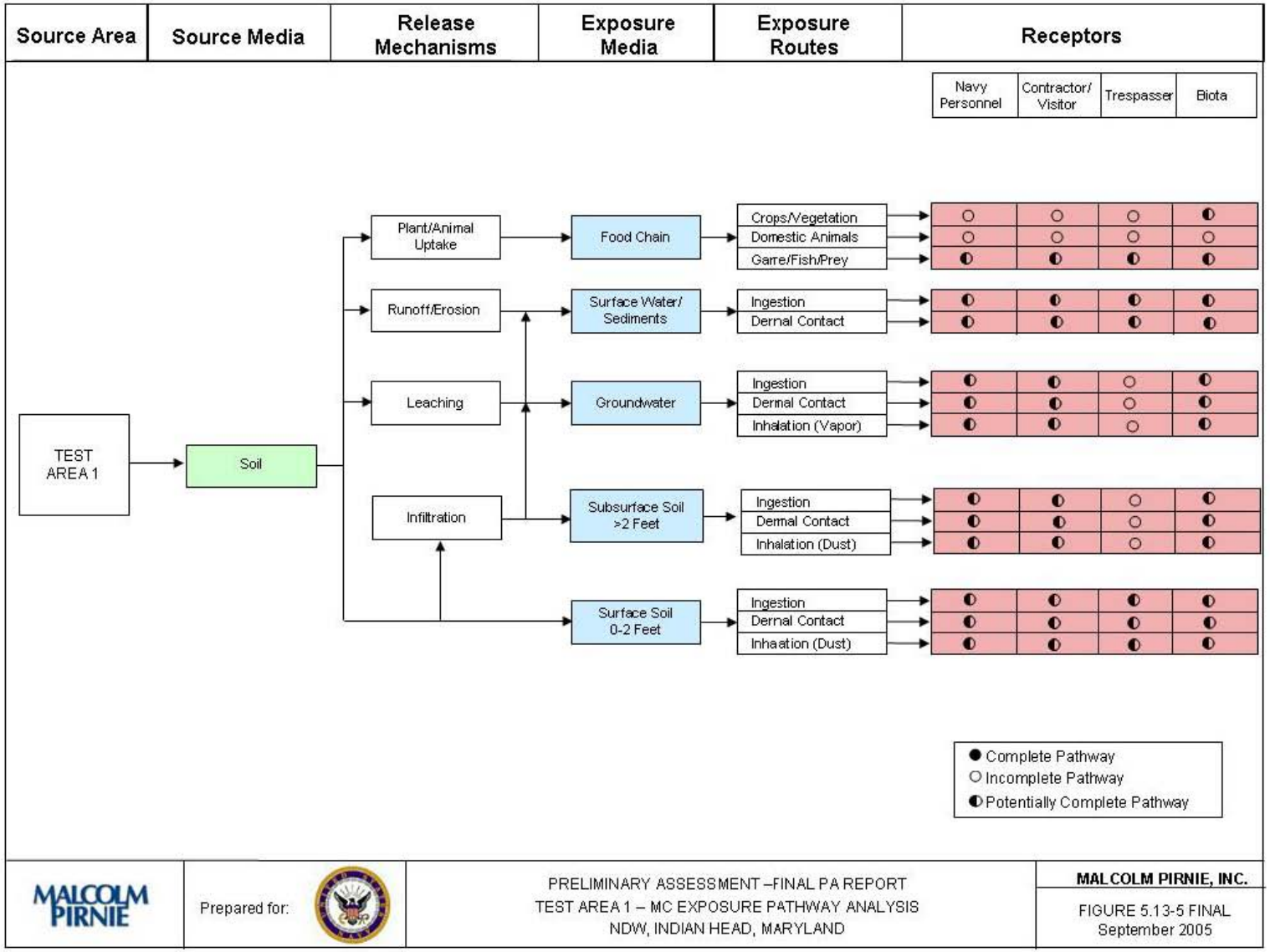


Figure 10.7-5: MC Exposure Pathway Analysis



10.7.12 Problem Definition Summary

Test Area 1 encompasses 4.5 acres in the central portion of Stump Neck Annex. It was initially developed for moon relay communications testing. Subsequently, IED and IND testing was reported to have been conducted at Test Area 1 during the 1980s. All training items were inert; however, the devices were connected to working components that would set off small charges (a quarter-pound block of TNT) located a short distance from the training item. The charges were sized for total consumption; however, it is expected that small amounts of residue may remain. Test Area 1 is considered a suspected MEC area, and MC (TNT and TNT breakdown products) may be present at or near the surface soil horizon.

Munitions Types

There is no evidence of munitions or ordnance at the site. Small (quarter-pound) charges of TNT were used in conjunction with inert AA&D and IED activities at Test Area 1 from the 1960s to 1980s. Students worked with inert items connected to TNT charges at a safe distance from the training item locations.

Maximum Probable Penetration Depth

There is no history of munitions used at Test Area 1. The small TNT charges used in Test Area 1 in conjunction with student training activities would not penetrate the ground, but could be expected to produce TNT residues (if not completely consumed by detonation) on the ground surface and within the immediate surface soil horizon at Test Area 1.

MEC Density

Reportedly only small TNT charges were used at Test Area 1. The charges were sized for total consumption; however, it is possible that small amounts of TNT residue may remain. All of Test Area 1 is a suspected MEC area, based on the historical use of the range for AA&D, IED, and IND training, but there is no known MEC density for the site.

MEC Scrap/Fragments

All of Test Area 1 is a suspected MEC area, based on the historical use of the range for AA&D, IED, and IND training. There were no physical indications of MEC scrap or fragments observed during the 2003 visual reconnaissance of Test Area 1.

Associated Munitions Constituents

Based on the documented use of small TNT charges with inert item student training activities at Test Area 1, TNT and TNT breakdown products (2-amino-4,6-dinitrotoluene, 4-amino-2,6-dinitrotoluene,

1,3,5-trinitrobenzene, 2,4-dinitrotoluene, and p-dinitrobenzene) are considered the most likely MC in surface soil.

Migration Routes/Release Mechanisms

The potential for TNT and TNT breakdown products in surface soil at Test Area 1 may result in the migration of these MC within soil, surface water, and groundwater. Precipitation infiltration may provide for contaminant mobility through subsurface soil to the shallow surficial aquifer. Soil surface runoff of rainfall and discharge of contaminated shallow groundwater to nearby surface water bodies are transport migration routes to be considered for Test Area 1 MC in soil.

The most likely release mechanism/exposure scenario for Test Area 1 involves direct human or biota contact with contaminated surface soil. Potential human receptors include Navy personnel, construction/ excavation contractors, range maintenance workers, and facility recreational workers. MC in surface soil may migrate via plant/animal uptake, and the primary ecological receptors include deer, wild turkey, and waterfowl.

Relationship of MEC/MC Sources to Habitat and Potential Receptors

Receptors may contact MC in surface soil. Receptors may have contact with MC directly through surface water/soil or indirectly through the food chain (bioaccumulated in plants and animals).

Problem Definition/Conceptual Site Model for Valley Impact Area (UXO 26)

10.8 VALLEY IMPACT AREA

10.8.1 History and Site Description

The Valley Impact Area, approximately 694 acres, covers the majority of the western side of Stump Neck Annex. The acreage of the Valley Impact Area includes the land portion of Stump Neck Annex that is covered by the firing fan Safety Danger Zone (SDZ) from the Valley and excludes acreages already calculated as part of other MRP sites. Historical documentation indicates that shells may have impacted the Valley Impact Area at Stump Neck Annex from projectiles fired from the Valley gun proving site located on the Indian Head Main Installation. The Valley Impact Area may have received a variety of projectiles from 1891 through 1921 because the firing fan (SDZ) from the Valley extends over the Valley Impact Area. In addition to the Valley Impact Area, the firing fan extends over areas of the Potomac River, Chicamuxen Creek, Mattawoman Creek, and portions of land outside the installation boundary to the south of Stump Neck Annex. These additional areas affected by the Valley firing fan are not included in this SAP. This SAP details information pertaining to the known impacts within the installation boundary on Stump Neck Annex not previously discussed in other PA site sections.

In addition to firing from the Valley at the Main Installation, impacts to the Valley Impact Area included a firing range set up by an agreement between the NSF Indian Head and Marine Corps Base Quantico. According to a Quantico report, the agreement set up an approximate 5,500-yard range to fire 75-mm guns and howitzers. The range was oriented to fire from the vicinity of Rum Point and impact the area on the far side of Stump Neck Annex (Headquarters United States Marine Corps, 1931); however, the exact location of the range is unknown. Therefore, the firing fan from firing in the vicinity of Rum Point has not been included on the maps in this section. In addition to the Marine Corps range, the agreement also permitted Quantico to fire large artillery at Stump Neck Annex for several years until 1934.

Other PA sites located within the boundary of the Valley Impact Area include Old Demolition Range, Advanced IED Area, Basic IED Area, Marine Rifle Range, Air Blast Pond, Stump Neck Impact Area, Old Skeet and Trap Range, Torpedo Burial Site, Sonar Training Area, EOD School Demolition Area. Other PA sites that may be located within the 5,500-yard Marine range on Stump Neck Annex include Battle Range Firing Area, Rum Point Skeet Range, Torpedo Casing Disposal Area, Roach Road Rifle Range, and Test Area 8. However, the exact firing point and targets for the 5,500-yard Quantico range are not known.

Topography

Section 10-3.2 of this appendix provides a general description of topography for Stump Neck Annex. The lowest points lie along the Mattawoman and Chicamuxen Creek shorelines. These shoreline areas are mostly flat, tidal marsh areas, although several 50- to 60-foot bluffs exist along Mattawoman Creek.

Geology

Section 10-3.3 of this appendix provides a geologic description for Indian Head and Stump Neck Annex.

Soil and Vegetation Types

Section 10-3.4 of this appendix provides a description of the soil and vegetation types at Indian Head and Stump Neck Annex. Because the Valley Impact Area covers such a large area, there are several varieties of vegetation and soil types associated with the site. Section 10-3.4 of this appendix provides a summary of the vegetation and soil types that may be present at the Valley Impact Area.

Hydrology

The Potomac River, Mattawoman Creek, and Chicamuxen Creek border the Valley Impact Area. As discussed in Section 3.5 of the PA, the Potomac River is a tidal tributary to the Chesapeake Bay. Mattawoman and Chicamuxen Creeks are tributaries of the Potomac River and are also tidally influenced. Mattawoman and Chicamuxen Creeks have large floodplains and contain large areas of tidal wetlands and swamps, some of which are located within the Valley Impact Area. Many small streams located throughout the Valley Impact Area flow to one of these three major waterways.

Hydrogeology

Section 10-3.6 of this appendix provides a description of hydrogeology for Indian Head and Stump Neck Annex, which includes the Valley Impact Area.

Cultural and Natural Resources

General cultural and natural resources for NSF Indian Head are provided in Section 10.3-7 of this appendix. According to the 2003-2004 Stump Neck Annex Hunting Map, hunting is permitted throughout various areas of the Valley Impact Area. The Chicamuxen WMA is located within the Valley Impact Area; however, this area is not located within the installation boundaries.

As discussed in Section 10.3.7 of this appendix, a Phase I Cultural Resources Survey and Supplemental Architectural Investigations were conducted at Stump Neck in 1996. The survey identified 10 sites of archeological and cultural significance in the Valley Impact Area. The sites and associated locations of positive prehistoric and historic findings are identified on Figures 10.8-1, 10.8-2, and 10.8-3.

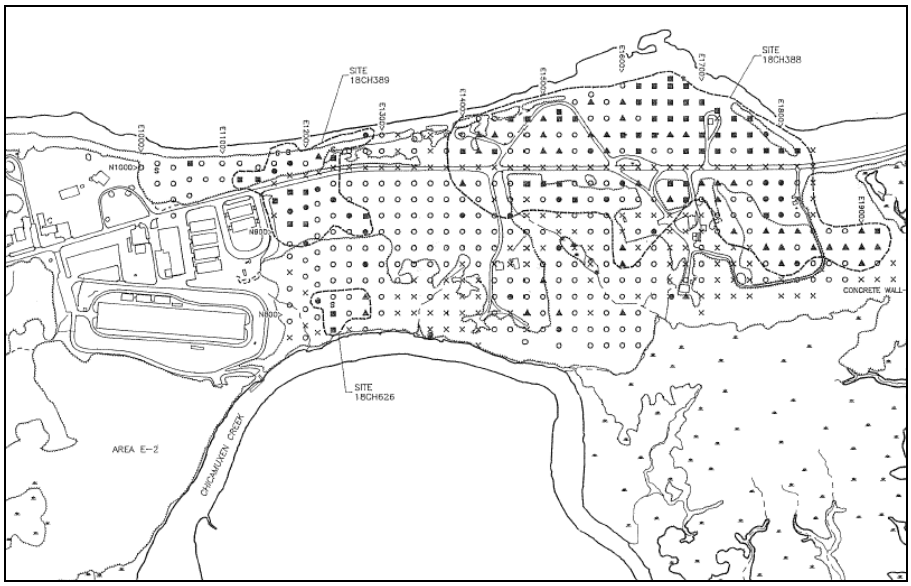


Figure10.8-1: Archeological Sites within the Eastern Most Portion of the Valley Impact Area

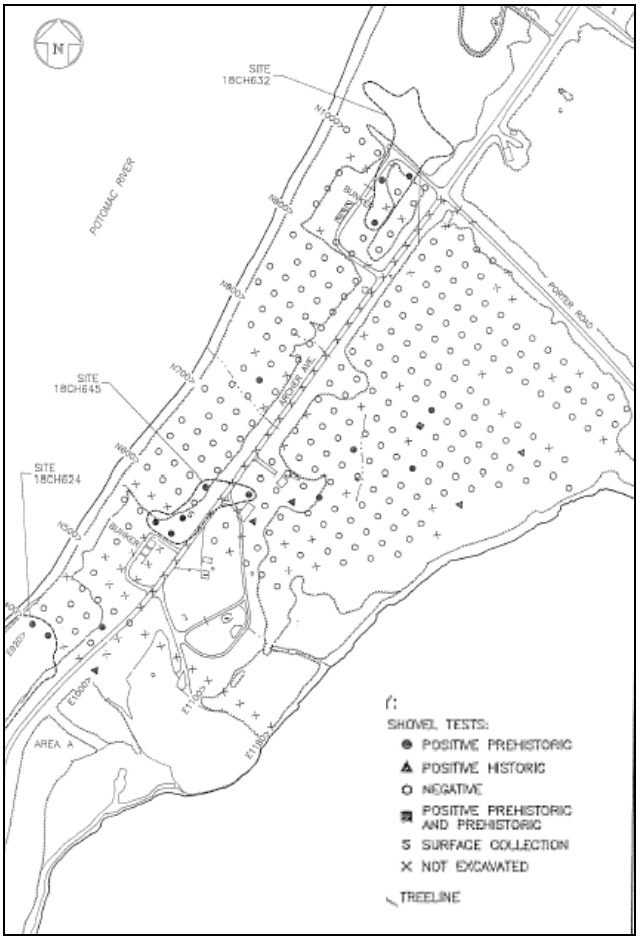


Figure 10.8-2: Archeological Sites within the Central Portion of the Valley Impact Area

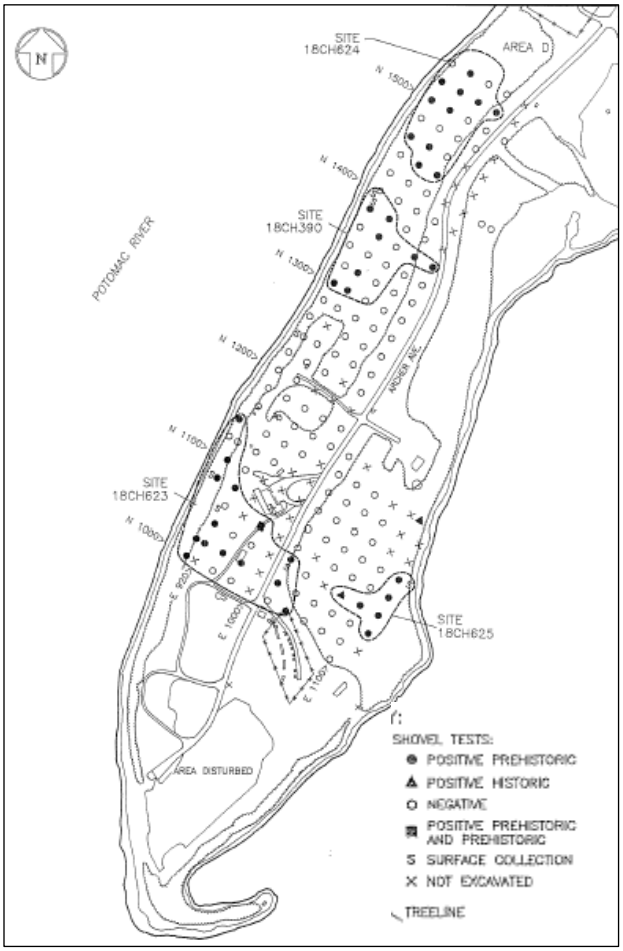


Figure 10.8-3: Archeological Sites within the Southwestern Tip of the Valley Impact Area

<u>Endangered and Special Status Species</u>

As discussed in Section 10-3.8 of this appendix, endangered species are reported to exist at Stump Neck Annex. Because the Valley Impact Area covers the majority of the western portion of the peninsula, animals and plants identified in Section 10-3.8 of this appendix are expected to be located at the Valley Impact Area.

10.8.2 <u>Visual Survey Observations and Results</u>

A visual survey of the Valley Impact Area was conducted on June 3, 2004, by Malcolm Pirnie personnel. Mr. Bob Harrison, NSF Indian Head Environmental Office, accompanied the team. In addition, several other portions of the Valley Impact Area were visually observed throughout various site visits conducted in June, August, and November 2003. The Valley Impact Area was visually inspected by walking along

the Potomac River shoreline, where the majority of impacts are anticipated to have occurred based on the firing fan down the Potomac River from the Valley. In total, the team was able to visually observe approximately 10 percent of the Valley Impact Area.

The visual survey revealed evidence of MEC along the western shoreline of the Stump Neck Annex peninsula; however, the MEC observed may be attributed to the active range (Range 6) near the area. No other evidence of MEC/MC associated with the Valley Impact Area was identified during the site walks.

The Valley Impact Area contains several installation development areas that include buildings, roadways and operational training areas. Because these areas are developed and used routinely, it is assumed that no MEC/MC associated with the Valley Impact Area is present within these areas. The undeveloped areas of the Valley Impact Area are overgrown wooded areas. During the visual survey, several potential impact craters were observed within the woodlands of the Valley Impact Area, indicating that impacts occurred in the area. No MEC attributable to the Valley Impact Area were observed during the site walk.

A visual depiction of the site reconnaissance is provided on Map 10.8-1 located at the end of Section 10.8 of this appendix.

10.8.3 Munitions and Munitions-Related Materials Associated with the Site

This section describes the munitions and munitions-related materials known or suspected to be at the site, including the types and estimated maximum penetration depths. This includes both MEC and non-hazardous munitions-related debris (e.g., fragmentation, base plates, inert mortar fins). Potential ordnance concentration areas are presented along with a discussion on the presence of any special consideration ordnance.

Historical documentation states that various calibers of guns (4-inch through 16-inch) were proved at the Valley with various projectiles. The Valley Impact Area received many of the projectiles from gun proving activities at the Valley. Tested shells contained different types of explosive fillers, including black powder, smokeless powder, brown prismatic powder, emmensite, joveite, wet gun cotton, randite and other high explosives (e.g., Thorite).

Records detailing specific types and quantities of munitions at the Valley Impact Area are limited. Identified records from testing at the Valley site listed items such as the number of guns proved and/or number of projectiles used, but documentation did not indicate specific explosive types and quantities that

could be used to determine the amount of MEC that may be located within the areas associated with the Valley Impact Area. Historical documents listed some quantities of explosive powders that were used during testing activities at the Valley. These quantities of explosive powders were recorded at the Valley as tested or fired; however, some of the actual impacts of these explosive powder-filled projectiles would be at the Valley Impact Area. Therefore, it should be assumed that the Valley Impact Area contains those materials as well. Listed below are some of the quantities of explosive powders used. This list is not intended to be all inclusive.

The 1892 Bureau of Ordnance Annual Report contained information on two specific shells filled with 42 pounds of explosive powder and 42 pounds of emmensite (high explosive). In addition, the following types and amounts of powder were documented:

- 1894 Annual Report – Powder expended during testing: 56,981 pounds
- 1897 Annual Report – Powder expended during testing: 50,000 pounds, including:
  - Wet gun cotton: 47 pounds
  - Shell powder: 220.25 pounds
  - Randite: 4 pounds and 3.2 ounces
  - Joveite: 10.75 pounds
  - Picric acid: 2 Pounds
- 1901 Annual Report – Powder: 46 pounds
- 1901 Annual Report – Powder: 350 pounds
- 1919 Annual Report – Smokeless Powder: 831,033 pounds
- 1920 Annual Report – Smokeless Powder: 419,607 pounds

In addition to munitions received from the Valley, 75-mm projectiles fired from MCB Quantico impacted the Valley Impact Area. Howitzer and 75-mm shells were also fired from a Marine range located at Stump Neck. No documentation was found identifying the quantities and types of these projectiles.

Based on the information obtained during the data collection process, no special consideration munitions are known or suspected to have been used at the site; therefore, the Valley Impact Area is not suspected to contain special consideration MEC.

10.8.4 MEC Presence

The entire site has been subdivided and categorized into one of three levels of MEC presence including known MEC areas, suspect MEC areas, and areas where no evidence exists to indicate that MEC is

known or is suspected to be at the site. The MEC presence is discussed below. Map 10.8-2 illustrates the munitions characterization of the Valley Impact Area, and is provided at the end of Worksheet #10.8.

Known MEC Areas

There are no known MEC areas associated with the Valley Impact Area. All identified munitions or munitions debris observed during the site visit can be attributed to the active range (Range 6) nearby.

Suspected MEC Areas

Because the Valley Impact Area covers the majority of the Stump Neck peninsula, the entire area overlapped by the Valley firing fan on the Stump Neck peninsula is considered a suspected MEC area. The additional other than operational ranges at Stump Neck Annex have been subtracted from the suspected MEC areas. The potential exists for MEC to be found throughout the peninsula. The suspect MEC area in the Valley Impact Area is depicted on Map 10.8-2.

Areas Not Suspected to Contain MEC

There are no areas not suspected to contain MEC at the Valley Impact Area.

10.8.5 Ordnance Penetration Estimates

The depth to which munitions penetrate below the ground surface depends on many factors, including the type of soil, angle of impact, size of the munition, velocity at impact, and site-specific environmental conditions. Over the years, DoD has studied and modeled munitions penetration depths and has issued various guidance and technical documents on the subject. For the purposes of the PA, maximum probable penetration depths are estimated following guidance listed in the latest draft (July 2002) of the DoD Directive on Explosives Safety issued by the DoD Explosives Safety Board [DoD Directive 6055.9 (DoD Ammunition and Explosives Safety Standards)]. The directive refers to TM 5.855.1 and NAVFAC P-1080.

Based on the historical use of the Valley Impact Area, the maximum projectile fired into the site was from a 16-inch gun. Using the equation provided in the TM 5.855.1, a soil penetration constant of 6.95 (soil containing vegetation), and an ordnance weight and velocity of the calculated 155-mm M107, a penetration depth of 18.4 feet was determined. Because the 16-inch projectile is approximately 2.6 times larger than the 155-mm projectile, an approximate maximum penetration depth of 47 feet was calculated for ordnance within the Valley Impact Area.

10.8.6 Munitions Constituents

Several environmental sampling events have been conducted on sites located within the Valley Impact Area. Information relating to MC from those sampling events is discussed in each individual PA site section.

Based on the history of the range as an impact area for an assortment of Naval ordnance, potential MC present at the Valley Impact Area could include Explosive D, black powder, TNT, magnesium, NH powder, CTNT, and other various metals and chemicals associated with pyrotechnics, such as perchlorate and propellants. For a partial list of known explosives used at the site, refer to Section 10.8.3 of Worksheet #10.8.

10.8.7 Contaminant Migration Routes

Contaminants at the Valley Impact Area may potentially migrate within the soil, groundwater, and surface water. Human activities that may disturb MEC include construction, excavation, plowing or tilling, and surface soil or vegetation removal. Based on the soil type found at the Valley Impact Area, erosion is considered a potential problem along the shorelines of the peninsula. Due to the topography and slope of the land, surface water runoff discharges into the Potomac River, Chicamuxen Creek, or Mattawoman Creek. Numerous wetland areas are located within the Valley Impact Area. Surface water could potentially erode the soil and transport contaminants in the wetlands. Precipitation infiltration may provide for contaminant mobility through the subsurface to the shallow surficial aquifer, which is assumed to be connected to nearby surface water bodies. Based on a review of hydrogeological data, it is unlikely that MC in shallow groundwater would migrate to the deeper aquifers that are used as water supplies. However, shallow groundwater is still considered a potential exposure medium.

10.8.8 Receptors

Potential human receptors include authorized Navy personnel (military and civilian), visitors, contractors, maintenance workers, recreational users, and trespassers. Plant and animal biota are also potential receptors. Examples of ecological receptors include deer, wild turkey, and waterfowl.

Nearby Populations

Nearby populations are as discussed in Section 10.1.8 of this appendix.

Buildings Near/Within Site

As previously discussed, the Valley Impact Area encompasses the majority of the western portion of Stump Neck Annex, and numerous Navy buildings are located within the site boundaries. These buildings are used for office and classroom space and munitions development for training purposes.

Utilities On/Near Site

According to the installation's 2003 Utilities Data Map, there are potable water, sewer, and electric lines in areas of the Valley Impact Area that are not included as Species Protection Areas.

10.8.9 Land Use

As mentioned in previous sections, the Valley Impact Area was used as a target (landing spot) for test firing from the Valley site from 1891 through 1921 and as a target for Marine firing from 1931 through 1934. In addition, the Valley Impact Area houses numerous Navy buildings, roads and utilities as part of the development of Stump Neck. These facilities are still used. Some portions of the Valley Impact Area are used as a Species Protection Area. There is no current information of any future land use plans for the Valley Impact Area. According to the 2003-2004 Stump Neck Annex Hunting Map, a large portion of the Valley Impact Area is located in an upland hunting area.

10.8.10 Access Controls/Restrictions

Access to the Valley Impact Area is limited by gated entrances, security patrols, and a perimeter fence; however, the area can be accessed by boat without any security measures. Some portions of the shorelines are steep cliffs with limited access. Only Navy personnel and authorized contractors/visitors are allowed on the installation.

According to the Soil Survey of Charles County, many of the soil types at the Valley Impact Area and Indian Head have load-bearing capacity limitations as a result of high water tables and extreme erodability conditions (USDA, 1974). Based on this information, the installation has limited the construction and use of septic systems in specific areas of concern.

10.8.11 Conceptual Site Model

Historical evidence indicates that MEC may be present at the Valley Impact area; however, the density of the MEC is unknown. Therefore, potentially complete pathways exist for human and ecological receptors for MEC in surface and subsurface soil. This includes receptors for hand/tread underfoot contact and

surface intrusive work that may be conducted at the Valley Impact Area. These activities include, but are not limited to, excavation, plowing, tilling, construction, and environmental sampling for human receptors. Ecological receptors may come in contact with MEC through burrowing, nesting or feeding activities that disturb surface soil. Trespassers are anticipated to be exposed via non-intrusive surface soil activities at the site, but it is unlikely they would be exposed to subsurface soil through intrusive activities. An Exposure Pathway Analysis for MEC is presented as Figure 10.8-4.

As illustrated in the MC Exposure Pathway Analysis (Figure 10.8-5), soil and surface water impacted by MC represents a primary source medium. Exposures to surface soil, subsurface soil, and surface water/sediment containing MC may present potentially complete pathways for human and ecological receptors. All human and ecological receptors have potentially complete exposure pathways for direct contact with MC in surface soil, which includes dermal contact, ingestion, and inhalation (dust). Runoff, discharges, and/or erosion may transport MC from surface soil to surface water/sediment. Precipitation infiltration may provide for contaminant mobility into the subsurface soil and into the shallow surficial aquifer, which is assumed to be connected to nearby surface water bodies. Because the Valley Impact Area is located within a hunting area, human and ecological receptors have a potentially complete pathway by ingesting game/prey that have consumed contaminated vegetation or prey. Potentially complete exposure pathways exist for MC in subsurface soil (direct contact, ingestion, and inhalation during intrusive work activities) for all human and ecological receptors. It is not anticipated that trespassers would come in contact with subsurface soil. Although confining layers are expected to prevent the migration of MC to the lower aquifers used for water supplies, potentially complete pathways exist for MC in shallow groundwater for human receptors.

Figure 10.8-4: MEC Exposure Pathway Analysis

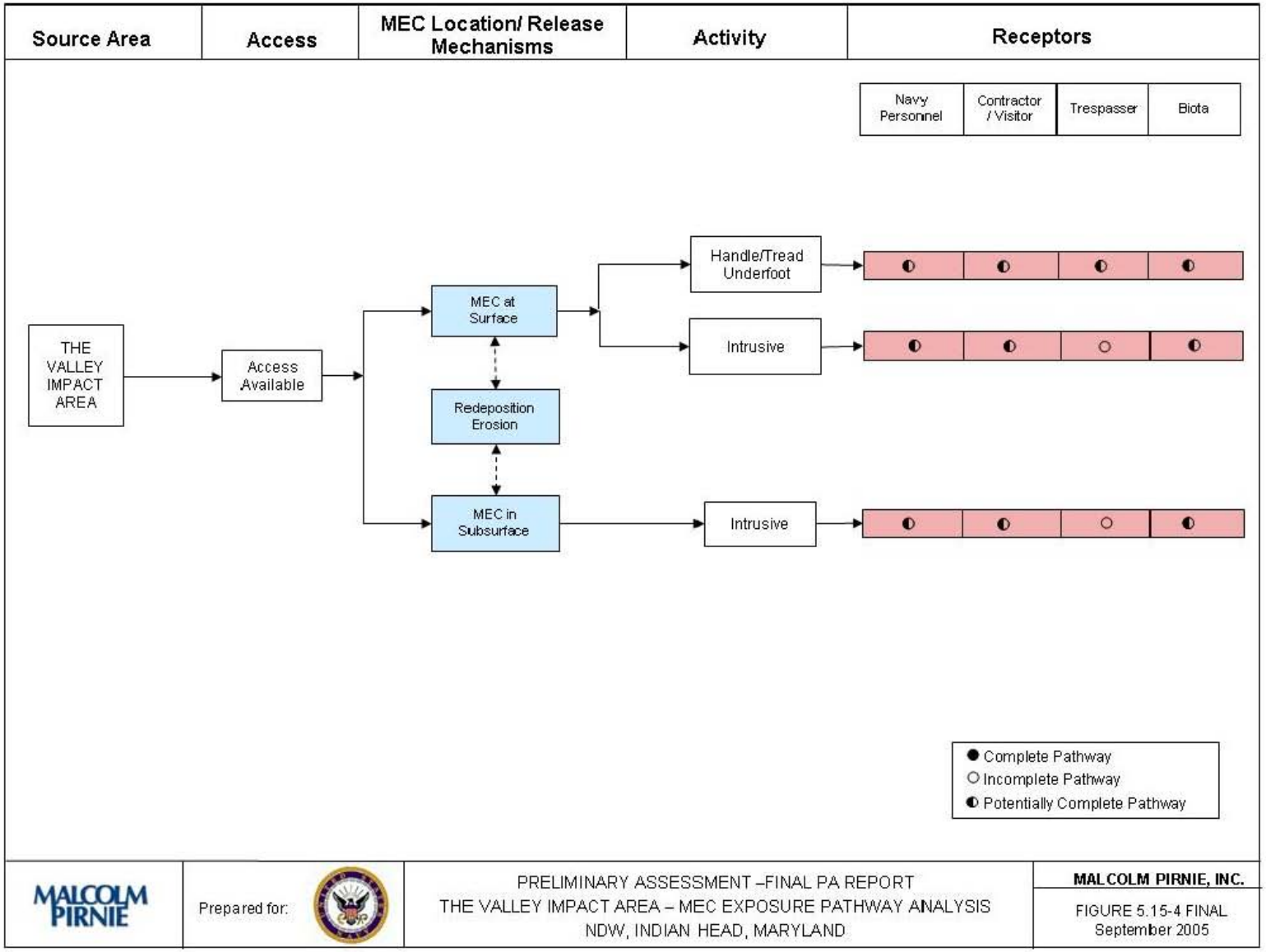
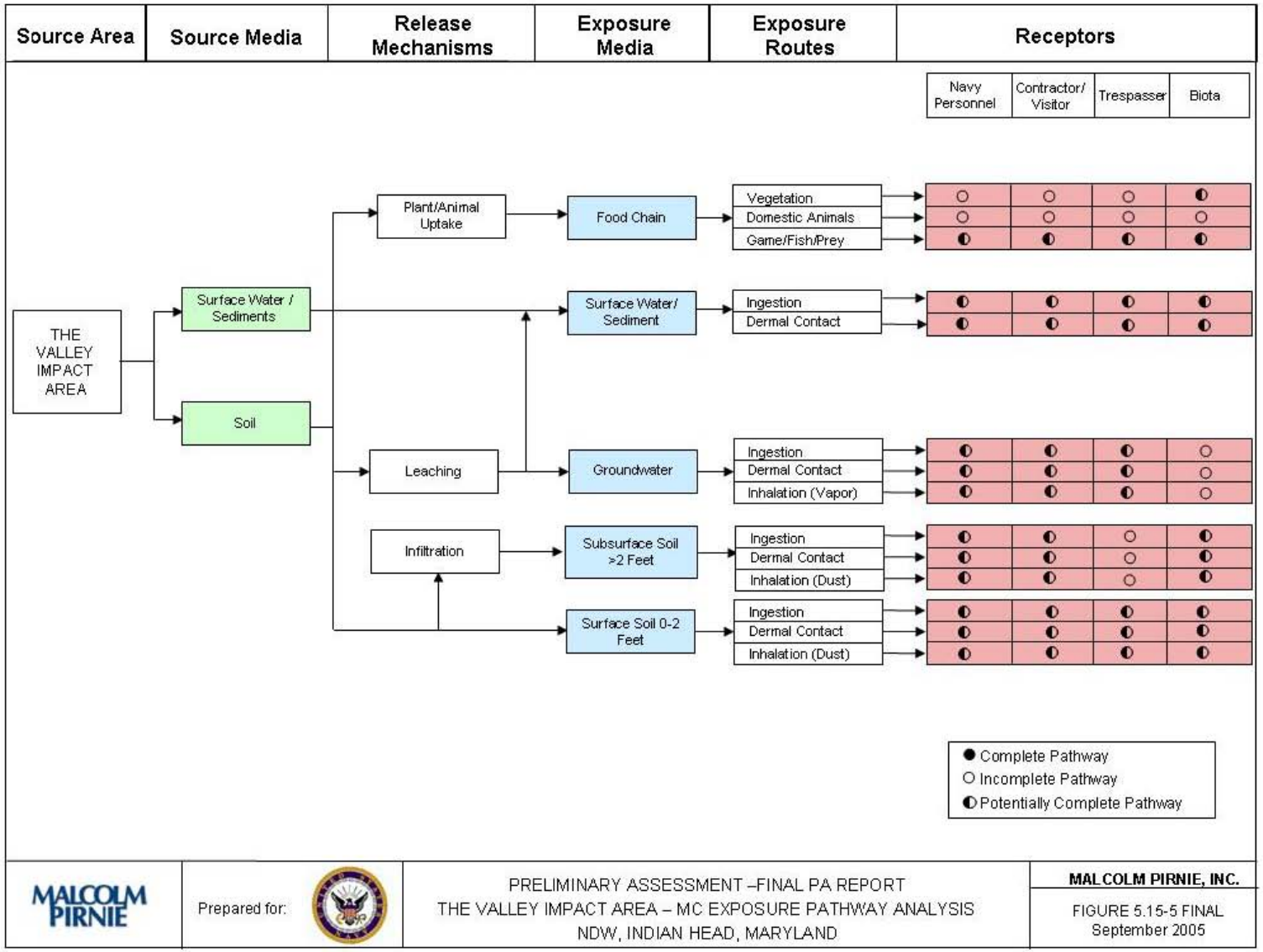


Figure 10.8-5: MC Exposure Pathway Analysis



10.8.12 Problem Definition Summary

The Valley Impact Area covers approximately 694 acres in the western portion of Stump Neck Annex. The acreage includes only areas within the installation boundary and excludes acreages already included as part of other MRP sites. The Valley Impact Area received fire from the Valley gun proving site located on the Main Installation of NSF Indian Head from 1891 through 1921. Various caliber guns (4-inch through 16-inch) were fired into the Valley Impact Area. The shells contained different types of explosive fillers including black powder, smokeless powder, brown prismatic powder, emmensite, joveite, wet gun cotton, randite, and other high explosives (e.g., Thorite). In addition to fire from the gun proving site, the Valley Impact Area received impacts from a firing range set up in the vicinity of Rum Point. The range was established by an agreement between the installation and MCB Quantico. The exact location of the range is unknown; however, firing was oriented towards the far side of Stump Neck Annex. MCB Quantico was also permitted to fire large artillery at Stump Neck Annex for several years until 1934. During the 2004 visual survey, MEC was observed along the western shoreline of the Potomac River; however, the MEC was attributed to the active range (Range 6) near the area. Potential MC includes Explosive D, black powder, TNT, magnesium, NH powder, CTNT, other various metals and chemicals associated with pyrotechnics, such as perchlorate and propellants.

Munitions Types

A variety of munitions and projectiles have been fired during proving ground tests at Stump Neck Annex. The Valley Impact Area (694 acres) covers most of the land portion of Stump Neck Annex west of the Stump Neck Impact Area within the firing fan of the Valley. The Valley Proving Ground tested and fired munitions associated with 1-inch, 3-inch, 4-inch, 5-inch, 6-inch, 7-inch, 8-inch, 10-inch, 12-inch, 14-inch and 16-inch Naval guns onto Stump Neck Annex impact areas (the Valley Impact Area) from 1891 to 1921. Additional proving ground and training activities may also have fired projectiles and test munitions into these impact areas.

The Valley Impact Area also received ordnance from a firing range set up by units from the MCB Quantico (on Stump Neck Annex near Rum Point—the exact location is unknown) for 75-mm guns and howitzers. Historical documentation also indicated that MCB Quantico was also permitted to fire large artillery at Stump Neck Annex for several years until 1934.

Historical records indicate that various projectiles were fired into the Valley Impact Area and included 4-inch, 5-inch, 6-inch, 7-inch, 8-inch, 10-inch, 12-inch, 14-inch, and 16-inch Naval guns (1891 to 1921) and 75-mm and howitzer projectiles from Marine Corps gunnery training (1931 to 1934). The shells fired onto the Valley Impact Area contained different types of explosive fillers including black powder,

smokeless powder, brown prismatic powders, emmensite, joveite, wet gun cotton, randite, and other high explosives, (e.g., Thorite).

Maximum Probable Penetration Depth

The ordnance penetration depths for munitions fired into the Valley Impact Area are variable, based on the variety of ordnance tested and fired into the impact range. The maximum estimated ordnance penetration depth for the largest known munitions (16-inch projectiles) fired onto the Valley Impact Area is 47 feet.

MEC Density

The anticipated MEC density at the site is low due to the construction, development, and continued use that has occurred at the site over the past 80 years.

MEC Scrap/Fragments

Various MEC debris and fragments were identified on portions of the site; however, the items found were attributed to Range 6 and not to the Valley Impact Area.

Associated Munitions Constituents

Potential munitions constituents associated with the Valley Impact Area include Explosive D, black powder, TNT, magnesium, NH powder, CTNT, and various metals and propellants.

The potential MC released by projectiles and munitions fired into the Valley Impact Area from the Valley Proving Ground gun and munitions testing activities include multiple metals, explosive constituents, and various chemical associated with pyrotechnics, such as perchlorate and propellants. A partial list of known explosives tested in the Valley includes the following:

- Powder
- Wet gun cotton
- Shell powder
- Randite
- Joveite
- Picric acid
- Smokeless powder

MC commonly included in 75-mm, 37-mm, and 155-mm ammunition are as follows:

- TNT
- HMX
- Composition B
- Composition D
- Perchlorate

No surface or subsurface sampling has been conducted at the Valley Impact Area. Potential MC include TNT, HMX, Composition B and D, perchlorate, and other explosives such as black powder, smokeless powder, brown prismatic powder, emmensite, joveite, wet gun cotton, and randite.

Migration Routes/Release Mechanisms

Soil surface runoff, soil leaching, groundwater discharge, site maintenance, construction, excavation.

Relationship of MEC/MC Sources to Habitat and Potential Receptors

Receptors may have direct or indirect contact with MEC and MC that exist in the environment or have been incorporated into the food chain.

Problem Definition/Conceptual Site Model for Torpedo Burial Site (UXO 12)

10.9 TORPEDO BURIAL SITE

10.9.1 History and Site Description

The Torpedo Burial Site is a 0.88-acre site located in a wooded area in the central portion of Stump Neck Annex, about 330 feet south of Building 2075. The site is semicircular in shape with the main axis oriented east-west, according to Indian Head staff. The original site boundary, as identified in the Navy's Range Inventory, was expanded after a 21-inch torpedo casing was observed during the 2003 visual survey (Map 10.9-1). Additional features include a wetland marsh immediately south and a seasonal tributary that bisects the site. The site is accessed via a southbound dirt road off Archer Avenue, then by proceeding easterly on foot along a utility right of way through the woods. The ground is wet with many small pools of standing water and is thinly covered with grass, shrubs, and trees.

Historical information on the Torpedo Burial Site is limited, so it is uncertain if torpedoes were buried at this location. According to available reports, the site consists of at least one unlined earthen pit used to bury waste material, including torpedoes, primers, detonators, fuzes, squibs, and other associated hardware transported from a torpedo station near Washington, D.C., in the late 1940s and early 1950s. The pits are not visually observable, nor is there any evidence of their possible locations. A section of a 21-inch torpedo casing was discovered on the site, but its origin is unknown. Although no details are available about the size or dimensions of the burial pits, they would have to have been greater than 15 feet in length to accommodate an average torpedo. The width and depth would depend on the quantity of waste buried. The Torpedo Burial Pit is located within the estimated firing fan from the Valley. Refer to Section 5.7 in the Final PA Report for the Main Installation, Indian Head for information on the Valley. Information is also provided under Section 10.8 of this appendix, the Valley Impact Area.

Topography

Section 10-3.2 of this appendix provides a general description of topography for Stump Neck Annex. The land surface at the Torpedo Burial Site gently slopes toward Chicamuxen Creek to the south. Elevations across the site range from approximately 1 to 5 feet above msl. Due to the topography of the area and the vegetative ground cover, severe erosion is not considered to be a problem.

Geology

Section 10-3.3 of this appendix provides a geologic description for Indian Head and Stump Neck Annex. This general description is applicable to the Torpedo Burial Site.

Soil and Vegetation Types

Section 10-3.4 of this appendix provides a description of the soil and vegetation types at Indian Head and Stump Neck Annex. According to the Soil Survey of Charles County, soil at the Torpedo Burial Site is identified as Mattapex silt loam with 0 to 2 percent slopes (USDA, 1974). Logs from soil borings and test pits installed at the Tool Burial Site (IR Site #34), less than 100 feet west of the Torpedo Burial Site, indicate shallow geologic conditions consisting primarily of sand and gravelly sand overlying clay and silt. The gravels are composed of quartz and are well rounded to subrounded. The vegetation at the Torpedo Burial Site is characterized by heavy grass, shrubs, and small trees. Hardwood trees on site are approximately 10 to 30 feet tall. The wetland area south of the site is classified by the installation as a Palustrine emergent/broad-leaved deciduous scrub-shrub wetland. Figure 10.9-1 illustrates the vegetation on the site.

Figure 10.9-1: Vegetation on the Torpedo Burial Site (Looking East Down the Utility Row)

Hydrology

Section 10-3.5 of this appendix provides a description of hydrology at Indian Head and Stump Neck Annex. The small tributary that bisects the Torpedo Burial Site is a surface runoff sink that overflows into the marsh directly south of the site during heavy rainfalls (Figure 10.9-2). Chicamuxen Creek, which borders the marsh on three sides, is also an important hydrologic feature because it may be another collection point for surface water runoff from the site. The wetlands and tributaries eventually drain into the Potomac River.

Figure 10.9-2: Small Tributary that Bisects the Torpedo Burial Site (Looking South Towards the Wetlands)

Hydrogeology

Section 10-3.6 of this appendix provides a description of hydrogeology for Indian Head and Stump Neck Annex. This information is applicable to the Torpedo Burial Site. However, studies at the adjacent IR Site #34 indicate a shallow unconfined aquifer at approximately 2 to 5 feet bgs. Groundwater flow is to the northwest, away from Chicamuxen Creek.

Cultural and Natural Resources

General cultural and natural resources for NSF Indian Head are provided in Section 10.3-7 of this appendix. According to the 1996 Phase I Cultural Resources Survey of Stump Neck Annex, there are no archeological/cultural sites within the Torpedo Burial Site. Several shovel test pits were excavated on the site, and all were negative for artifacts.

Endangered and Special Status Species

As discussed in Section 10-3.8 of this appendix, endangered species are reported to exist at Stump Neck Annex. No endangered or special status species are known to inhabit the Torpedo Burial Site. However, the reported endangered and special status species have the potential to inhabit the Torpedo Burial Site.

10.9.2 Visual Survey Observations and Results

A visual survey of the Torpedo Burial Site was conducted on June 24, 2003, by Malcolm Pirnie personnel. Mr. Jorgensen and Ms. Morgan, NSF Indian Head Environmental Office, accompanied the team. The survey team entered the area from the west via a utility right of way and then walked along a rectangular transect through the center of the site. Grass, shrubs, and a sparse population of hardwood trees covered the swampy ground. Figure 10.9-3 depicts examples of metallic debris that was scattered throughout the site. Figure 10.9-4 shows a 21-inch torpedo casing that was found in a pool of standing water. The torpedo appeared to have been demilitarized because of the hole in the casing. No geophysical inspection of the site has been completed to date.

Figure 10.9-3 Examples of Metallic Debris

Figure 10.9-4: 21-inch Torpedo Casing Appears to be Demilitarized by Hole in Side

10.9.3 Munitions and Munitions-Related Materials Associated with the Site

This section describes the munitions and munitions-related materials known or suspected to be at the site. This includes both MEC and non-hazardous munitions-related debris (e.g., fragmentation, base plates, inert mortar fins). The Torpedo Burial Site was believed to be used to dispose of torpedoes and related accessories. With the exception of the items discussed in Section 10.9.2 of this appendix, no other MEC or munitions-related debris are known to be at the Torpedo Burial Site.

The Torpedo Burial Site is overlapped by the firing fan from the Valley located at the Main Installation. Thus, there is a potential for munitions associated with the Valley to be present at the Torpedo Burial Site. Information on the Valley is also provided in Section 10.8 of this appendix, the Valley Impact Area.

Based on the information obtained during the data collection process, the Torpedo Burial Site may contain electrically fuzed munitions. It is not suspected to contain CWM-filled munitions or DU-associated munitions.

10.9.4 MEC Presence

The entire site has been subdivided and categorized into one of three levels of MEC presence including known MEC areas, suspected MEC areas, and areas where no evidence exists to indicate that MEC are known or are suspected to be at the site. Map 10.9-2 illustrates the munitions characterization of the Torpedo Burial Site and is provided at the end of Section 10.9 of this appendix.

Known MEC Areas

The only known MEC area at the Torpedo Burial Site is the location where the torpedo casing section was discovered.

Suspected MEC Areas

The entire Torpedo Burial Site is considered a suspect MEC area; however, the potential relative concentration or density of MEC is not known.

Areas Not Suspected to Contain MEC

According to historical documents and information obtained during the data collection process, there is evidence of the presence of MEC at the Torpedo Burial Site. Therefore, there are no areas at the Torpedo Burial Site that are not suspected to contain MEC.

10.9.5 Ordnance Penetration Estimates

Ground penetration due to impact is not considered at this site. However, according to historical documents and information obtained during the data collection process, the site is reported to have at least one burial pit of unknown dimension. The pit would have to have been large enough to accommodate torpedoes averaging 15 feet in length and 21 inches in diameter. Figure 10.9-5 depicts two torpedoes from the WWII era that resemble those believed buried at this site. The Torpedo Burial Site is overlapped by the firing fan from the Valley located at the Main Installation. Thus, there is a potential for munitions associated with the Valley to be present at the Torpedo Burial Site. The ordnance penetration depth associated with munitions fired from the Valley is provided in Section 10.8 of this appendix. Only the munitions constituents that specifically relate to the Torpedo Burial Site are considered in this SI.

Figure 10.9-5 WWII Era Torpedoes Resembling those Allegedly Buried at this Site

10.9.6 Munitions Constituents

MC are suspected to be present at this site. MC commonly found in torpedoes include the following:

- TNT
- RDX
- Composition A
- Composition B
- Composition C
- Torpex
- PETN
- Dynamite
- Nitrocellulose
- Cordite
- Perchlorate

The relative concentrations of these MC are not known but are not anticipated to exceed 10 percent in soil. No MC were observed during the 2003 visual survey. There was no record found of any excavations or environmental sampling on the site. The Torpedo Burial Site is overlapped by the firing fan from the Valley, located at the Main Installation. Thus, there is a potential for munitions associated with the Valley to be present at the Torpedo Burial Site. Information on the Valley is provided in Section 10.8 of this appendix, the Valley Impact Area. Only the munitions constituents that specifically relate to the Torpedo Burial Site are considered.

10.9.7 Contaminant Migration Routes

Contaminants at the Torpedo Burial Site may potentially migrate within soil, groundwater, and surface water runoff. Due to the high erodability of the soils in the area, contaminants may become mobile within surface soil, particularly during extended periods of surface runoff. The Torpedo Burial Site is a low-lying area bordered by wetlands on the southern edge. Surface runoff occurs either easterly into Chicamuxen Creek, southerly into the wetlands, or into the seasonal tributary that bisects the site. Runoff in the direction of Mattawoman Creek is unlikely to cross Archer Avenue. Contaminants on site can potentially migrate to shallow groundwater through infiltration. Based on a review of hydrogeological data, it is unlikely that MC in shallow groundwater would migrate to the deeper aquifers that are used as water supplies. However, shallow groundwater is still considered a potential exposure medium.

10.9.8 Receptors

Potential human receptors include authorized Navy personnel (military and civilian), visitors, contractors, maintenance workers, recreational, users, and trespassers. Plant and animal biota are also potential receptors. Examples of ecological receptors include deer, wild turkey, and waterfowl.

Nearby Populations

Nearby populations are as discussed in Section 10.1.8 of this appendix.

Buildings Near/Within Site

Building 2075 is within approximately 330 feet of the Torpedo Burial Site and is the only building nearby. The building is now condemned. There is no evidence of any pre-existing structure at the site.

Utilities On/Near Site

This site is undeveloped, and there is no evidence of utilities on the Torpedo Burial Site. The Team accessed the site via a utility right of way, which suggests that water, electricity, or both are available. The aforementioned building is no longer in use; however, it is assumed that water and electricity were previously available.

10.9.9 Land Use

There is no additional information about this area's land use prior to and since the late 1940s and early 1950s when it was used for torpedo burial. According to installation personnel, there are no planned future activities at the site**.**

10.9.10 Access Controls/Restrictions

No public access is authorized to Stump Neck Annex. Signs, partial fencing, locked/secured gates, login book/office check-in, and vehicle security patrols are used to control the entire facility. There are no access control features specific to the Torpedo Burial Site. Access from the water is not controlled.

According to the Soil Survey of Charles County, many of the soil types on Stump Neck and Indian Head have load-bearing capacity limitations as a result of high water tables and extreme erodability conditions (USDA, 1974). Based on this information, the installation has limited construction and the use of septic systems in specific areas of concern. The Torpedo Burial Site is located in an area that has a seasonal high water table and overlaps an area containing hydric soils. Parts of the area located in two restriction areas, one in which septic systems are prohibited and the other in which a waiver is required for septic systems.

10.9.11 Conceptual Site Model

The Torpedo Burial Site is overlapped by the firing fan from the Valley located at the Main Installation. Thus, there is a potential for munitions associated with the Valley to be present at the Torpedo Burial Site. However for the purpose of the PA, only MEC and/or MC associated with the Torpedo Burial Site is considered in the CSM exposure pathway analysis. For exposure pathway analysis for the Valley Impact Area, refer to Section 10.8.11 of this appendix.

Historical and visual evidence indicate that MEC may be present at the site; therefore, an Exposure Pathway Analysis for MEC was created and is presented as Figure10.9-6. Potentially complete pathways exist for human and ecological receptors for MEC in surface soil. This includes receptors for hand/tread underfoot contact and surface intrusive work that may be conducted at the Torpedo Burial Site. These activities include, but are not limited to, excavation, plowing, tilling, construction, and environmental sampling for human receptors. Ecological receptors may come in contact with MEC through burrowing, nesting, or feeding activities that disturb surface soil. Trespassers are anticipated to be exposed via non-intrusive surface soil activities at the site, but it is unlikely they would be exposed to surface soil through intrusive activities. MEC are expected to be present in subsurface soil; therefore, potentially complete pathways exist for ecological and human receptors with the exception of trespassers. It is not anticipated that trespassers would come in contact with subsurface soil.

Soil and surface water/sediment impacted by MC represent a primary potential source medium, as illustrated in the Exposure Pathway Analysis for MC, Figure 10.9-7. Potential receptors include both human and ecological receptors that may disturb, unbury, or remove the source medium from the site. Potentially complete exposure pathways exist for surface soil through ingestion, dermal contact, and inhalation for both human and ecological receptors. A seasonal tributary bisects the site. Runoff, discharges, and/or erosion may transport MC from surface soil to surface water/sediment, so potentially complete pathways also exists for all human and ecological receptors of surface water/sediment. Soil also represents an exposure medium when considering plant/animal uptake for biota (including game such as deer) and human receptors consuming the affected biota (e.g., hunting). Because this is a potential burial site, MC is expected to be present in subsurface soil. It is not anticipated that trespassers would come in contact with subsurface soil. There is a potential for MC present in soil to infiltrate to surficial groundwater. Although confining layers are expected to prevent the migration of MC to the lower aquifers used for water supplies, potentially complete pathways exist for MC in shallow groundwater for human receptors. A graphical illustration of the Torpedo Burial Site is presented as Figure 10.9-8.

Figure 10.9-6: MEC Exposure Pathway Analysis

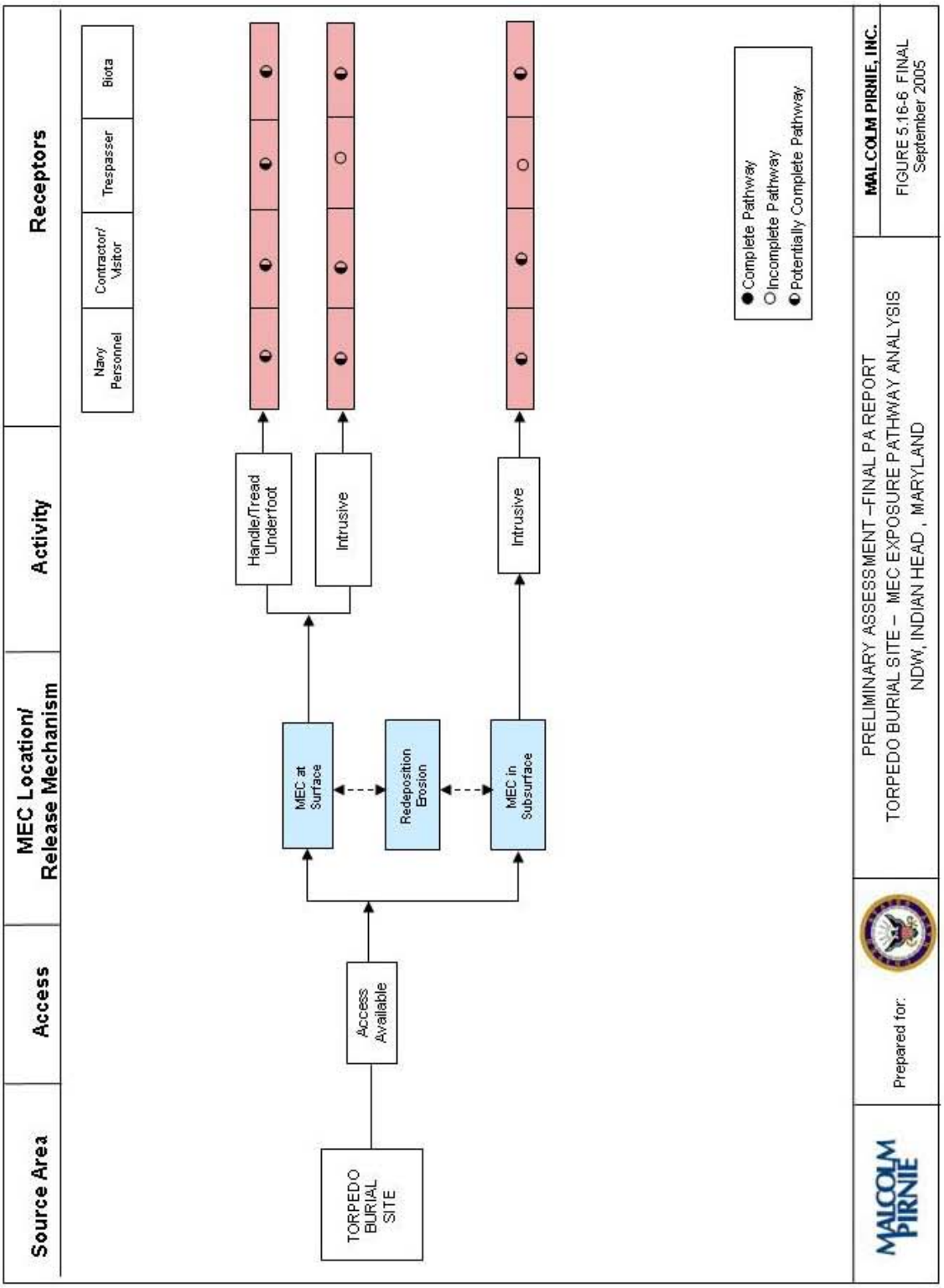


Figure 10.9-7: MC Exposure Pathway Analysis

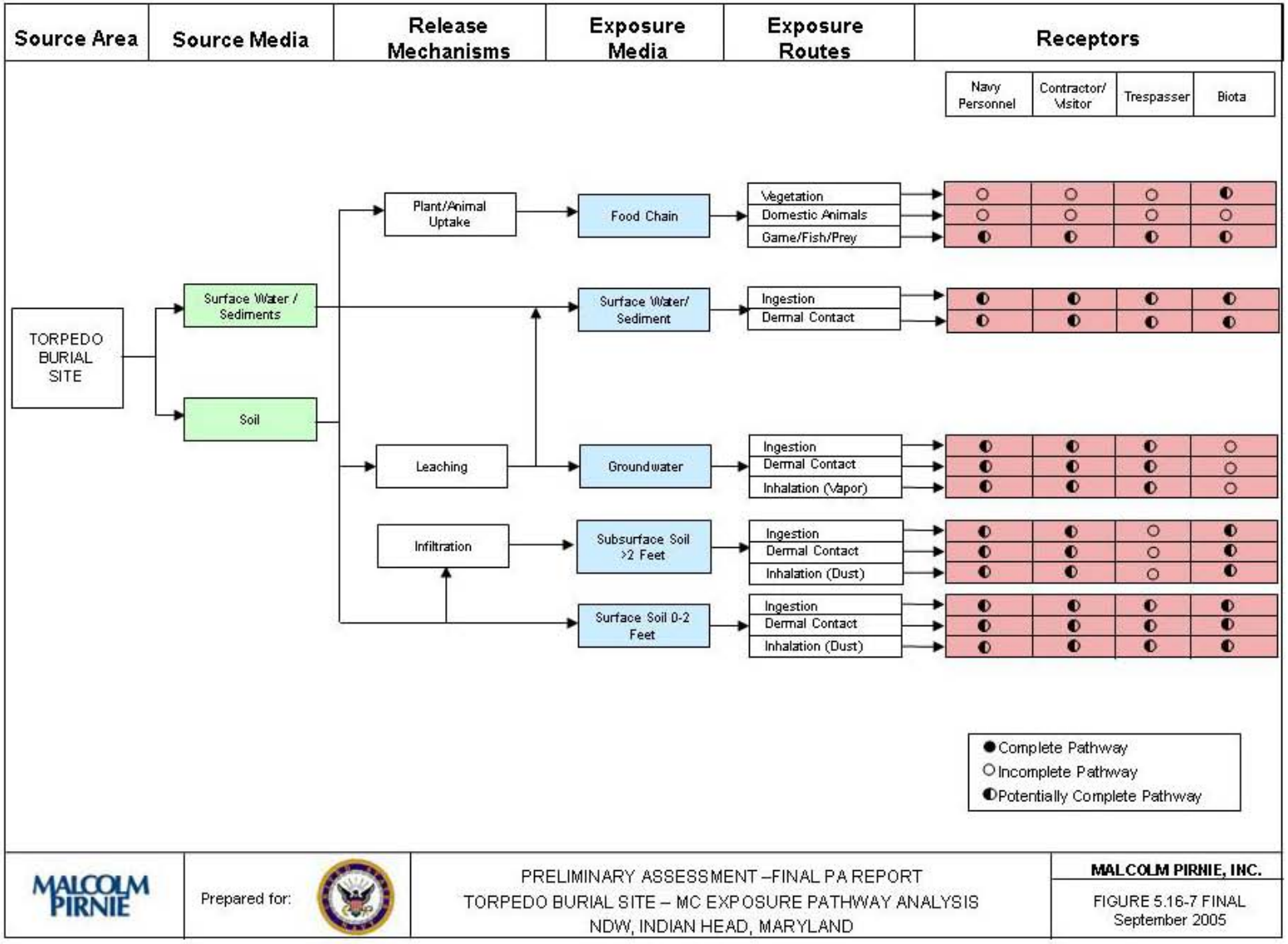
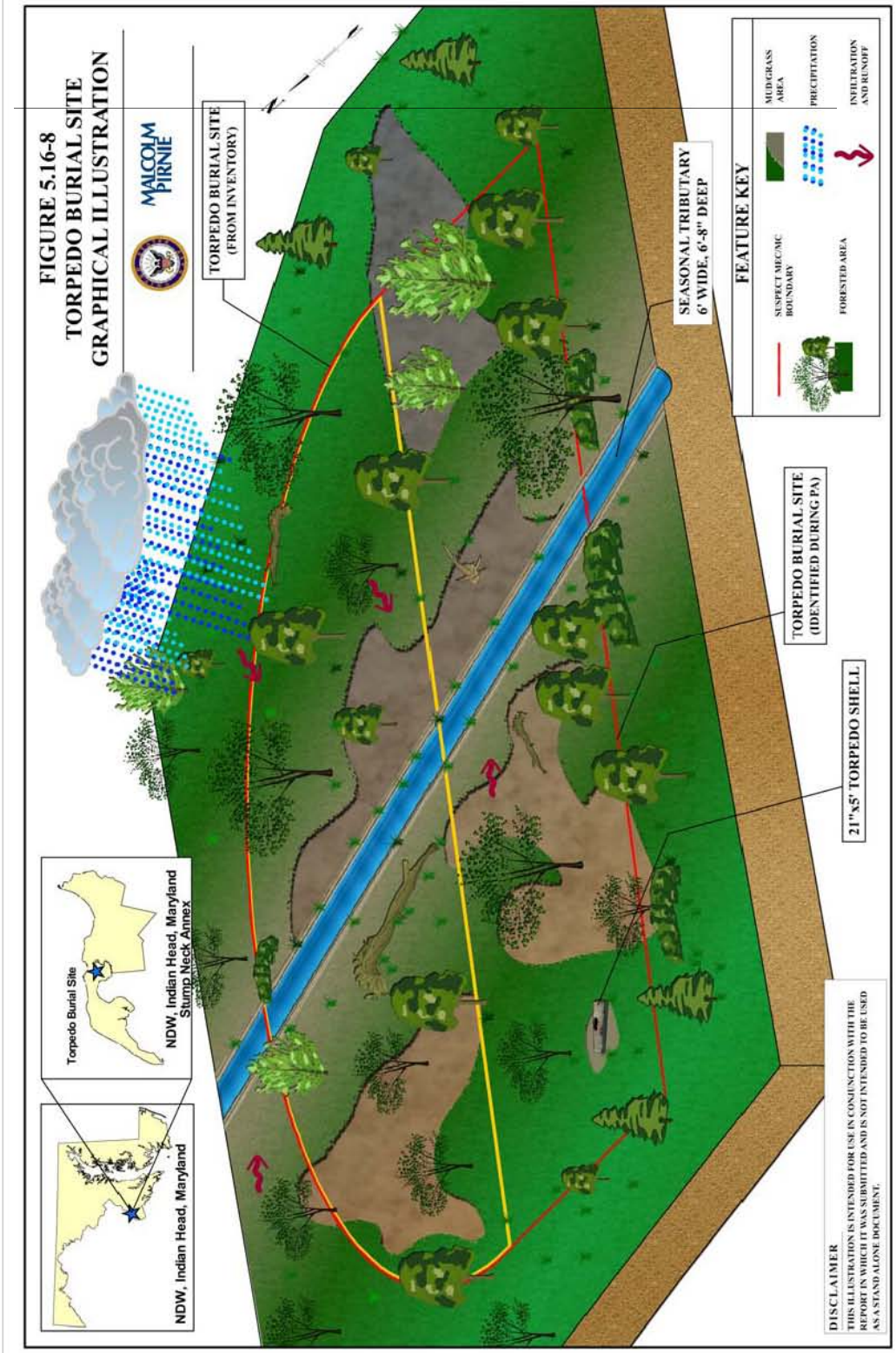


Figure 10.9-8: Torpedo Burial Site Graphical Illustration



10.9.12 Problem Definition Summary

The Torpedo Burial Site encompasses 0.88 acres in the north-central region of Stump Neck Annex. The site is situated in the woods off Archer Avenue, about 330 feet south of Building 2075. The site was first identified in a 1983 IAS completed when USEPA was preparing to issue a RCRA permit to the Navy for its facility on Stump Neck. Under a FFA between USEPA and the Navy, the site (also known as IR Site #35) was identified as a Site Screening Area, which would undergo a Site Screening Process to determine if a Remedial Investigation, Feasibility Study, or no further action would be required. The results of the Site Screening Process are unknown. According to a 1990 Fact Sheet for Hazardous Waste Management Facility Permit, the site contained unknown quantities of inert objects including discarded torpedo shells and associated hardware deposited there between the late 1940s and early 1950s. In that report, USEPA concluded that no further action was necessary at that time.

A 21-inch torpedo shell was observed in a small pool of standing water at the site. No further information is available about the torpedo, except that it appears to have been demilitarized. Large pieces of munitions debris and miscellaneous metal fragments have also been found at the site. It is uncertain if these items were once buried and have since resurfaced or if they were moved to the site from another location.

Geophysical sampling was performed near the Torpedo Burial Site at IR Site #34. As indicated in the Site Screening Process Report dated March 2003, no explosives were detected in groundwater samples.

Munitions Types

The Torpedo Burial Site was used for the disposal of torpedoes, casings, primers, detonators, fuzes, and squibs. Historical documents report that these munitions types were buried at the site over a period of no less than 5 years.

Maximum Probable Penetration Depth

MEC was buried in at least one pit of unknown dimension on the Torpedo Burial Site. The excavation for the burial site is believed to have been at least 15 feet long and 21 inches wide, to accommodate the average size of a WWII-era torpedo.

MEC Density

The area of the Torpedo Burial Site where the 21-inch torpedo casing section was located has been classified as a known MEC area. The actual torpedo burial pit would be expected to have a high density

of MEC, related to the disposal of torpedoes, primers, detonators, fuzes, and squibs in at least one unlined earthen pit.

MEC Scrap/Fragments

A 21-inch torpedo (demilitarized) was identified in standing water, and two or three other pieces of non-identifiable debris were observed at the site. Scattered metallic debris was observed across the site during the 2003 visual survey.

Associated Munitions Constituents

There was no record of environmental sampling for the Torpedo Burial Site.

MC from torpedoes, casings, primers, detonators, fuzes, and squibs are suspected to be in the Torpedo Burial Site. The potential MC at the site (based on the possible presence of torpedoes and their components) include the following:

- TNT
- RDX
- Composition A
- Composition B
- Composition C
- Torpex
- PETN
- Dynamite
- Nitrocellulose
- Cordite
- Perchlorate

Migration Routes/Release Mechanisms

Soil surface runoff; groundwater discharge; site maintenance; construction; excavation.

Relationship of MEC/MC Sources to Habitat and Potential Receptors

Receptors may contact MEC in subsurface soil. Receptors may have contact with MC directly through surface water/soil or indirectly through the food chain (bioaccumulated in plants and animals).

Problem Definition/Conceptual Site Model for Torpedo Casing Disposal Area (UXO 23)

10.10 TORPEDO CASING DISPOSAL SITE

10.10.1 History and Site Description

The Torpedo Casing Disposal Area encompasses approximately 0.74 acre 200 feet north of Archer Avenue and partially within a designated wildlife area. The wildlife area is a cleared strip of land approximately 20 feet wide extending north from Archer Avenue to the Potomac River. The disposal site reportedly overlays the western edge of the cleared area and extends into the bordering tree line. The site is rectangular in shape and approximately 165 feet wide and 330 feet long. The area was identified through the Navy Range Inventory; however, its location was initially described incorrectly. Initial maps showed the area positioned under the water tower adjacent to Archer Avenue, east of the corrected location. The approximate size and shape of the Torpedo Casing Disposal Area was provided by the inventory. Map 10.10-1 (located at the end of Section 10.10 of this appendix) shows the location of the site and the initial incorrect location as delineated by the installation. There are no maps or aerial photographs that specifically identify the former disposal area. The cleared wildlife area/firebreak appears on several installation maps and photographs, the earliest one dated 1947. Information about the site was primarily gathered from interviews with installation personnel.

Little available historical information about the Torpedo Casings Disposal Area exists. According to Navy personnel, the area was used as a disposal site for torpedo casings during the 1950s. The exact dates of use are unknown as is the depth or number of torpedo casings possibly buried at the site. The torpedo casings may have originated from training at the EOD School or from use during WWII. During WWII, foreign torpedoes were often retrieved and brought to Stump Neck for testing. A munitions factory in Alexandria, Virginia was known to supply the base with torpedoes beginning in the 1920s. The factory produced over 10,000 MK-14 torpedoes. There is, however, no specific information about where the torpedoes originated before being buried at the Torpedo Casing Disposal Area.

According to installation personnel, a magnetic training range was established in the mid-1970s in the area between the northern end of the current wildlife area and the Potomac River. This range was approximately 300 to 400 feet from the northern edge of the Torpedo Casing Disposal Area and was used only until Test Area 2 was constructed in the late 1970s. Inert ordnance was buried in this former range area, including empty cases of 60-mm mortars, 81-mm mortars, 105-mm projectiles, 155-mm projectiles, MK81s (250-pound bombs), and MK82s (500-pound bombs). During the initial set-up of this range, a geophysical investigation was performed and magnetic anomalies were detected at depths greater than 3 feet, indicating that large items were buried in the area of the Torpedo Casing Disposal Area. At that

time, the cleared wildlife area was used as a firebreak. Natural Resources converted the firebreak to a wildlife refuge area in 1981 or 1982. The entire wildlife area was disked (a method that turns and loosens the soil with a series of disks) and planted with grass. This process reportedly uncovered inert ordnance material from the magnetic testing area. According to installation personnel, most, if not all, of the ordnance buried for the magnetic testing was removed during this process.

Topography

Section 10-3.2 of this appendix provides a general description of topography for Stump Neck Annex. The topography at the Torpedo Casing Disposal Area is fairly flat to slightly downward sloping from south to north. This 0.74-acre area is located at an elevation of approximately 80 feet above msl. The elevation at Archer Avenue is 95 feet and slopes to an elevation of 75 feet at the northern end of the site. Due to the heavy vegetation and gently sloping land, severe erosion is not considered to be a problem.

Geology

Section 10-3.3 of this appendix provides a geologic description for Indian Head and Stump Neck Annex. There is no site-specific geology for the Torpedo Casing Disposal Area because there are no wells within its boundaries and no sampling has been performed.

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Soil and Vegetation Types

Section 10-3.4 of this appendix provides a description of the soil and vegetation types at Indian Head and Stump Neck Annex. The vegetation on the former disposal area is a mix of high grasses in the open field associated with the wildlife area and dense, hardwood forest throughout the rest of the area. The boundaries of the area overlap the eastern side of the wildlife area and extend into the hardwood forest. According to the Soil Survey of Charles County, the soil in this area is Beltsville silt loam with 2 to 5 percent slopes and moderate erodability (USDA, 1974). These soils are generally located on terrain that is nearly level to moderately sloping. They are considered moderately well drained, strongly acidic, and slowly permeable. These soils are particularly eroded around surface water bodies or areas with poor drainage where water is able to pool on the surface. The Torpedo Casing Disposal Area does not have any surface water bodies and is generally well drained. Thus, erosion of the soil on site is not considered severe.

Hydrology

Section 10-3.5 of this appendix provides a description of hydrology at Indian Head and Stump Neck Annex. There are no streams within the boundaries of the Torpedo Casing Disposal Area. One small stream is south of the site across Archer Avenue. Although there are no wetlands on the site, drainage most likely follows surface topography in the direction of a small area of wetlands northeast of the wildlife area. The land slopes downward to Mattawoman Creek, which is located approximately 1,100 feet north of the site. Surface water runoff from the site drains into the wetland and Mattawoman Creek and eventually to the Potomac River.

Hydrogeology

Section 10-3.6 of this appendix provides a description of hydrogeology for Indian Head and Stump Neck Annex. There are no potable wells in the vicinity of the Torpedo Casing Disposal Area.

Cultural and Natural Resources

General cultural and natural resources for NSF Indian Head are provided in Section 10-3.7 of this appendix. The eastern edge of the Torpedo Casing Disposal Area overlaps a wildlife protection area. According to the 1996 Phase I Cultural Resources Survey and Supplemental Architectural Investigations conducted at Stump Neck Annex, there are no known cultural resources located within the former Torpedo Casing Disposal Area.

Endangered and Special Status Species

As discussed in Section 10-3.8 of this appendix, endangered and special status species are reported to exist at Stump Neck Annex. The Torpedo Casing Disposal Area is partially located in a wildlife protected area. No endangered or special status species are known to exist at the site.

10.10.2 Visual Survey Observations and Results

A visual survey of the Torpedo Casing Disposal Area was conducted on June 25, 2003. The approximate perimeter of the site was walked during the survey. The site walk was conducted by walking north from Archer Avenue through the open grass corridor and then returning to the road through the woods. The site is located off Archer Avenue on the northern side of the jogging trail adjacent to the road. There are “Do Not Disturb” signs posted along the trail for the wildlife area. The change in vegetation from dense forest to a grass field clearly marks the borders of the wildlife protected area. The site vegetation is illustrated on Figure 10.10-1.

There was no physical evidence (such as soil disturbance or excavation) to suggest where torpedo casings were buried on the site. The boundaries of the site were not clearly visible. There are no buildings or structures on the disposal area. No evidence of MC or MEC was observed during the survey.

Figure 10.10-1: The Torpedo Casing Disposal Area and Wildlife Protection Area

10.10.3 Munitions and Munitions-Related Materials Associated with the Site

This section describes the munitions and munitions-related materials known or suspected to be at the site, including the types and estimated maximum penetration depths. This includes both MEC and non-hazardous munitions-related debris (e.g., fragmentation, base plates, inert mortar fins). Potential ordnance concentration areas are presented along with a discussion on the presence of any special consideration ordnance.

Inert torpedo casings, which are not considered munitions, were reportedly buried at this site. No other information exists regarding the potential for munitions or MC in this area.

Based on the information obtained during the data collection process, no CWM-filled munitions, electrically fuzed munitions, or DU-associated munitions are known or suspected to have been used at the site.

10.10.4 MEC Presence

The entire site has been subdivided and categorized into one of three levels of MEC presence including known MEC areas, suspected MEC areas, and areas where no evidence exists to indicate that MEC are known or are suspected to be at the site. The MEC presence is discussed below.

Map 10.10-2 illustrates the munitions characterization of the Torpedo Casing Disposal Area and is provided at the end of Section 10.10 of this appendix.

Known MEC Areas

There are no known MEC areas associated with this site. Only inert torpedo casings are known to be buried at this site.

Suspected MEC Areas

There are no suspected MEC areas associated with this site. Only inert torpedo casings are reported to have been buried at this site.

Areas Not Suspected to Contain MEC

The disposal area was used exclusively for torpedo casings. The casings are reportedly inert with no explosive components; therefore, the entire site is not suspected to contain MEC.

10.10.5 Ordnance Penetration Estimates

The potential burial depth of the torpedo casings on site is unknown. A previous geophysical investigation suggests anomalies at greater than 3 feet bgs. There were no burial pits or areas of visible soil disturbance observed during the 2003 site survey. Reportedly, the site was used exclusively as a disposal area. No firing or explosions are known to have occurred on the site; therefore, ordnance penetration depth does not apply.

10.10.6 Munitions Constituents

At the Torpedo Casing Disposal Area, only empty, inert torpedo casings were reported to have been buried. The expected MC are elevated levels of metals from the weathering of the torpedo casings. Depending on the origin and use of the torpedo casings prior to burial, there is the potential for small amounts of residue on the interiors of the casings. No sampling has been performed in the area.

10.10.7 Contaminant Migration Routes

Contaminants at the Torpedo Casing Disposal Area may potentially migrate within soil, surface water runoff, or groundwater. At the Torpedo Casing Disposal Area, all potential contaminants from the torpedo casings would originate in the subsurface where the casings were buried. The torpedo casings are estimated to be buried at a depth greater than 3 feet bgs. No MC are expected in the top 3 feet of soil, and therefore there are no migration routes from surface soil at the site. Precipitation infiltration may provide for contaminant mobility through the subsurface to the shallow surficial aquifer, which is assumed to be connected to nearby surface water bodies. Based on a review of hydrogeological data, it is unlikely that MC in shallow groundwater would migrate to the deeper aquifers that are used as water supplies. However, shallow groundwater is still considered a potential exposure medium.

10.10.8 Receptors

Potential human receptors include authorized Navy personnel (military and civilian), visitors, contractors, maintenance workers, recreational users, and trespassers. Plant and animal biota are also potential receptors. Examples of ecological receptors include deer, wild turkey, and waterfowl.

Nearby Populations

Nearby populations are discussed in Section 10.1.8 of this appendix. The Torpedo Casing Disposal Area overlaps a wildlife protection area.

Buildings Near/Within Site

There are no buildings or structures located within the Torpedo Casing Disposal Area or on the adjacent wildlife protection area. An explosives storage complex, including over a dozen buildings, is located approximately 490 feet northwest of the site. A water tower is located 720 feet southeast of the site along Archer Avenue.

Utilities On/Near Site

There was no visual evidence of any utilities on the former Torpedo Casing Disposal Area. According to a 2003 Stump Neck Utility Map, water, electric and sewer lines run along Archer Avenue, approximately 200 feet south of the area.

10.10.9 Land Use

The land was unused prior to its use as a burial site for torpedo casings during the 1950s. Currently, the land overlaps a wildlife refuge, which was used as a firebreak prior to 1981. The date of the logging and establishment of the firebreak is unknown. The protected area is not regularly maintained and is characterized by high grasses. The remainder of the site is located within a heavily forested area and is unused and not maintained.

Hunting is permitted on Stump Neck, including within the Torpedo Casing Disposal Area, except for the wildlife refuge. There is no anticipated change in land use at the site.

10.10.10 Access Controls/Restrictions

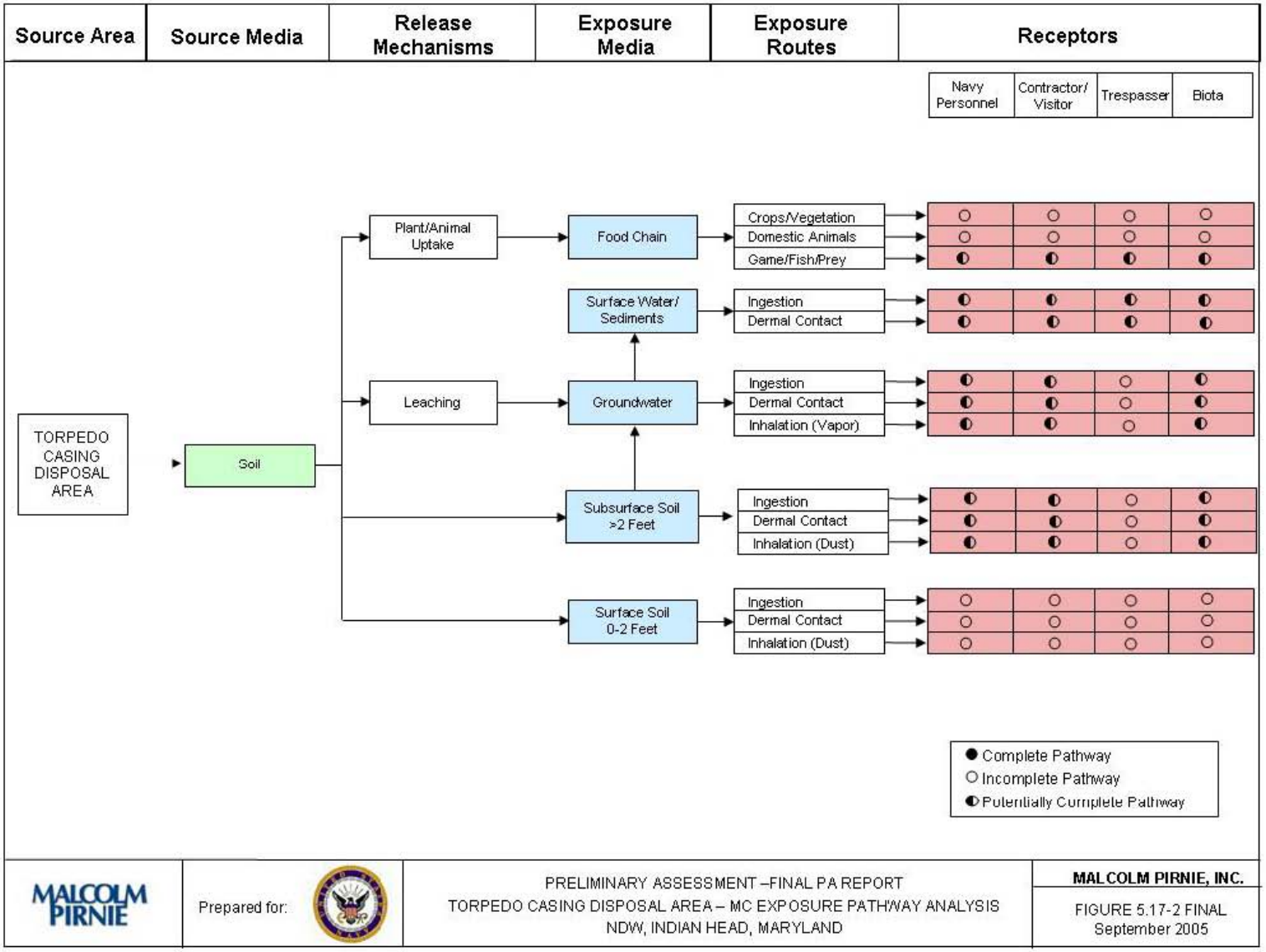
Access to the Stump Neck Annex is limited by gated entrances, security patrols, and a perimeter fence. Only Navy personnel and authorized contractors/visitors are allowed on the installation. The Torpedo Casing Disposal Area is accessible directly from Archer Avenue. Several “Do Not Disturb” signs along the road identify the wildlife area. There are no site-specific security measures at this site. There are no known restrictions at the Torpedo Casing Disposal Area.

10.10.11 Conceptual Site Model

Historical and visual evidence indicate that MEC are not present at the site; therefore, there are no complete exposure pathways for MEC. As such, an Exposure Pathway Analysis for MEC was not created. Soil impacted by MC represents a primary potential source medium, as illustrated in the Exposure Pathway Analysis for MC (Figure 10.10-2). There are no potentially complete pathways for exposure to surface soil because the torpedo casings are buried at a depth greater than 3 feet. Potential receptors include Navy personnel and contractors who could disturb subsurface soil and unbury or remove the source medium from the site. Activities include excavation of the site for construction purposes or for possible environmental sampling. It is not anticipated that trespassers would come in contact with subsurface soil. Burrowing animals may also come into contact with buried MEC. Soil also represents an exposure medium when considering plant/animal uptake for biota (including game such as deer) and human receptors consuming the affected biota (e.g., hunting). There is a potential for the MC present in subsurface soil to infiltrate to surficial groundwater. Precipitation infiltration may provide for contaminant mobility into subsurface soil and the shallow surficial aquifer, which is assumed to be connected to nearby surface water bodies. Thus, there are potentially complete pathways to MC in surface water/sediment for all receptors. Although confining layers are expected to prevent the migration

of MC to the lower aquifers used for water supplies, potentially complete pathways exist for MC in shallow groundwater for human receptors.

Figure 10.10-2: MC Exposure Pathway Analysis



10.10.12 Problem Definition Summary

The Torpedo Casing Disposal Area encompasses 0.74 acre in the central portion of Stump Neck Annex. It was reportedly used during the 1950s as a burial site for torpedo casings. The precise dates of use and types of torpedo casings buried are unknown. The current conditions of the casings are also unknown. The casings are presumed to be inert with no explosive risk. Depending on the uses of the torpedos, there is the possibility of residue left within the casing. Due to weathering, there may be elevated levels of metals in soil on site. No visual signs (e.g., casings, pits, or soil disturbance) of the former disposal area remain. A former magnetic training area is located north of the Torpedo Casing Disposal Area. A geophysical investigation in this area revealed no magnetic anomalies shallower than 3 feet; however, there were magnetic anomalies found at greater than 3 feet in the location of the Torpedo Casing Disposal Area. According to installation personnel, the adjacent wildlife area was disked during its establishment in 1981 or 1982, and most or all of the buried ordnance from the magnetic test range was uncovered. This ordnance removal has not been confirmed.

Munitions Types

Little available historical information on the Torpedo Casing Disposal Area exists, but according to Navy personnel, the area was used as a disposal site for inert torpedo casings during the 1950s. The exact dates of site use are unknown. There is no specific information about where the torpedoes originated before being buried at the Torpedo Casing Disposal Area. Inert torpedo casings were the only munitions type disposed of in this area.

Maximum Probable Penetration Depth

Penetration depth estimations are not applicable to the Torpedo Casing Disposal Area activities or operations. The disposal that occurred in the area did not involve firing projectile-type ordnance items. The depth and number of torpedo casings buried at the Torpedo Casing Disposal Area are unknown. Facility personnel indicate that during the mid-1970s, a geophysical study was performed near the Torpedo Casing Disposal Area in conjunction with the establishment of a magnetic training range (about 300 to 400 feet north of the northern edge of the area). During the initial set-up of the magnetic training range, the geophysical investigation uncovered magnetic anomalies at depths greater than 3 feet, indicating that large items were buried in the area of the Torpedo Casing Disposal Area.

MEC Density

The presence or density of MEC at the Torpedo Casing Disposal Area is unknown. During the 2003 visual site survey, no live MEC were observed or reported. Based on the reported activity of burying inert

torpedo casings with no explosive components, the entire 0.74-acre Torpedo Casing Disposal Area is not suspected to contain MEC.

MEC Scrap/Fragments

MEC scrap and fragments are not anticipated in the Torpedo Casing Disposal Area. Only inert torpedo casings without explosive components were reportedly buried at this site.

Associated Munitions Constituents

Weathering of torpedo casings may create elevated levels of metals in soil. There may be potential MCs from residue remaining on the insides of the torpedo casings.

Migration Routes/Release Mechanisms

Basic activities such as general site maintenance, local construction operations, or excavation activities in the immediate area of the Torpedo Casing Disposal Area could potentially release MC in the subsurface or expose humans and ecological receptors to residual MC remaining on the buried torpedo casings.

Relationship of MEC/MC Sources to Habitat and Potential Receptors

Because the casings are buried at an unknown depth and density, only intrusive activities could potentially expose receptors. It is presumed that the inert torpedo casings were buried at least 3 feet bgs.

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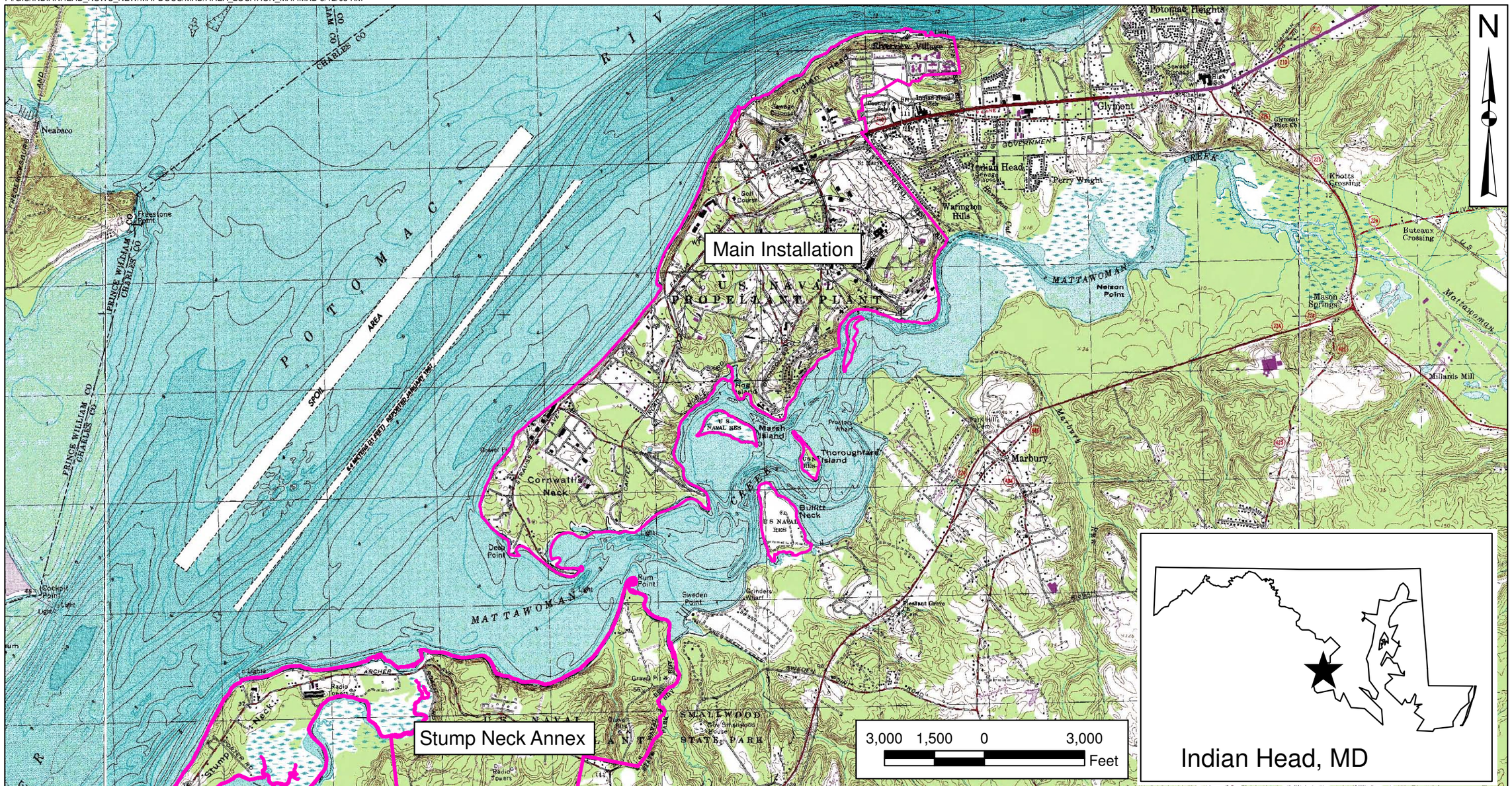

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COST/SCHEDULE-AREA			APPROVED BY — / DATE —
SCALE AS NOTED			FIGURE NO. MAP 10-1 / REV 0

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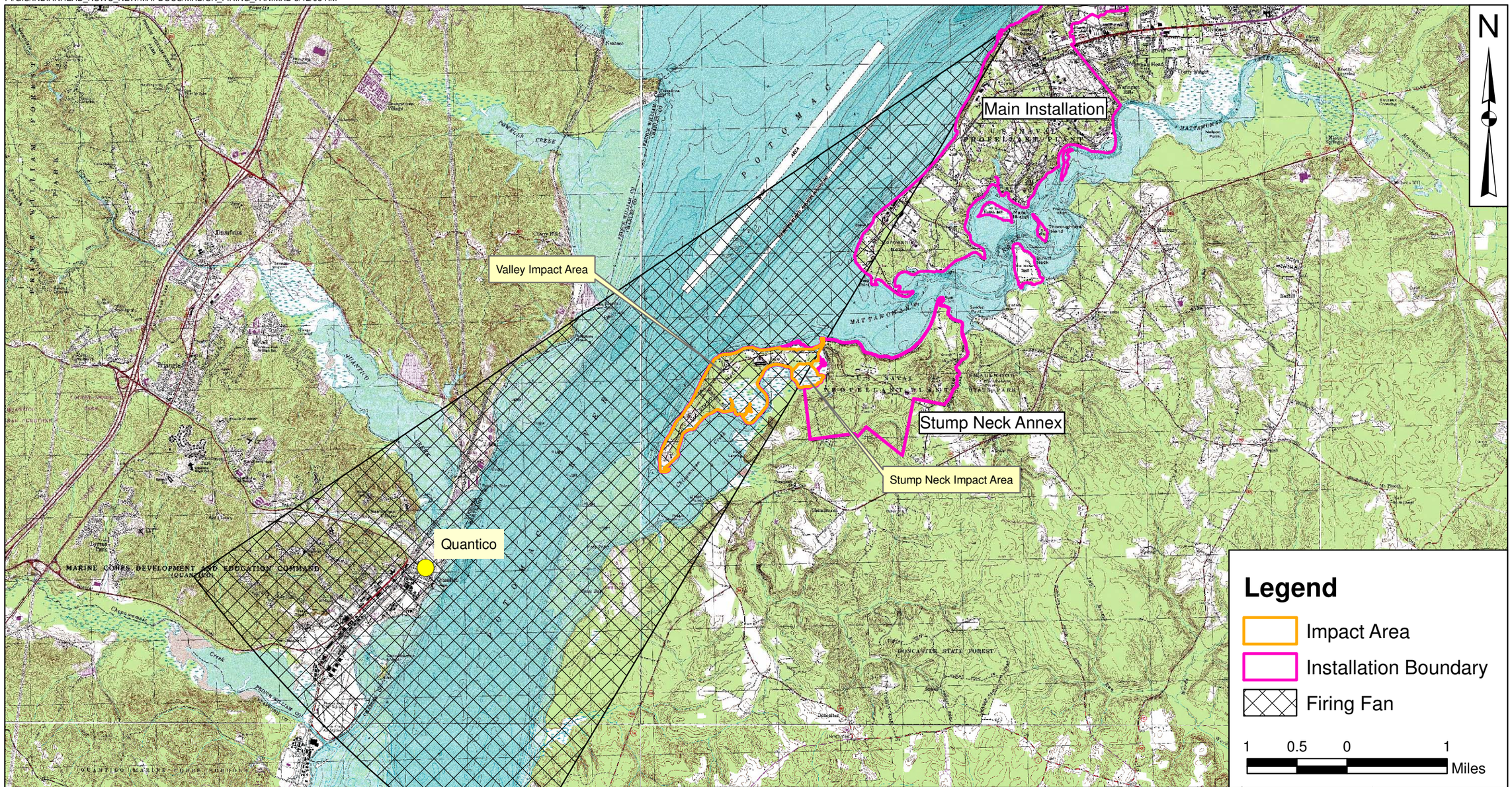

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COST/SCHEDULE-AREA			APPROVED BY —	DATE —
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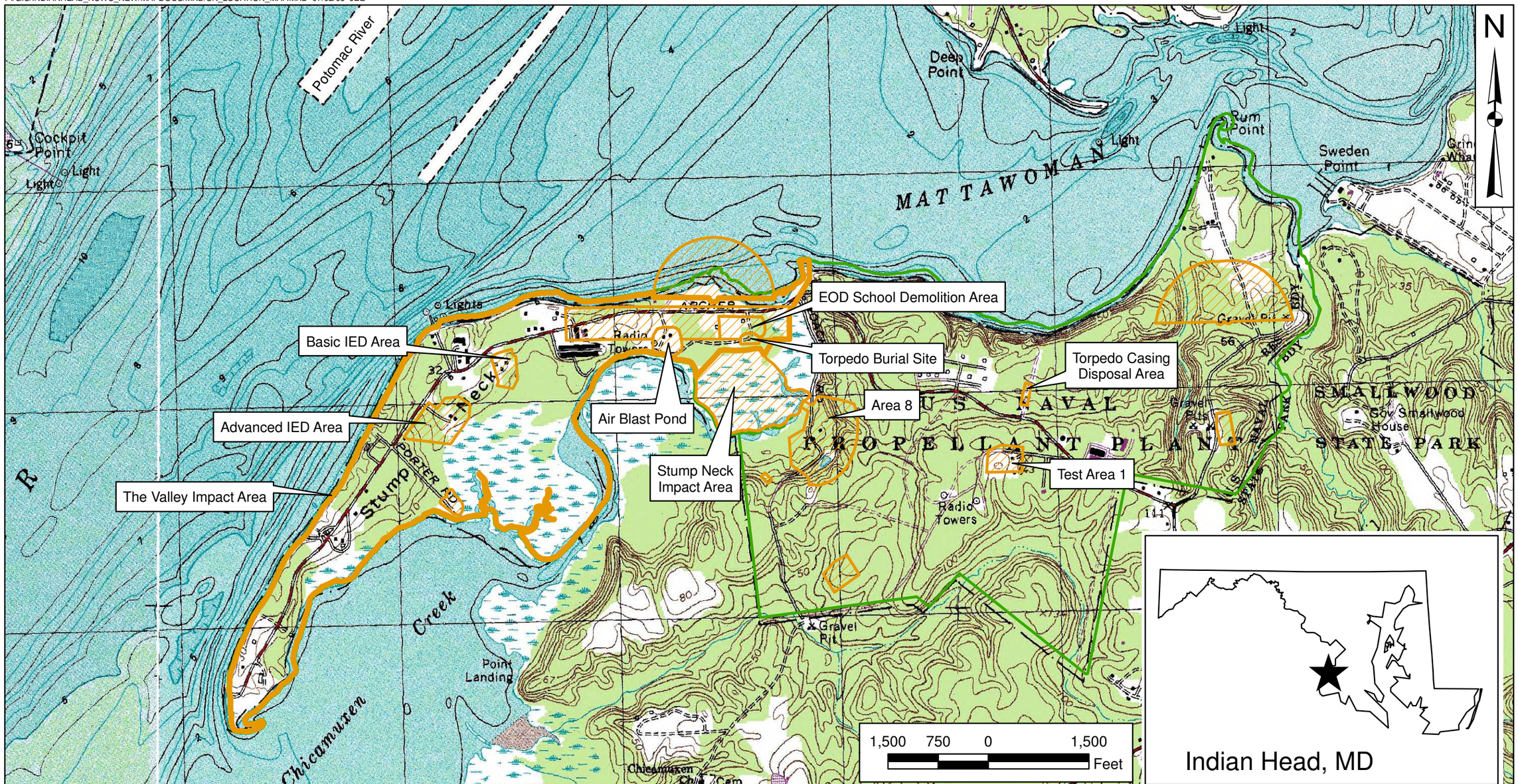

Legend

- MRP Site Boundary for Valley Impact Area
- MRP Site Boundary
- Installation Boundary

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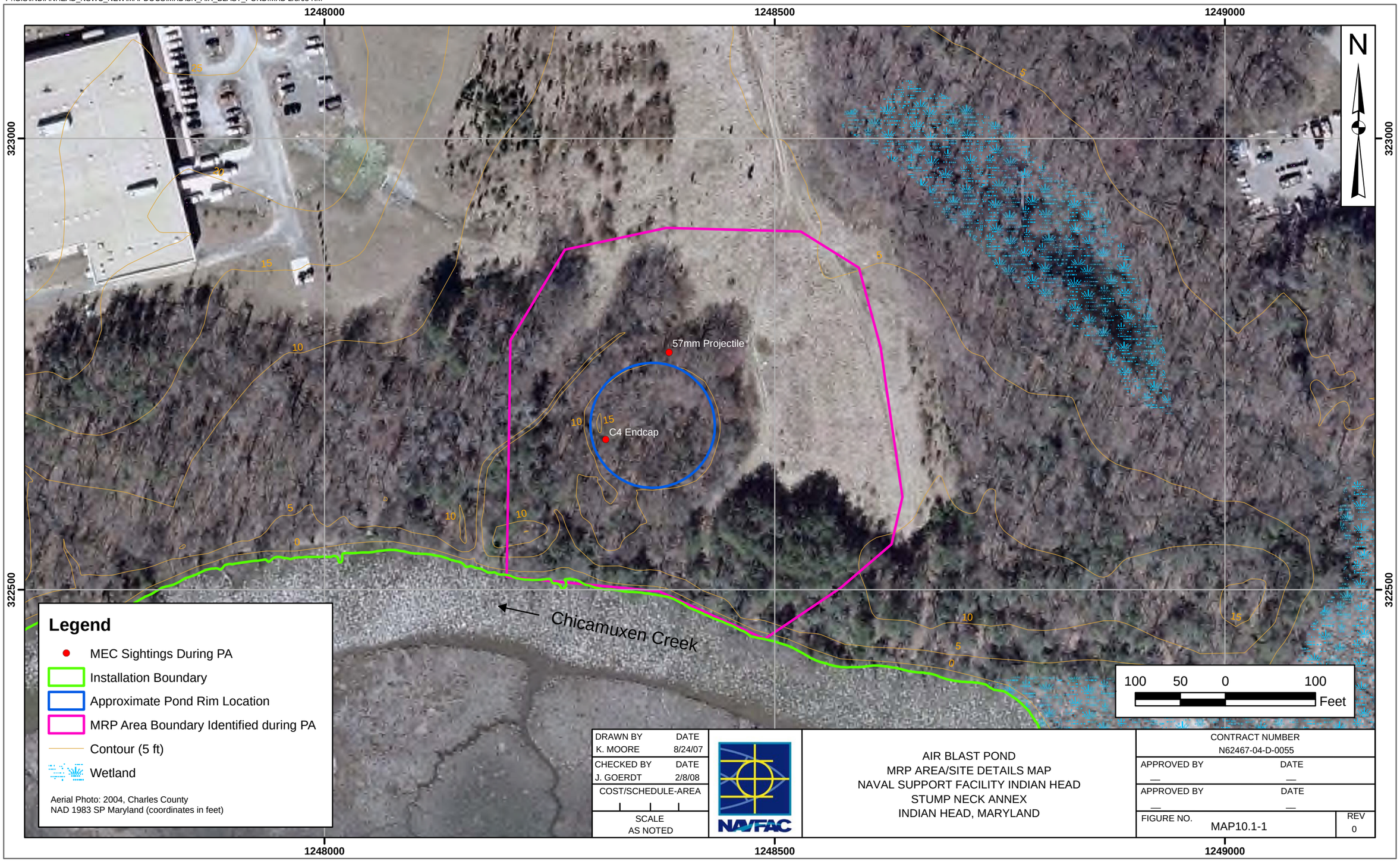

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J. GOERDT	2/8/08
COST/SCHEDULE-AREA	
SCALE AS NOTED	

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AIR BLAST POND
MRP AREA/SITE DETAILS MAP
NAVAL SUPPORT FACILITY INDIAN HEAD
STUMP NECK ANNEX
INDIAN HEAD, MARYLAND

CONTRACT NUMBER	
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FIGURE NO. MAP10.1-1	REV 0

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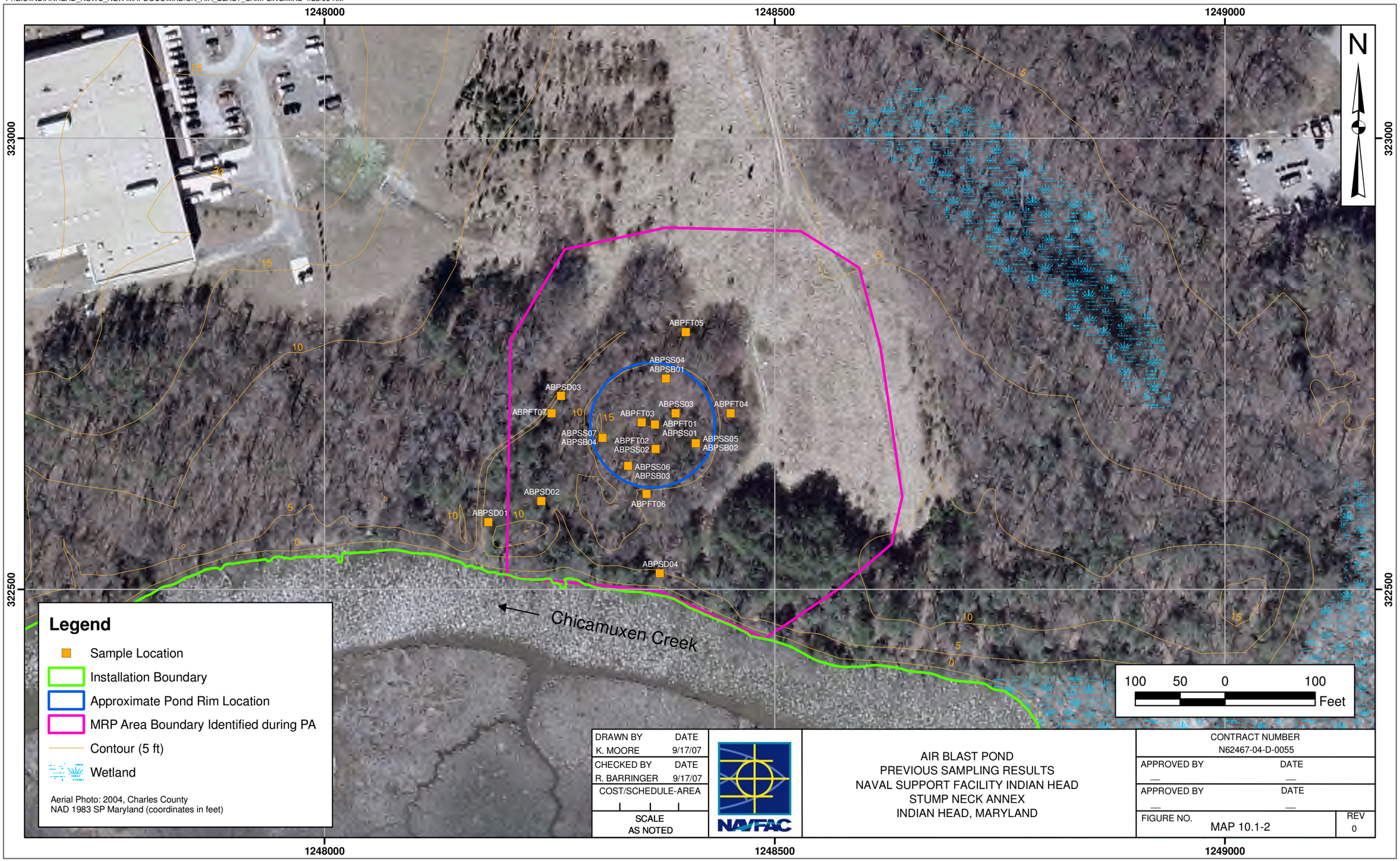

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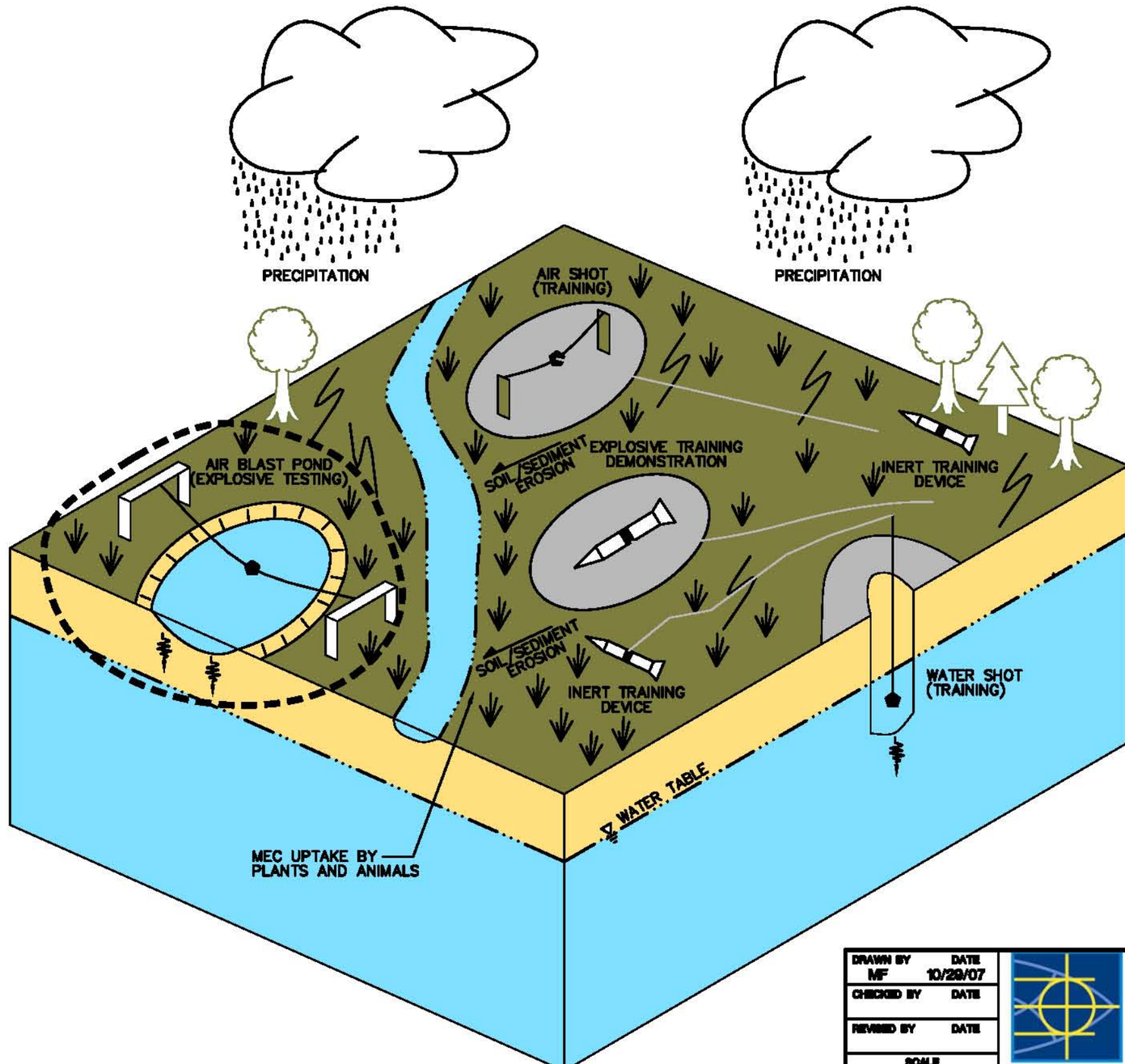

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REVISED BY	DATE		APPROVED BY / DATE
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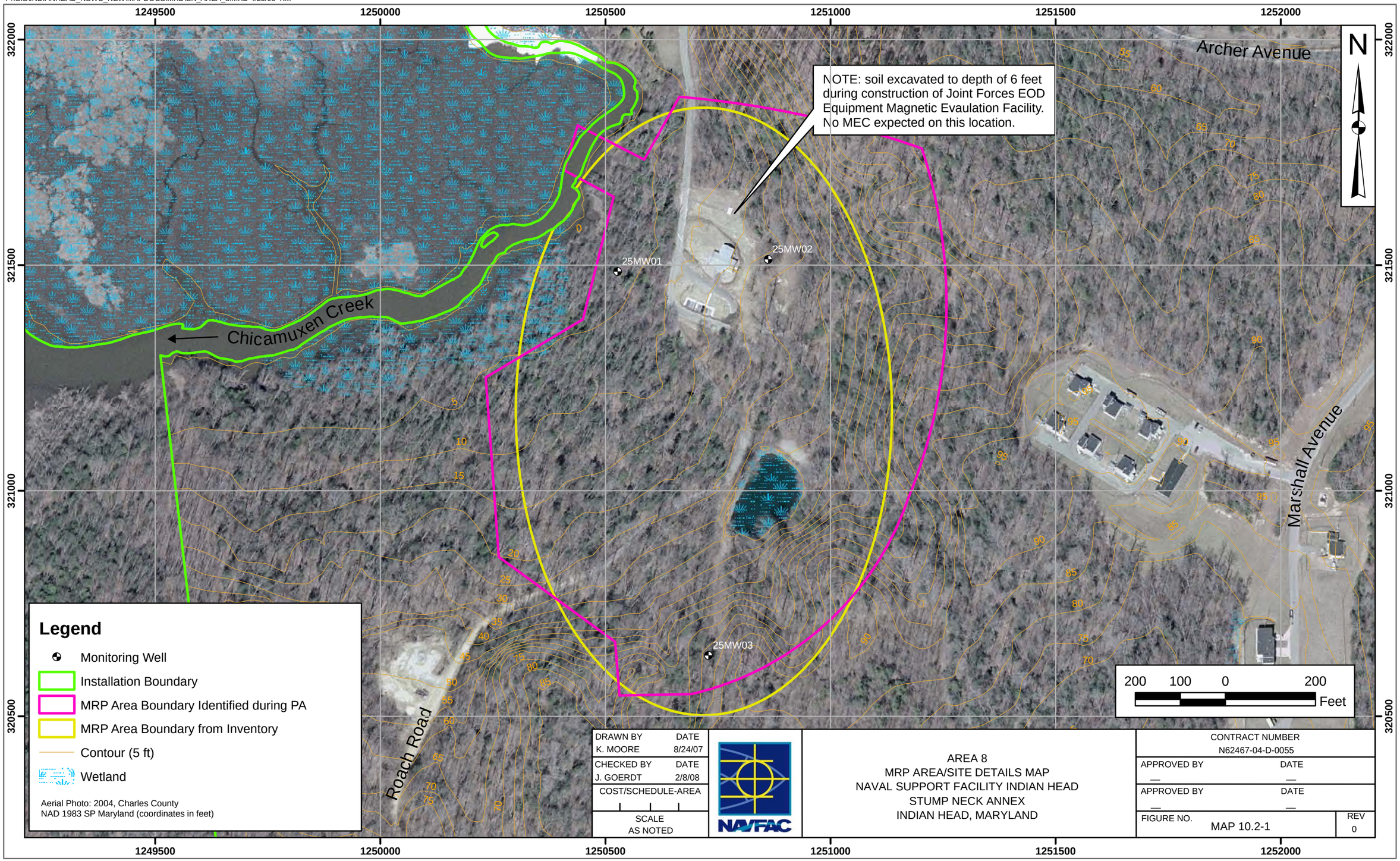

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SCALE AS NOTED	

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AREA 8
MRP AREA/SITE DETAILS MAP
NAVAL SUPPORT FACILITY INDIAN HEAD
STUMP NECK ANNEX
INDIAN HEAD, MARYLAND

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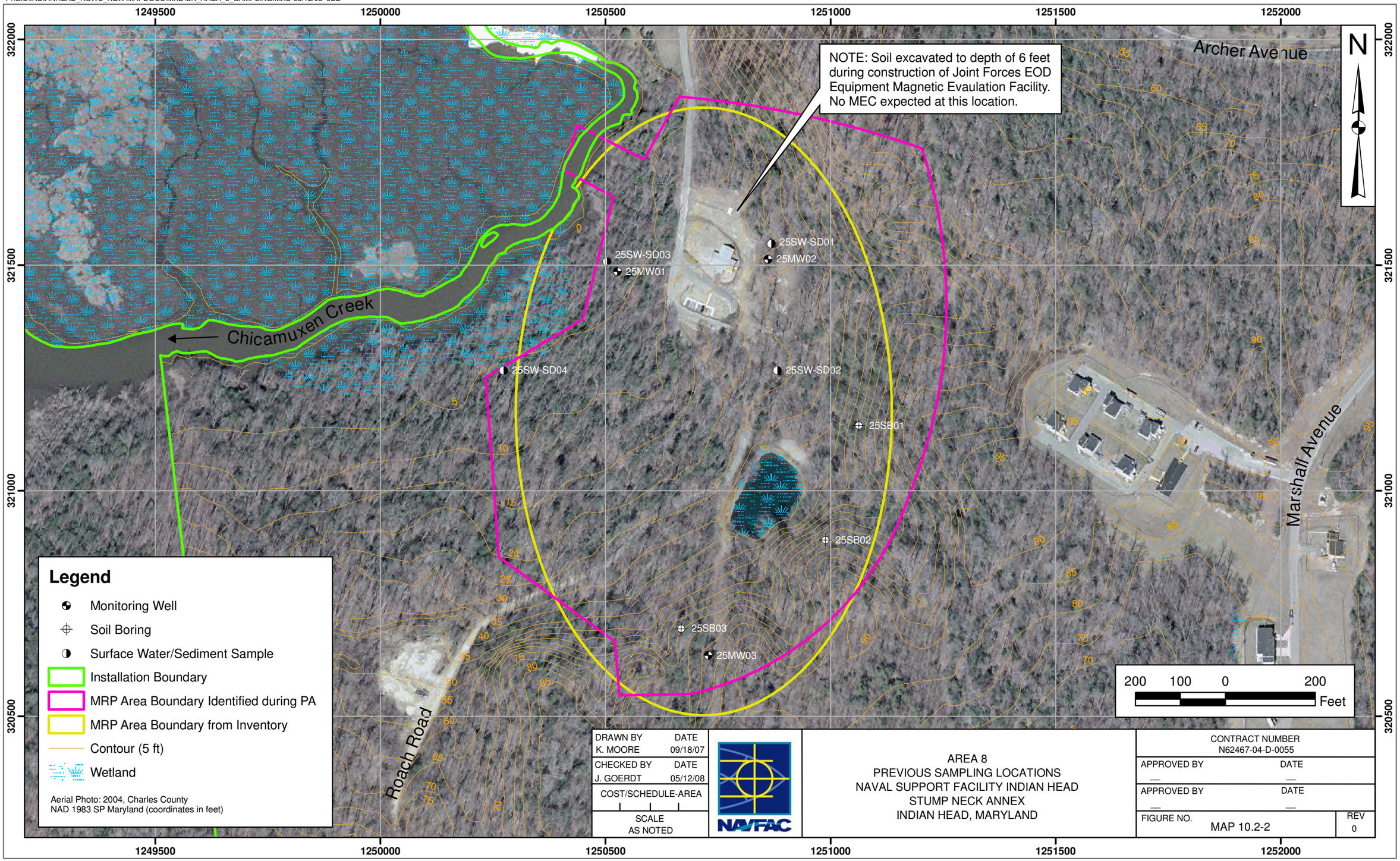

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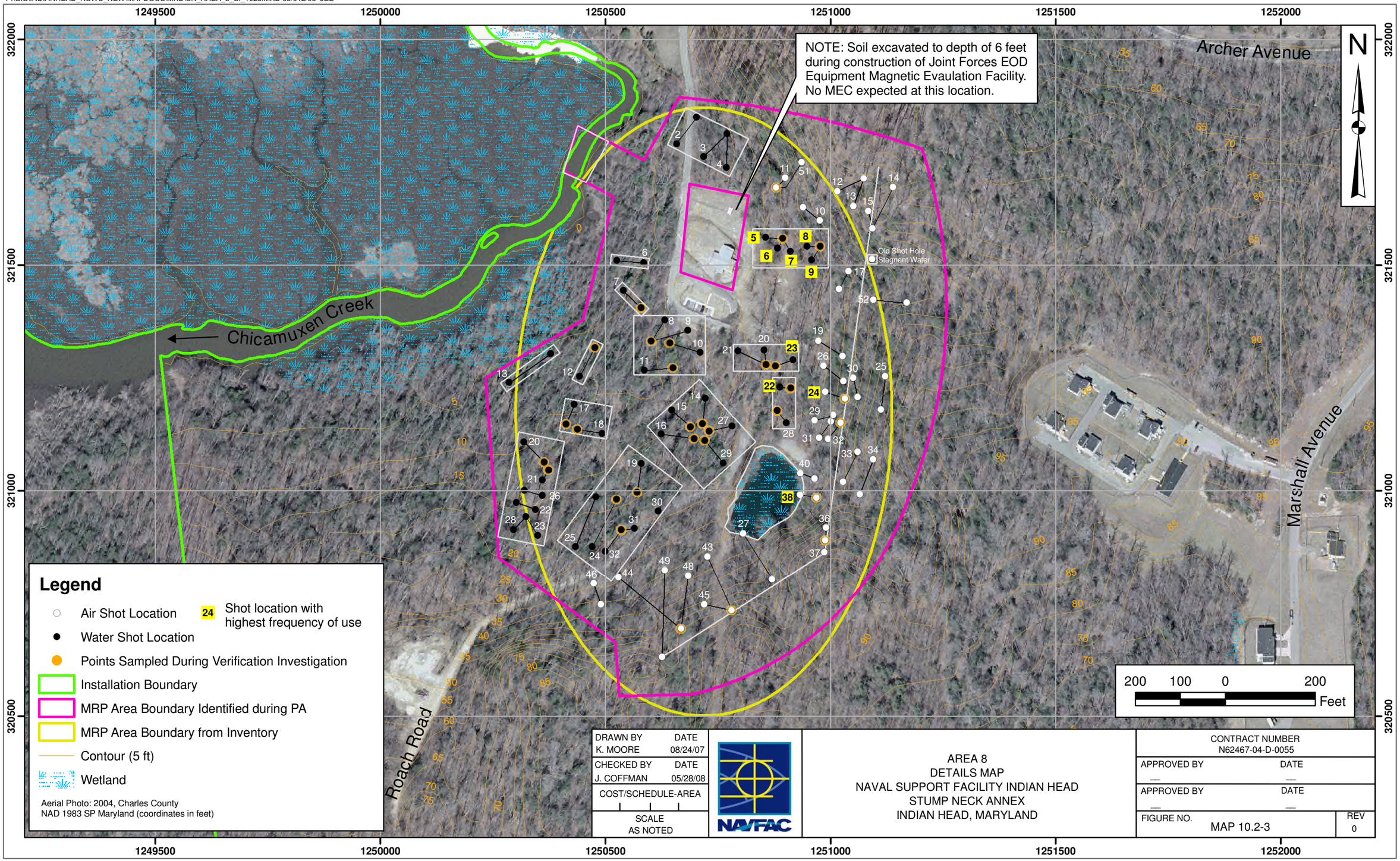

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SCALE AS NOTED	

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AREA 8
DETAILS MAP
NAVAL SUPPORT FACILITY INDIAN HEAD
STUMP NECK ANNEX
INDIAN HEAD, MARYLAND

CONTRACT NUMBER N62467-04-D-0055	
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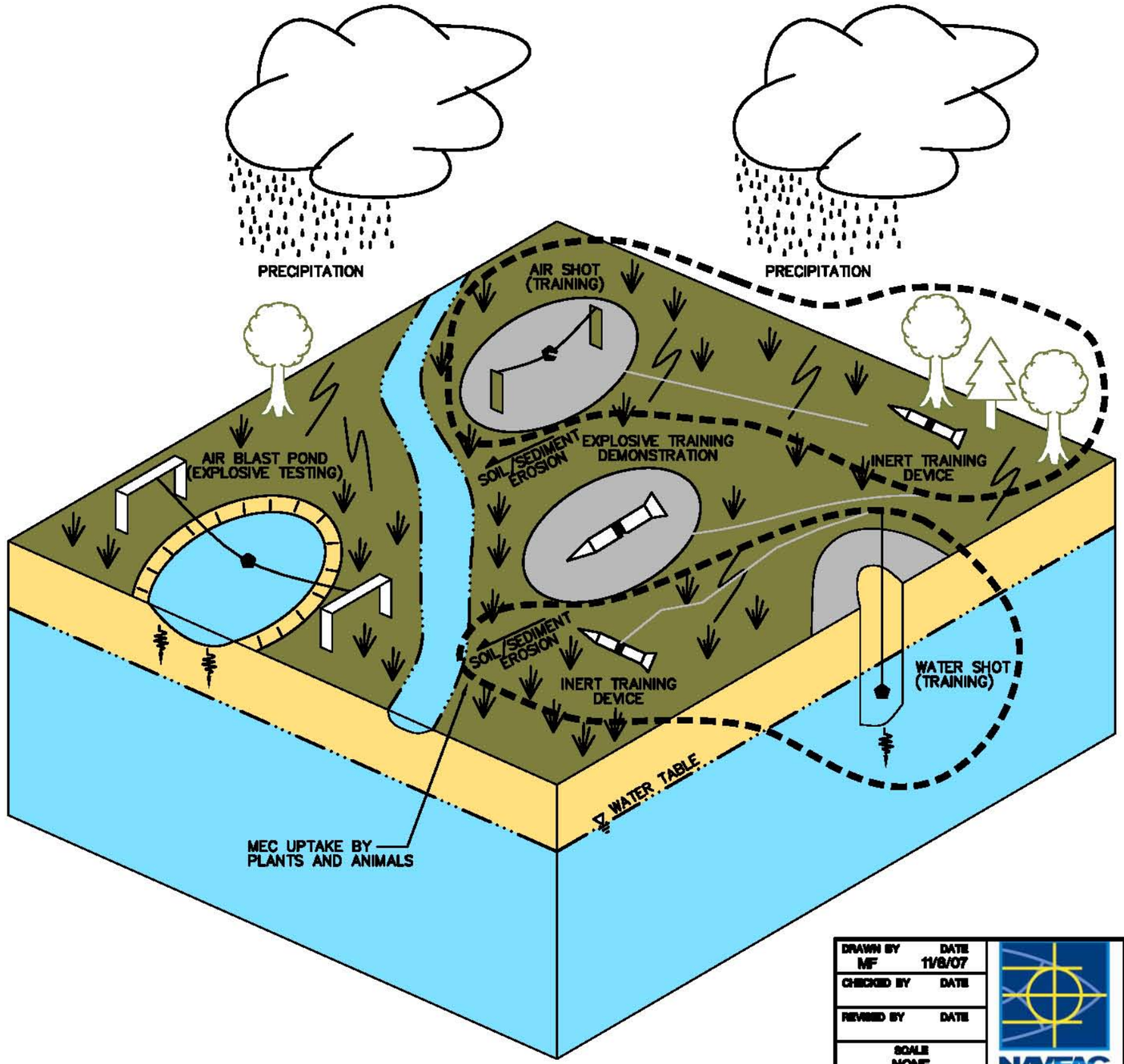

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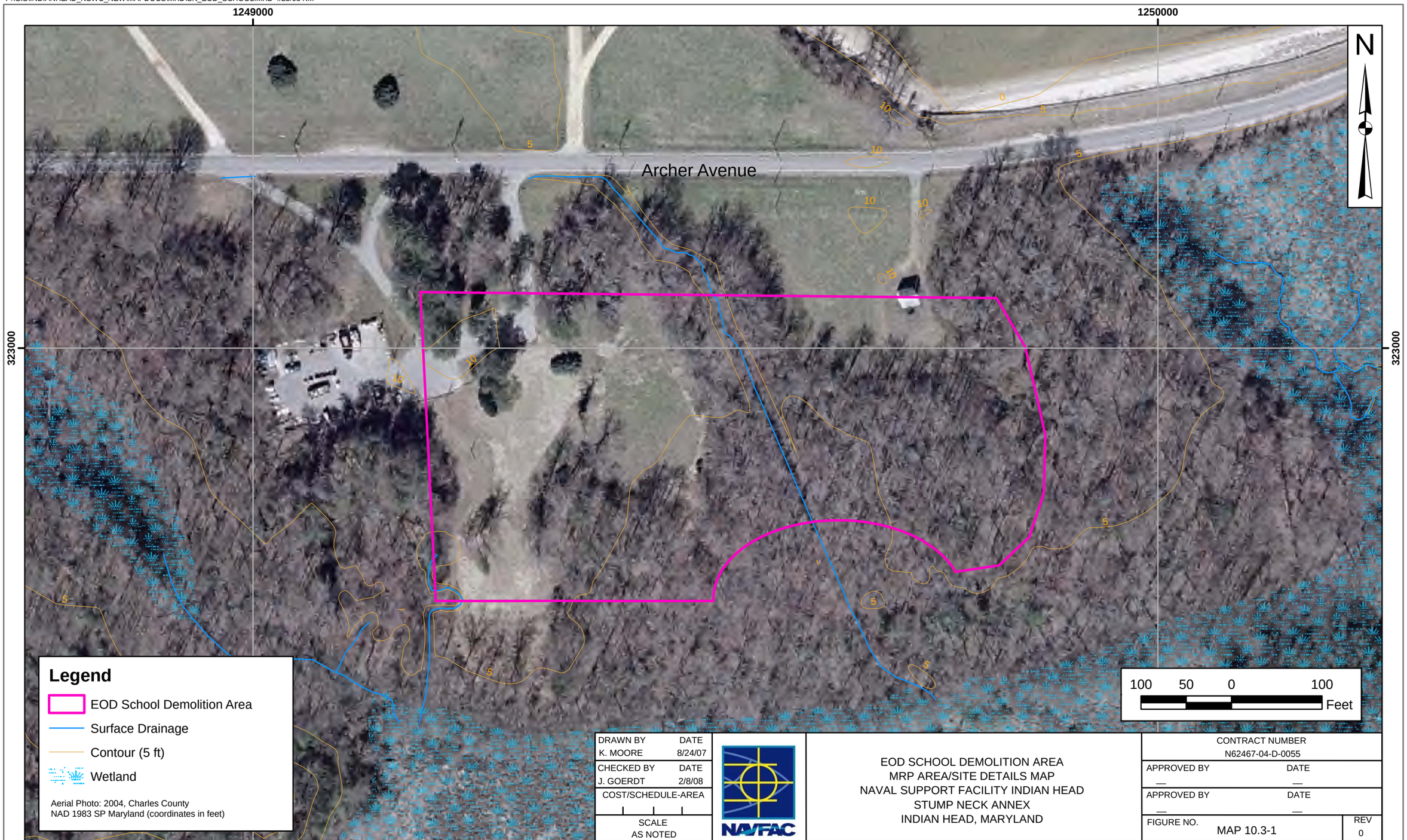

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SCALE AS NOTED	

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EOD SCHOOL DEMOLITION AREA
MRP AREA/SITE DETAILS MAP
NAVAL SUPPORT FACILITY INDIAN HEAD
STUMP NECK ANNEX
INDIAN HEAD, MARYLAND

CONTRACT NUMBER	
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FIGURE NO. MAP 10.3-1	REV 0

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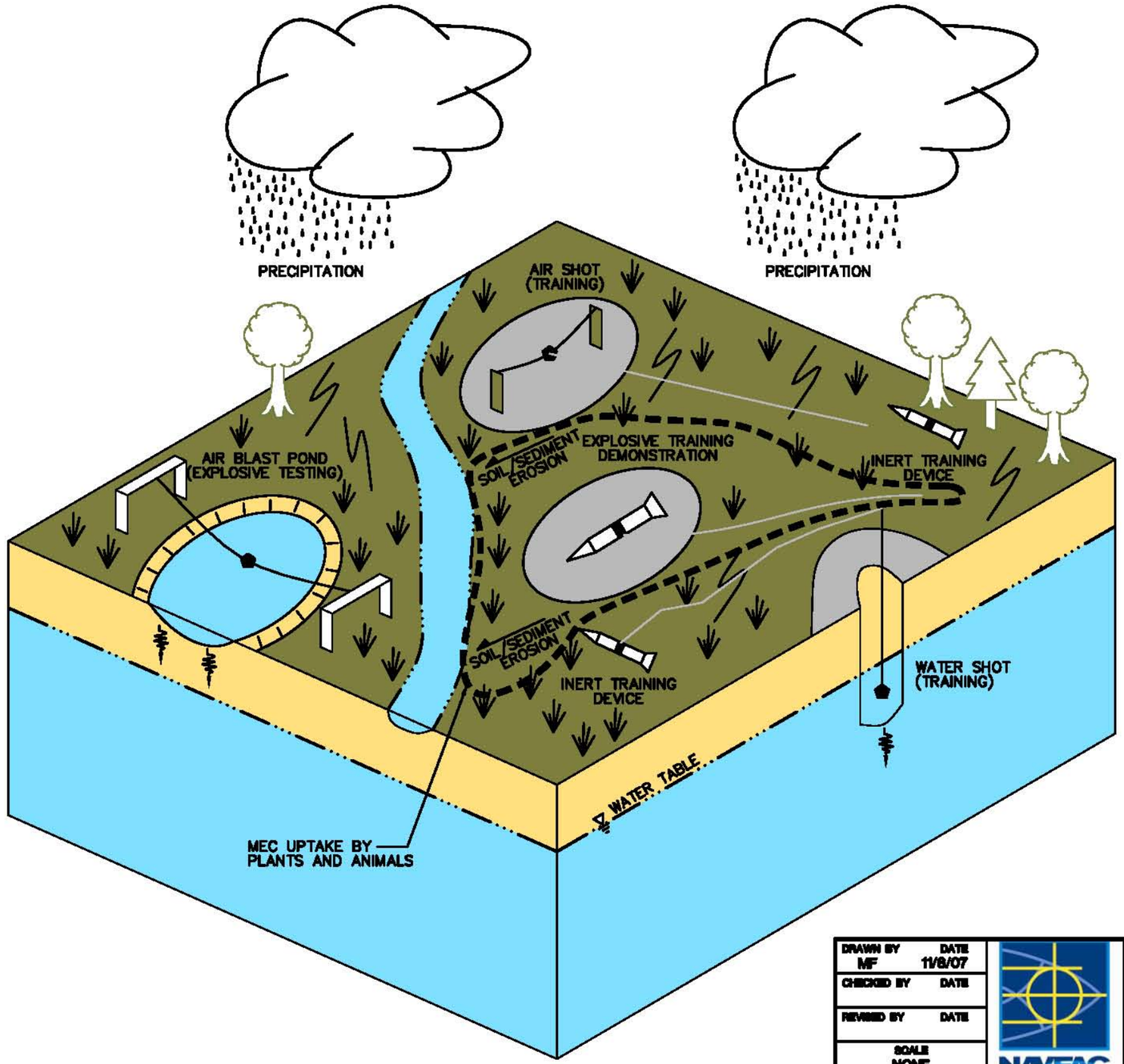

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CHECKED BY	DATE		OWNER NO.
REVISED BY	DATE		APPROVED BY / DATE
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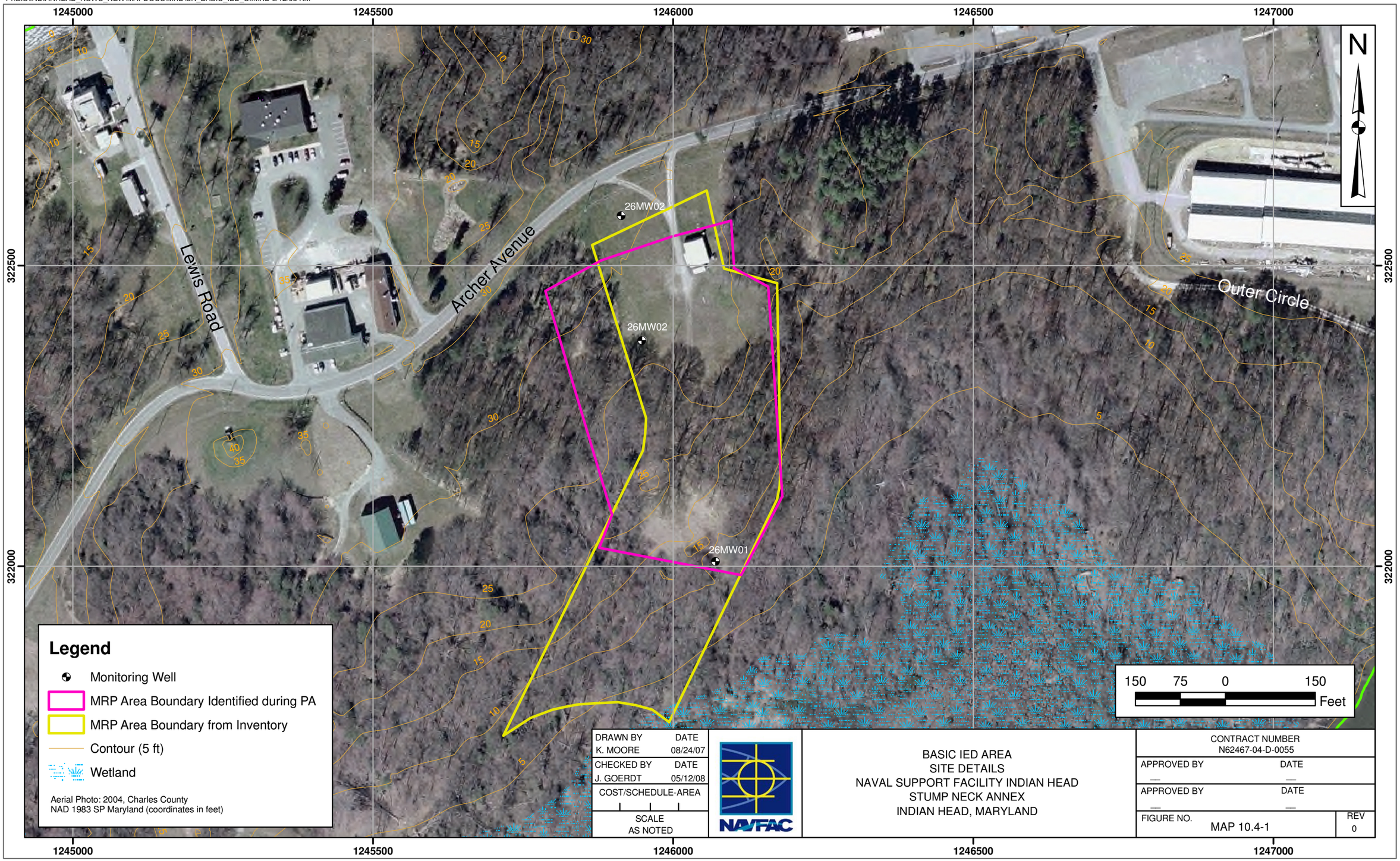

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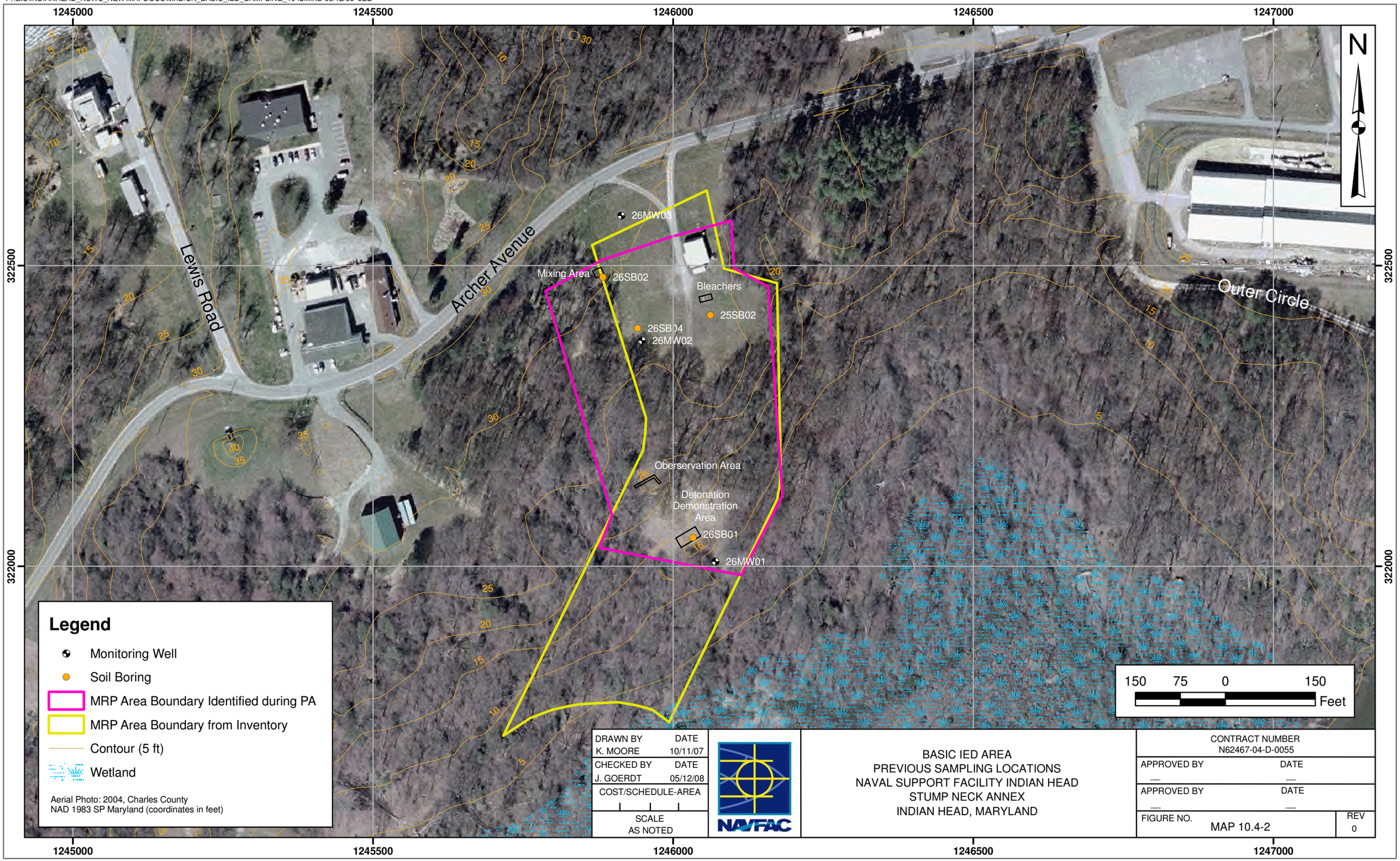

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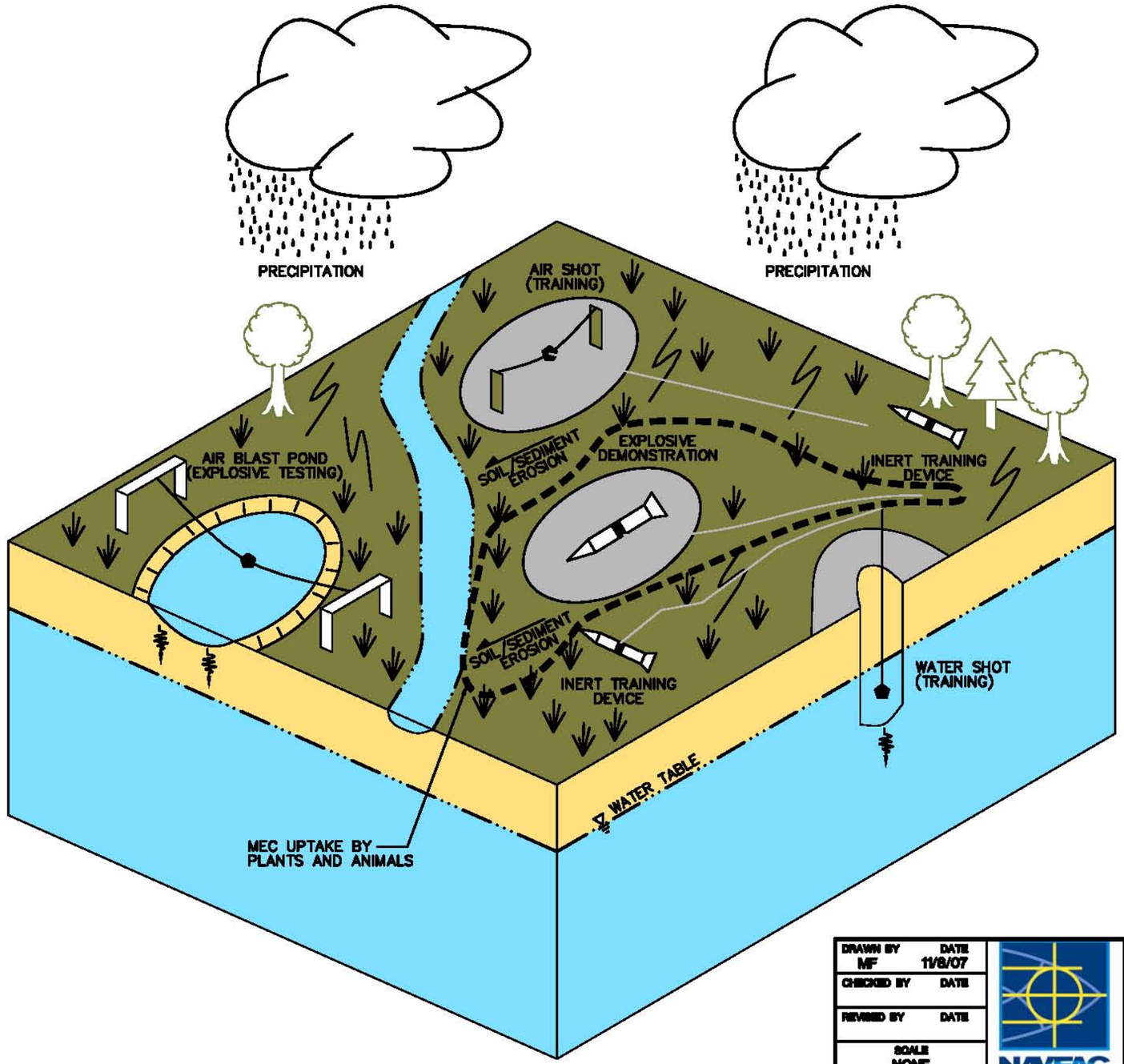

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CHECKED BY	DATE		OWNER NO.
REVISED BY	DATE		APPROVED BY / DATE
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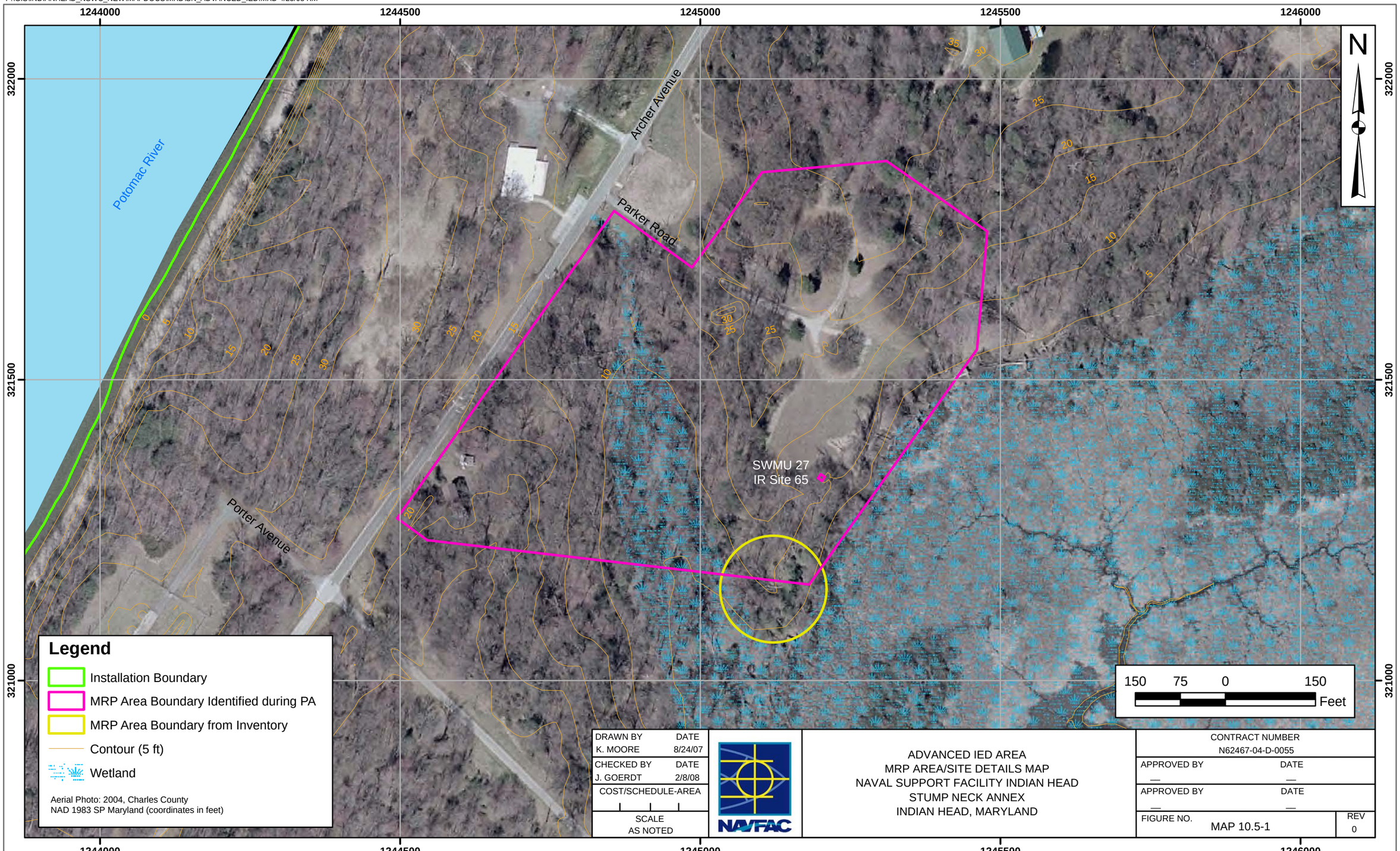

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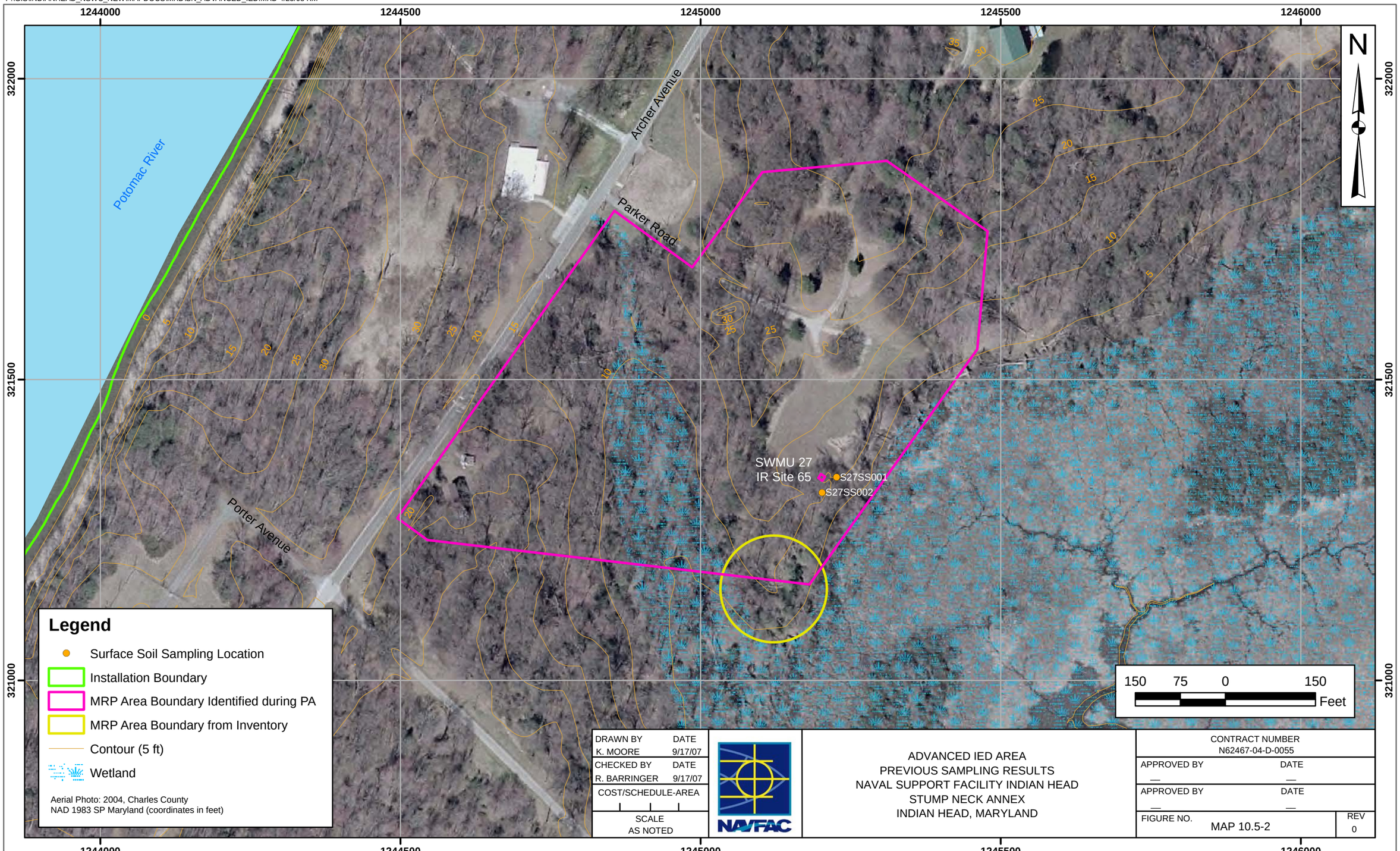

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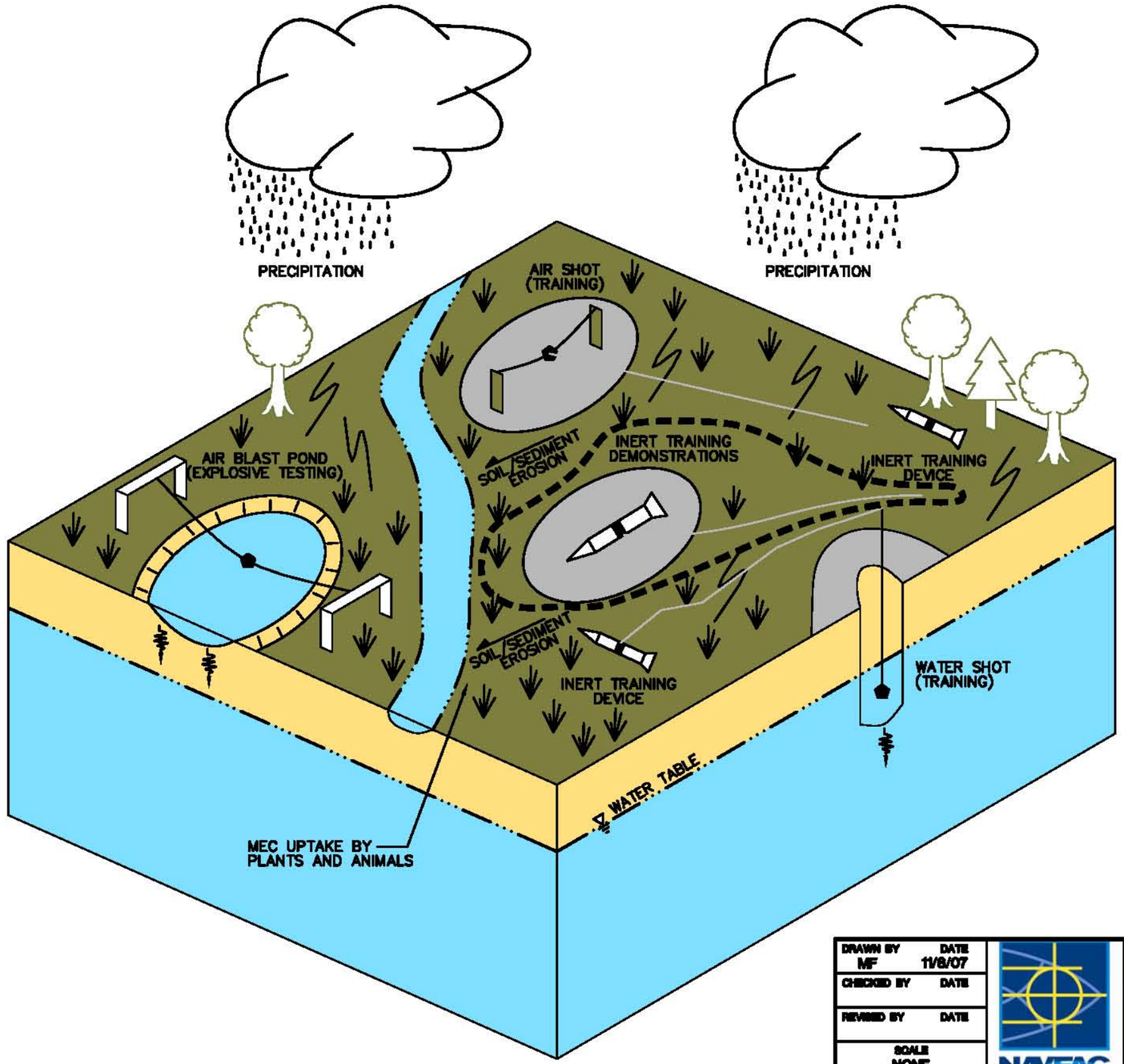

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REVISED BY	DATE		APPROVED BY / DATE
SCALE NONE			DRAWING NO. MAP 10.5-3 / REV. 0

FORM CADD NO. SDIV-BH.DWG – REV 1 – 9/10/98

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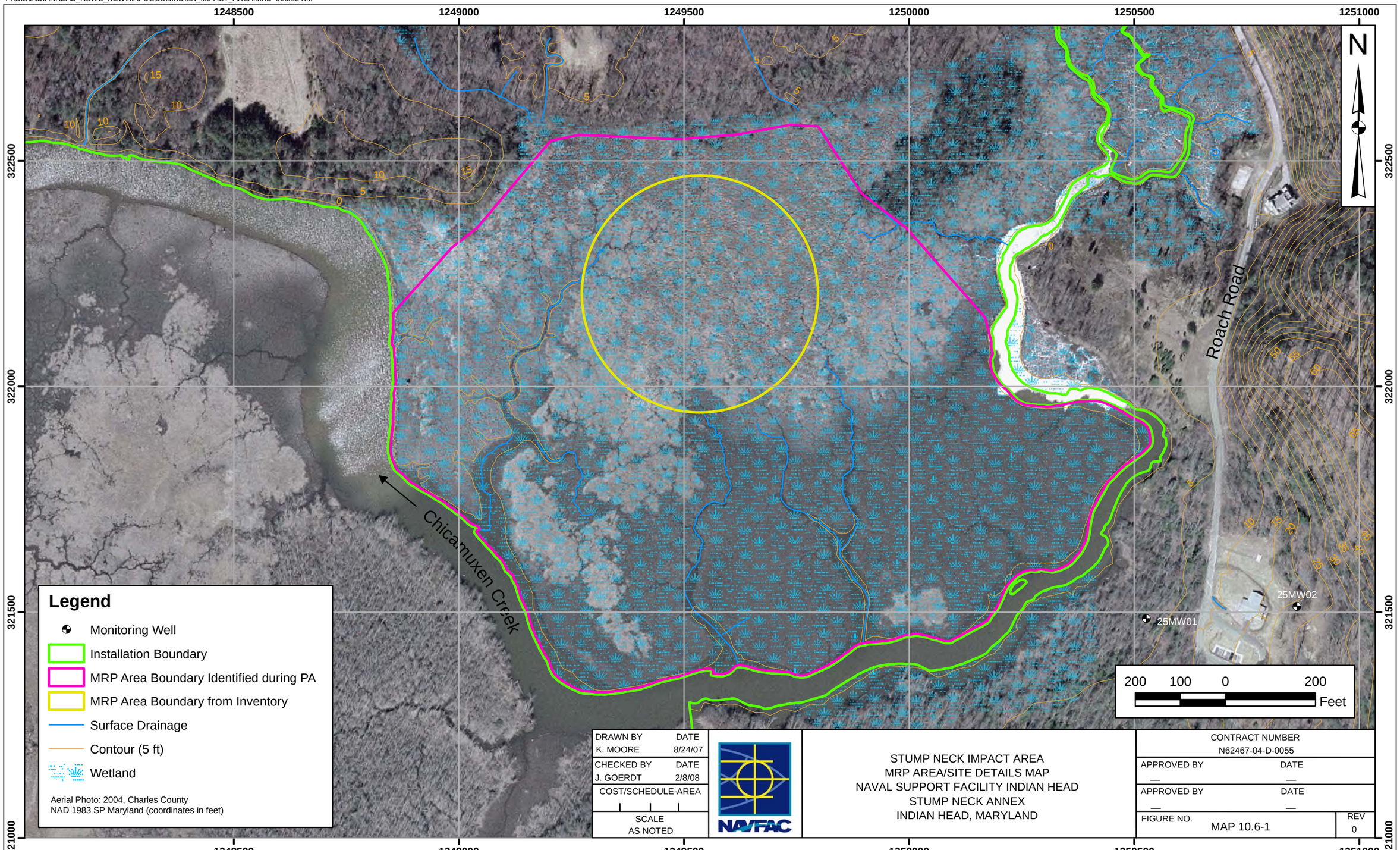

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K. MOORE	8/24/07
CHECKED BY	DATE
J. GOERDT	2/8/08
COST/SCHEDULE-AREA	
SCALE AS NOTED	

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STUMP NECK IMPACT AREA
MRP AREA/SITE DETAILS MAP
NAVAL SUPPORT FACILITY INDIAN HEAD
STUMP NECK ANNEX
INDIAN HEAD, MARYLAND

CONTRACT NUMBER	
N62467-04-D-0055	
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FIGURE NO. MAP 10.6-1	REV 0

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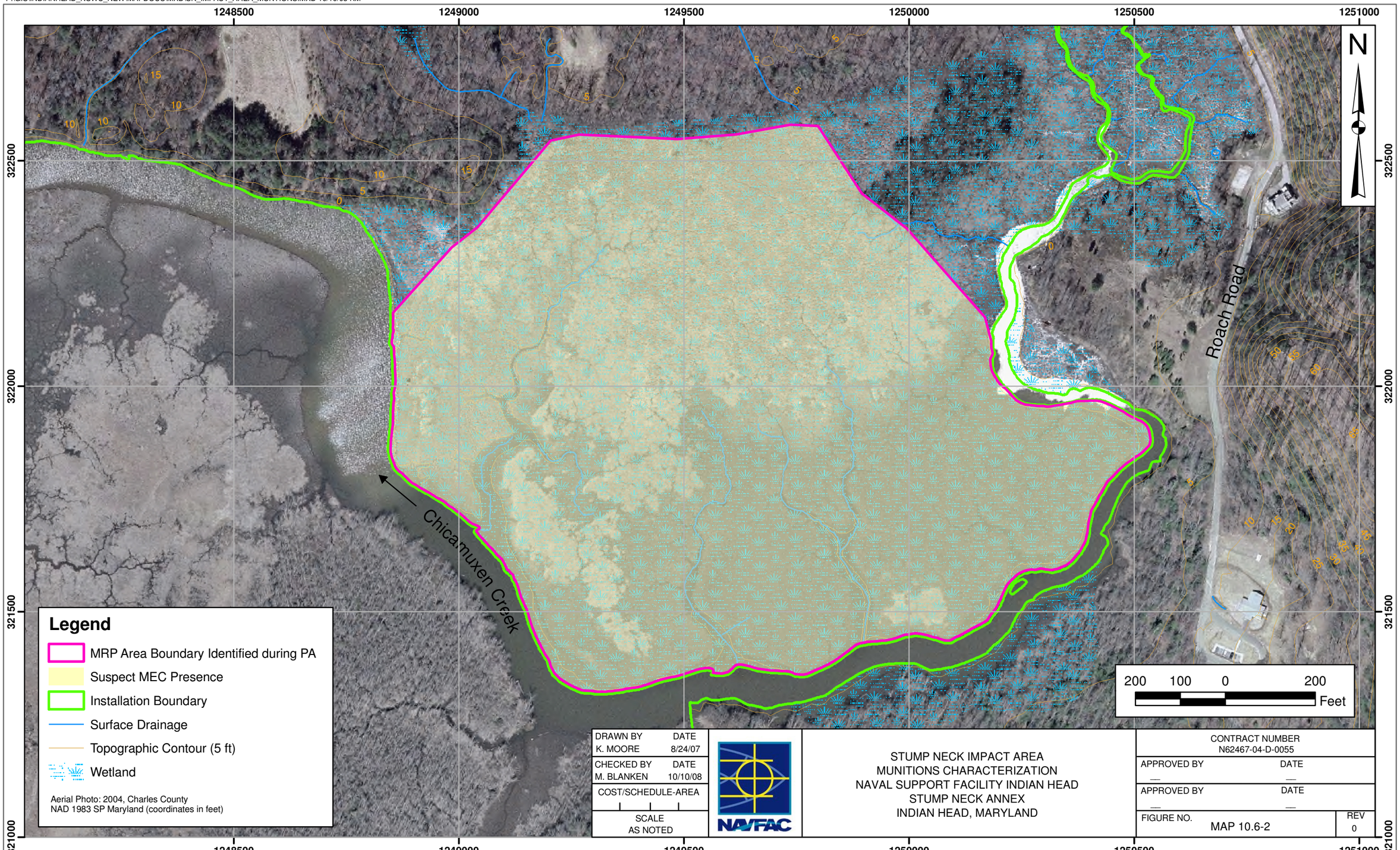

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CHECKED BY	DATE
J. GOERDT	2/8/08
COST/SCHEDULE-AREA	
SCALE AS NOTED	

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TEST AREA 1
MRP AREA/SITE DETAILS MAP
NAVAL SUPPORT FACILITY INDIAN HEAD
STUMP NECK ANNEX
INDIAN HEAD, MARYLAND

CONTRACT NUMBER	
N62467-04-D-0055	
APPROVED BY	DATE
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FIGURE NO. MAP 10.7-1	REV 0

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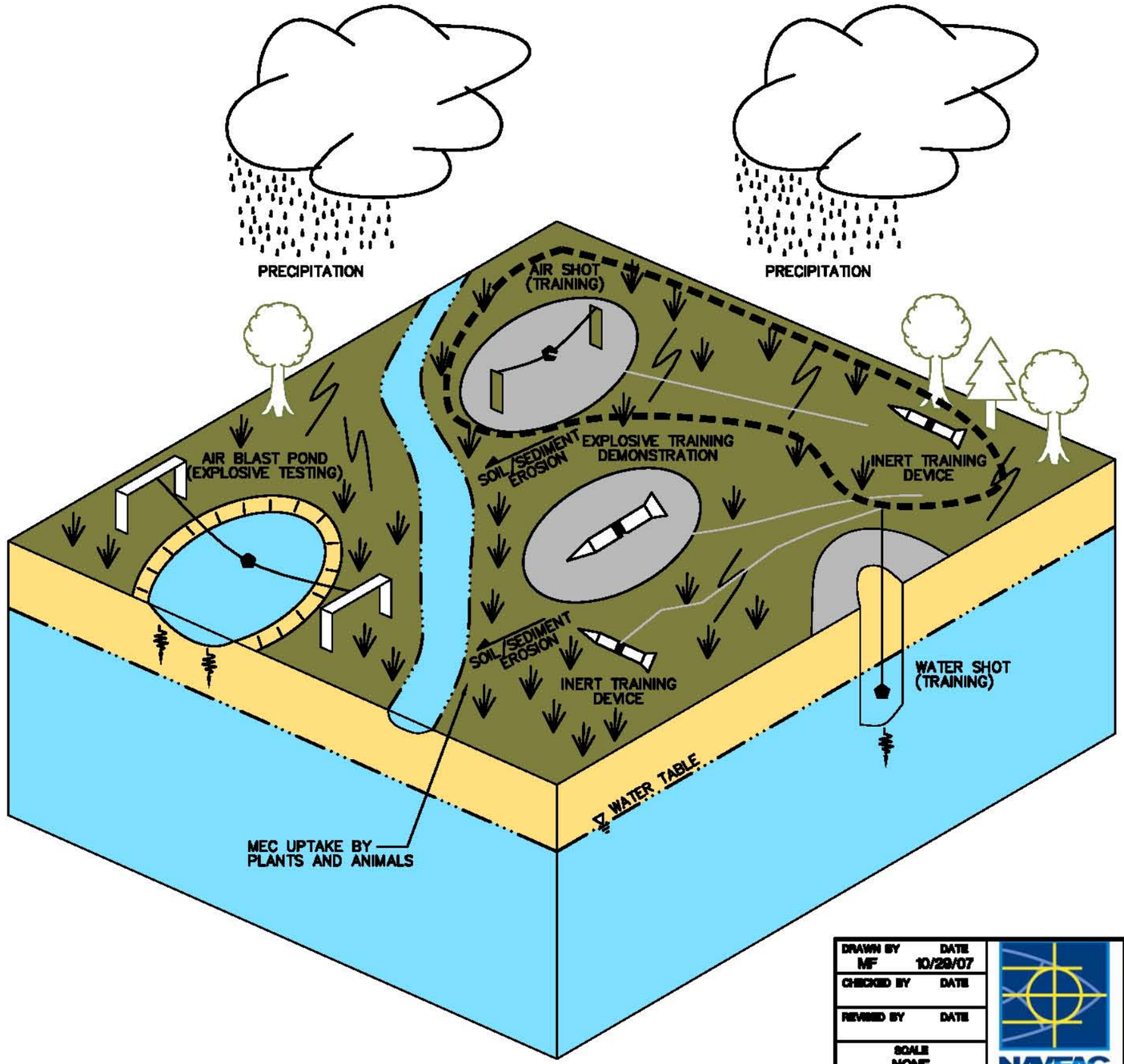

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CHECKED BY	DATE		OWNER NO.
REVISED BY	DATE		APPROVED BY / DATE
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FORM CADD NO. SDIV-BH.DWG – REV 1 – 9/10/98

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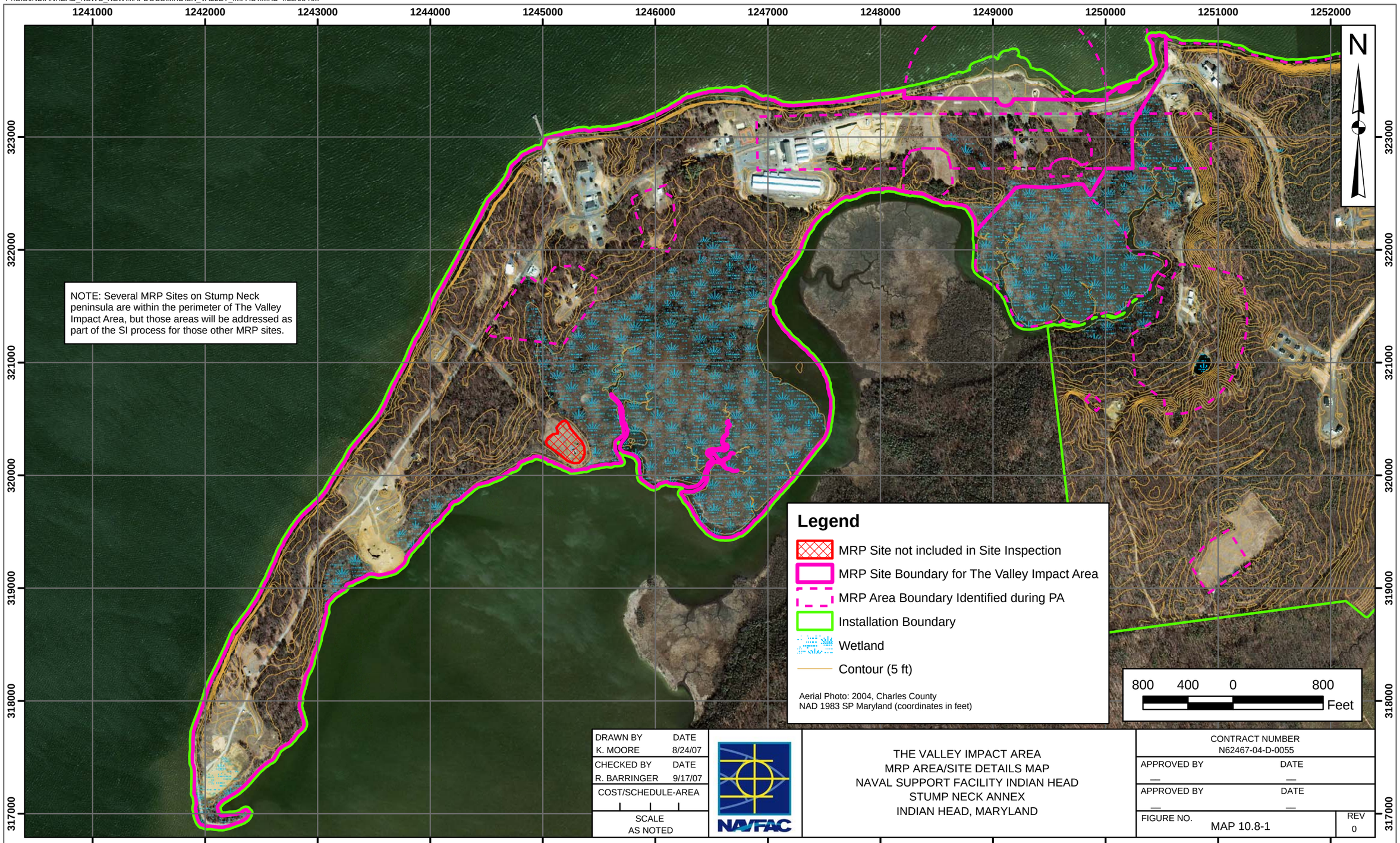

DRAWN BY	DATE
K. MOORE	8/24/07
CHECKED BY	DATE
R. BARRINGER	9/17/07
COST/SCHEDULE-AREA	
SCALE AS NOTED	

NAVFAC

THE VALLEY IMPACT AREA
MRP AREA/SITE DETAILS MAP
NAVAL SUPPORT FACILITY INDIAN HEAD
STUMP NECK ANNEX
INDIAN HEAD, MARYLAND

CONTRACT NUMBER N62467-04-D-0055	
APPROVED BY —	DATE —
APPROVED BY —	DATE —
FIGURE NO. MAP 10.8-1	REV 0

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DRAWN BY	DATE
K. MOORE	10/10/08
CHECKED BY	DATE
M. BLANKEN	10/10/08
COST/SCHEDULE-AREA	
SCALE AS NOTED	

NAVFAC

THE VALLEY IMPACT AREA
MUNITIONS CHARACTERIZATION
NAVAL SUPPORT FACILITY INDIAN HEAD
STUMP NECK ANNEX
INDIAN HEAD, MARYLAND

CONTRACT NUMBER N62467-04-D-0055	
APPROVED BY —	DATE —
APPROVED BY —	DATE —
FIGURE NO. MAP 10.8-2	REV 0

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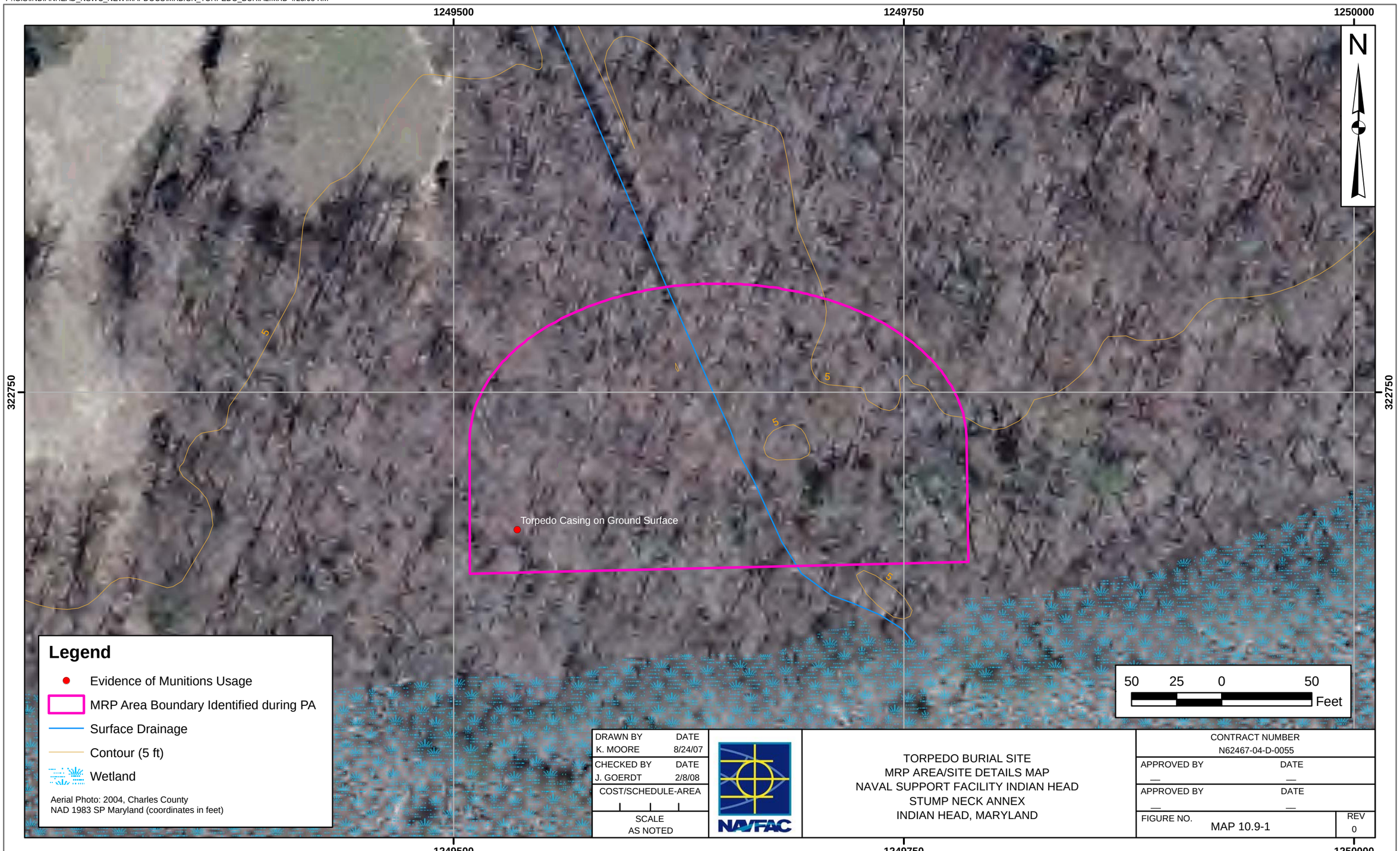

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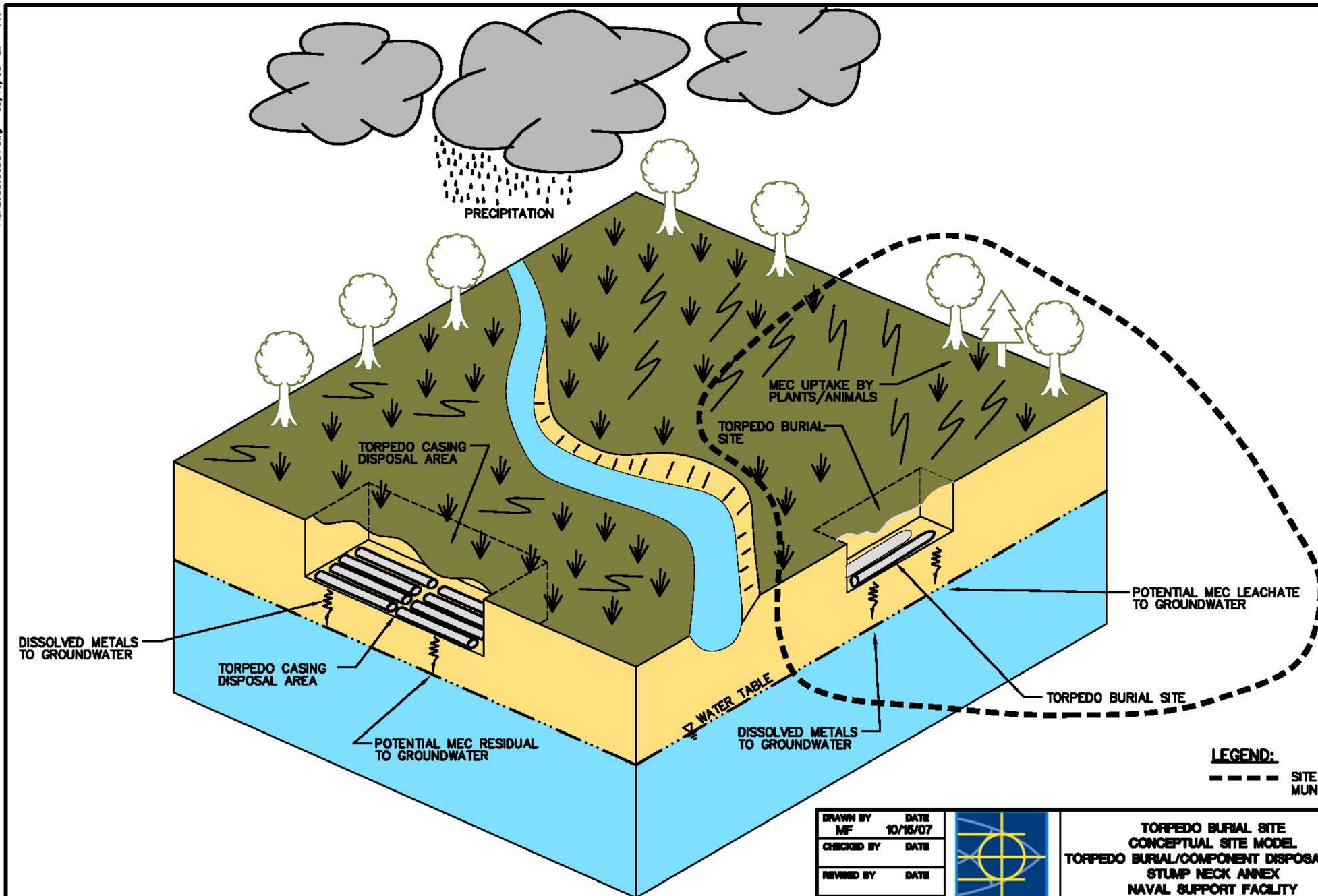


LEGEND:

- - - - SITE SPECIFIC ACTIVITY OR TYPE OF MUNITIONS USED

DRAWN BY MF	DATE 10/15/07	TORPEDO BURIAL SITE CONCEPTUAL SITE MODEL TORPEDO BURIAL/COMPONENT DISPOSAL SITE STUMP NECK ANNEX NAVAL SUPPORT FACILITY INDIAN HEAD, MARYLAND	CONTRACT NO. 0610
CHECKED BY	DATE		OWNER NO.
REVISED BY	DATE		APPROVED BY / DATE
SCALE NONE			DRAWING NO. MAP 10.9-2 / REV. 0

FORM CADD NO. SDIV-BH.DWG – REV 1 – 9/10/98

P:\GIS\INDIANHEAD_NSWC_NEW\MAPDOCS\MXD\SN_TORPEDO_DISPOSAL_SI.MXD 11/12/08 SS

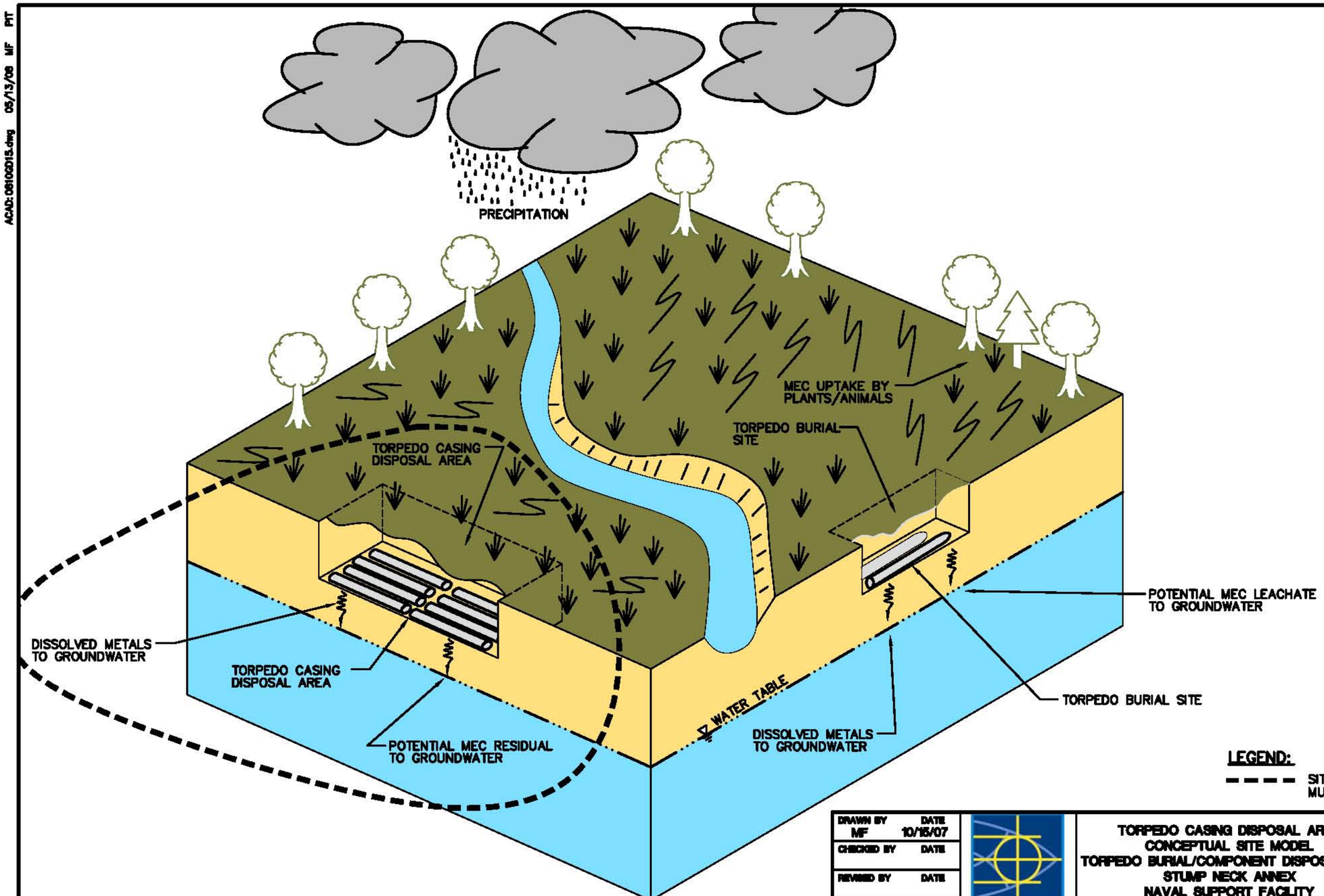
DRAWN BY	DATE
K. MOORE	8/24/07
CHECKED BY	DATE
M. BLANKEN	11/12/08
COST/SCHEDULE-AREA	
SCALE AS NOTED	

NAVFAC

TORPEDO CASING DISPOSAL AREA
MRP AREA/SITE DETAILS MAP
NAVAL SUPPORT FACILITY INDIAN HEAD
STUMP NECK ANNEX
INDIAN HEAD, MARYLAND

CONTRACT NUMBER N62467-04-D-0055	
APPROVED BY —	DATE —
APPROVED BY —	DATE —
FIGURE NO. MAP 10.10-1	REV 0

ACAD: 0610CD15.dwg 05/13/08 MF PIT



LEGEND:

- - - - SITE SPECIFIC ACTIVITY OR TYPE OF MUNITIONS USED

DRAWN BY MF	DATE 10/15/07	TORPEDO CASING DISPOSAL AREA CONCEPTUAL SITE MODEL TORPEDO BURIAL/COMPONENT DISPOSAL SITE STUMP NECK ANNEX NAVAL SUPPORT FACILITY INDIAN HEAD, MARYLAND	CONTRACT NO. 0610
CHECKED BY	DATE		OWNER NO.
REVISED BY	DATE		APPROVED BY / DATE
SCALE NONE			DRAWING NO. MAP 10.10-2 / REV. 0

NAVFAC

FORM CADD NO. SDIV-BH.DWG – REV 1 – 9/10/98

APPENDIX C

SOIL BACKGROUND CONCENTRATIONS AND WORKSHEET 15 REFERENCE LIMITS AND BACKGROUND TABLES

TABLE 4-1

SUMMARY OF DESCRIPTIVE STATISTICS FOR ALL SURFACE AND SUBSURFACE SOILS
BACKGROUND INVESTIGATION REPORT FOR SOILS
INDIAN HEAD DIVISION
NSWC INDIAN HEAD, MARYLAND

Chemical	Cas Number	Frequency of Detection	Minimum Detection	Minimum Qualifier	Maximum Detection	Maximum Qualifier	Average of Positive Detections	Average of All Detections	Minimum Nondetect	Maximum Nondetect	Location of Maximum	Distribution of Data	95% Upper Confidence Limit	95% Upper Tolerance Limit	Eastern U.S. Soils [1]	Maryland Soils [2]	Residential Risk-Based Concentration [3]	Industrial Risk-Based Concentration [3]
Volatile Organic Compounds (ug/kg)																		
ACETONE	67-64-1	3/40	1800		13000	L	5700	430	1.4	24	RN6SS0170101	Undefined	13000	13000	NA	NA	7800000	200000000
CYCLOHEXANE	110-82-7	1/22	3.6	J	3.6	J	3.6	5.1	5.3	15	IS11SS420001	Undefined	3.6	3.6	NA	NA	NA	NA
ETHYLBENZENE	100-41-4	1/40	2.4	J	2.4	J	2.4	4.9	1.5	15	IS11SS400001	Undefined	2.4	2.4	NA	NA	7800000	200000000
GASOLINE RANGE ORGANICS	TTNUS005	2/9	0.1225		0.17		0.15	8.4	0.12	150	IS11SS420001	Undefined	0.17	0.17	NA	NA	NA	NA
METHYL ACETATE	79-20-9	1/22	2.3	J	2.3	J	2.3	5.0	5.3	15	IS11SS390001	Undefined	2.3	2.3	NA	NA	78000000	2000000000
STYRENE	100-42-5	1/40	1.3	J	1.3	J	1.3	5.0	0.34	15	BGDSS0120101-AVG	Undefined	1.3	1.3	NA	NA	16000000	410000000
TOLUENE	108-88-3	4/40	3.3	J	140	J	61	11	0.32	15	IS11SS400001	Undefined	140	140	NA	NA	16000000	410000000
TOTAL XYLENES	1330-20-7	5/24	1.7	J	9.9	J	5.6	6.5	0.78	18	IS11SS420001	Undefined	9.9	9.9	NA	NA	160000000	4100000000
TRICHLOROFLUOROMETHANE	75-69-4	7/40	1.7	J	2.7	J	2.2	4.9	0.33	15	BGDSB0110101	Undefined	2.7	2.7	NA	NA	23000000	610000000
Semivolatile Organic Compounds (ug/kg)																		
1,3-DINITROBENZENE	99-65-0	1/20	32	J	32	J	32	120	37.2	393	IS11SB260203	Undefined	32	32	NA	NA	7800	200000
2-METHYLNAPHTHALENE	91-57-6	1/40	73	L	73	L	73	140	42	490	IS21SS200001	Undefined	73	73	NA	NA	1600000	41000000
ACENAPHTHENE	83-32-9	1/40	140		140		140	140	38.7	490	BGDSS0160101	Undefined	140	140	NA	NA	4700000	120000000
ACETOPHENONE	98-86-2	3/40	46	J	64	J	58	140	52	490	IS11SS400001	Undefined	64	64	NA	NA	7800000	200000000
ANTHRACENE	120-12-7	1/40	260		260		260	140	26.2	490	BGDSS0160101	Undefined	260	260	NA	NA	23000000	610000000
BENZALDEHYDE	100-52-7	1/34	59	J	59	J	59	150	130	490	IS25SS190001	Undefined	59	59	NA	NA	7800000	200000000
BENZO(A)ANTHRACENE	56-55-3	1/40	480		480		480	150	13.6	490	BGDSS0160101	Undefined	480	480	NA	NA	870	7800
BENZO(A)PYRENE	50-32-8	1/40	390		**390**		390	150	16.9	490	BGDSS0160101	Undefined	390	390	NA	NA	**87**	780
BENZO(B)FLUORANTHENE	205-99-2	1/40	420		420		420	150	35	490	BGDSS0160101	Undefined	420	420	NA	NA	870	7800
BENZO(G,H,I)PERYLENE[5]	191-24-2	1/40	130		130		130	140	45	490	BGDSS0160101	Undefined	130	130	NA	NA	2300000	61000000
BENZO(K)FLUORANTHENE	207-08-9	1/40	360	J	360	J	360	150	41.6	490	BGDSS0160101	Undefined	360	360	NA	NA	8700	78000
BIS(2-ETHYLHEXYL)PHTHALATE	117-81-7	14/40	51	J	7500	J	660	320	58	490	BGDSS0200101	Undefined	7500	7500	NA	NA	46000	410000
CARBAZOLE	86-74-8	1/34	130	J	130	J	130	140	35	490	BGDSS0160101	Undefined	130	130	NA	NA	32000	290000
CHRYSENE	218-01-9	1/40	440		440		440	150	21	490	BGDSS0160101	Undefined	440	440	NA	NA	87000	780000
DIBENZOFURAN	132-64-9	1/40	65	J	65	J	65	140	28.7	490	BGDSS0160101	Undefined	65	65	NA	NA	310000	8200000
FLUORANTHENE	206-44-0	2/40	65	J	1100		580	160	35	490	BGDSS0160101	Undefined	1100	1100	NA	NA	3100000	82000000
FLUORENE	86-73-7	1/40	150		150		150	140	27.1	490	BGDSS0160101	Undefined	150	150	NA	NA	3100000	82000000
INDENO(1,2,3-CD)PYRENE	193-39-5	1/40	100		100		100	140	46.4	490	BGDSS0160101	Undefined	100	100	NA	NA	870	7800
NAPHTHALENE	91-20-3	1/40	110	L	110	L	110	140	34.5	490	IS21SS200001	Undefined	110	110	NA	NA	1600000	41000000
PHENANTHRENE[5]	85-01-8	1/40	1100		1100		1100	160	35	490	BGDSS0160101	Undefined	1100	1100	NA	NA	2300000	61000000
PYRENE	129-00-0	2/40	120	J	880		500	160	35	490	BGDSS0160101	Undefined	880	880	NA	NA	2300000	61000000
Explosives (ug/kg)																		
2-NITROTOLUENE	88-72-2	1/15	150	J	150	J	150	100	81.4	250	IS11SS400001	Undefined	150	150	NA	NA	780000	20000000
4-NITROTOLUENE	99-99-0	1/15	210	J	210	J	210	110	87.2	250	IS11SS400001	Undefined	210	210	NA	NA	780000	20000000
Pesticides/PCBs (ug/kg)																		
4,4'-DDE	72-55-9	11/40	0.23	J	10	J	1.7	1.4	1.4	4.2	BGDSS0080101	Undefined	10	10	NA	NA	1900	17000
4,4'-DDT	50-29-3	7/39	0.38	J	9.4	J	2.3	2.0	1.8	5.7	BGDSS0080101	Undefined	9.4	9.4	NA	NA	1900	17000
Inorganics (mg/kg)																		
ALUMINUM	7429-90-5	58/58	2010		25300		9750	9750	NA	NA	BGDSB0030101	Lognormal	11500	27400	7000 - > 100000	NA	78000	2000000
ANTIMONY	7440-36-0	3/61	0.68	J	1.8	J	1.4	0.51	0.174	2.15	BGDSB0030101	Undefined	1.8	1.8	<1 - 8.8	NA	31	820
ARSENIC	7440-38-2	54/62	0.78		**18.3**		5.1	4.6	0.76	4.5	BGDSS0190101	Undefined	18.3	18.3	<0.1 - 73	**1.1 - 7.1**	**0.43**	**3.8**
BARIUM	7440-39-3	62/62	9.07		101		41.4	41.4	NA	NA	BGDSB0030101	Undefined	101	101	10 - 1500	150 - 700	5500	140000
BERYLLIUM	7440-41-7	48/62	0.05	J	1.1	L	0.45	0.36	0.047	0.53	BGDSB0030101	Undefined	1.1	1.1	<1 -7	ND - 3	160	4100
CADMIUM	7440-43-9	20/62	0.095		2.5		0.31	0.16	0.06	0.59	IS25SS190001	Lognormal	0.18	0.56	NA	<0.01 - 5.6	78	2000
CALCIUM	7440-70-2	37/58	50.7		2420		415	287	49.6	275	IS13SS100001	Undefined	2420	2420	100 - 280000	NA	NA	NA
CHROMIUM	7440-47-3	62/62	3.5	K	46.5	J	17.3	17.3	NA	NA	BGDSB0150101	Undefined	46.5	46.5	1 - 1000	15 - 100	230	6100
COBALT	7440-48-4	62/62	0.58		**133**		6.8	6.8	NA	NA	BGDSB0030101	Undefined	133	133	**<0.3 - 70**	**ND -20**	1600	41000
COPPER	7440-50-8	58/62	1.6		25.9		8.1	7.7	1.53	4.6	BGDSB0150101	Undefined	25.9	25.9	<1 - 700	5 - 70	3100	82000
CYANIDE	57-12-5	7/16	0.59		0.73		0.64	0.53	0.073	2.5	IS21SS190001	Undefined	0.73	0.73	NA	NA	1600	41000
IRON	7439-89-6	58/58	2770		**61600**	J	18000	18000	NA	NA	BGDSB0150101	Lognormal	21700	57200	100 - > 100000	NA	**23000**	610000
LEAD	7439-92-1	57/62	3.1		**149**		15.4	14.7	5.3	28.8	BGDSS0080101	Undefined	149	149	<10 - 300	**10 - 50**	400[4]	750[4]
MAGNESIUM	7439-95-4	58/58	143	K	1990		704	704	NA	NA	BGDSB0030101	Lognormal	809	1820	50 - 50000	NA	NA	NA
MANGANESE	7439-96-5	58/58	15.9	J	1270	J	187	187	NA	NA	BGDSB0030101	Lognormal	266	952	<2 - 7000	NA	1600	41000
MERCURY	7439-97-6	40/62	0.01		**0.18**	L	0.059	0.047	0.02	0.077	IS11SB250203	Lognormal	0.06	0.15	0.01 - 3.4	**0.04 - 0.14**	23	610
NICKEL	7440-02-0	62/62	1.005		18.2	L	5.8	5.8	NA	NA	BGDSB0030101	Undefined	18.2	18.2	<5 - 700	ND - 30	1600	41000
POTASSIUM	09/07/40	58/58	128		2845	J	617	617	NA	NA	BGDSB0060101-AVG	Undefined	2845	2845	50 - 37000	NA	NA	NA
SELENIUM	7782-49-2	27/62	0.168	L	**2.7**	L	0.94	0.64	0.153	1.9	BGDSB0190101	Lognormal	0.82	2.4	<0.1 - 3.9	**<0.1 - 0.5**	390	10000
SILVER	7440-22-4	18/62	0.27	L	2.25	J	0.78	0.33	0.06	0.92	BGDSB0160101-AVG	Undefined	2.2	2.2	NA	NA	390	10000
SODIUM	7440-23-5	31/58	38.5		232		79.8	69.9	18.4	447	BGDSB0060101-AVG	Undefined	232	232	<500 - 50000	NA	NA	NA
THALLIUM	7440-28-0	17/62	0.48		**6.05**	L	1.9	0.79	0.22	3	BGDSB0160101-AVG	Undefined	6.0	6.0	NA	NA	**5.5**	140
VANADIUM	7440-62-2	62/62	9.78	L	127		29.3	29.3	NA	NA	BGDSB0150101	Undefined	127	127	<7 - 300	20 - 150	550	14000
ZINC	7440-66-6	62/62	6.2		70.4		21.1	21.1	NA	NA	BGDSB0030101	Undefined	70.4	70.4	<5 - 2900	8 - 113	23000	610000
Miscellaneous (mg/kg)																		
AMMONIA	7664-41-7	4/4	7.8		49.9		22.3	22.3	NA	NA	S26-MW03-001	Lognormal	49.9	49.9	NA	NA	NA	NA
DIESEL RANGE ORGANICS	TTNUS004	4/9	4.3		47		18.4	9.2	3.5	4.1	IS11SS400001	Undefined	47.0	47.0	NA	NA	NA	NA
NITRITE/NITRATE	TTNUS029	1/4	1.9		1.9		1.9	1.2	1.5	2.6	S25-MW03-001	Lognormal	1.9	1.9	NA	NA	NA	NA
PH (S.U.)	TTNUS002	7/7	4.5		7		5.3	5.3	NA	NA	IS13SS100001	Lognormal	6.0	7.0	NA	NA	NA	NA
TOTAL ORGANIC CARBON	TTNUS003	50/51	261		40100		7640	7490	87.5	87.5	IS11SS420001	Undefined	40100	40100	NA	NA	NA	NA
TOTAL ORGANIC HALIDES	TTNUS043	1/20	55.2		55.2		55.2	24.7	35.9	57.1	BGDSB0040101	Undefined	55.2	55.2	NA	NA	NA	NA
TOTAL PETROLEUM HYDROCARBONS	TTNUS001	2/2	33.7	L	39.1	L	36.4	36.4	NA	NA	S26-MW03-002	Undefined	39.1	39.1	NA	NA	NA	NA
TOTAL SOLIDS (%)	TTNUS046	7/7	66		79.2		75.4	75.4	NA	NA	IS25SS180001	Undefined	79.2	79.2	NA	NA	NA	NA

1 - Shacklette, H. T. and J. G. Boerngen (1984) (surface soil values are presented in table)
2 - Dragun, J. (1991) (surface soil values are presented in table)
3 - EPA Region III Risk-Based Concentrations, October, 2002.
4 - EPA Region 9 PRGs Table, October, 2002.
5 - Pyrene is used as a surrogate for Benzo(g,h,i)perylene, and Phenanthrene.
Bolded values represent exceedances of Region III RBC's or background concentrations reported in literature background references
NA - Not available
J Positive detection is qualified as an estimate.
K Positive detection is qualified as biased high.
L Positive result is qualified as biased low.

TABLE 4-2

SUMMARY OF DESCRIPTIVE STATISTICS FOR SURFACE SOILS
BACKGROUND INVESTIGATION REPORT FOR SOILS
INDIAN HEAD DIVISION
NSWC INDIAN HEAD, MARYLAND

Chemical	Cas Number	Frequency of Detection	Minimum Detection	Minimum Qualifier	Maximum Detection	Maximum Qualifier	Average of Positive Detections	Average of All Detections	Minimum Nondetect	Maximum Nondetect	Location of Maximum	Distribution of Data	95% Upper onfidence Lim	95% Upper Tolerance Limit	Eastern U.S. Soils [1]	Maryland Soils [2]	Residential Risk-Based Concentration [3]	Industrial Risk-Based Concentration [3]
Volatile Organic Compounds (ug/kg)																		
ACETONE	67-64-1	2/23	2200		13000	L	7600	660	1.9	23	RN6SS0170101	UNDEFINED	13000	13000	NA	NA	7800000	200000000
CYCLOHEXANE	110-82-7	1/14	3.6	J	3.6	J	3.6	5.3	5.4	15	IS11SS420001	UNDEFINED	3.6	3.6	NA	NA	NA	NA
ETHYLBENZENE	100-41-4	1/23	2.4	J	2.4	J	2.4	5.0	1.5	15	IS11SS400001	UNDEFINED	2.4	2.4	NA	NA	7800000	200000000
GASOLINE RANGE ORGANICS	TTNUS005	2/5	0.1225		0.17		0.15	15	0.13	150	IS11SS420001	UNDEFINED	0.17	0.17	NA	NA	NA	NA
METHYL ACETATE	79-20-9	1/14	2.3	J	2.3	J	2.3	5.3	5.4	15	IS11SS390001	UNDEFINED	2.3	2.3	NA	NA	78000000	2000000000
STYRENE	100-42-5	1/23	1.3	J	1.3	J	1.3	5.2	0.34	15	BGDSS0120101-AVG	UNDEFINED	1.3	1.3	NA	NA	16000000	410000000
TOLUENE	108-88-3	3/23	32.5		140	J	81	15	1.9	15	IS11SS400001	UNDEFINED	140	140	NA	NA	16000000	410000000
TOTAL XYLENES	1330-20-7	3/15	1.7	J	9.9	J	5.6	6.4	0.78	17	IS11SS420001	UNDEFINED	9.9	9.9	NA	NA	160000000	4100000000
TRICHLOROFLUOROMETHANE	75-69-4	3/23	1.7	J	2.5	J	2.1	5.2	0.33	15	BGDSS0200101	UNDEFINED	2.5	2.5	NA	NA	23000000	610000000
Semivolatile Organic Compounds (ug/kg)																		
2-METHYLNAPHTHALENE	91-57-6	1/23	73	L	73	L	73	140	42	490	IS21SS200001	UNDEFINED	73	73	NA	NA	1600000	41000000
ACENAPHTHENE	83-32-9	1/23	140		140		140	160	38.7	490	BGDSS0160101	UNDEFINED	140	140	NA	NA	4700000	120000000
ACETOPHENONE	98-86-2	3/23	46	J	64	J	58	140	52	490	IS11SS400001	UNDEFINED	64	64	NA	NA	7800000	200000000
ANTHRACENE	120-12-7	1/23	260		260		260	160	26.2	490	BGDSS0160101	UNDEFINED	260	260	NA	NA	23000000	610000000
BENZALDEHYDE	100-52-7	1/20	59	J	59	J	59	160	130	490	IS25SS190001	UNDEFINED	59	59	NA	NA	7800000	200000000
BENZO(A)ANTHRACENE	56-55-3	1/23	480		480		480	170	13.6	490	BGDSS0160101	UNDEFINED	480	480	NA	NA	870	7800
BENZO(A)PYRENE	50-32-8	1/23	390		**390**		390	170	16.9	490	BGDSS0160101	UNDEFINED	390	390	NA	NA	**87**	780
BENZO(B)FLUORANTHENE	205-99-2	1/23	420		420		420	170	35	490	BGDSS0160101	UNDEFINED	420	420	NA	NA	870	7800
BENZO(G,H,I)PERYLENE[5]	191-24-2	1/23	130		130		130	160	45	490	BGDSS0160101	UNDEFINED	130	130	NA	NA	2300000	61000000
BENZO(K)FLUORANTHENE	207-08-9	1/23	360	J	360	J	360	170	41.6	490	BGDSS0160101	UNDEFINED	360	360	NA	NA	8700	78000
BIS(2-ETHYLHEXYL)PHTHALATE	117-81-7	8/23	51	J	7500	J	1100	470	58	490	BGDSS0200101	UNDEFINED	7500	7500	NA	NA	46000	410000
CARBAZOLE	86-74-8	1/20	130	J	130	J	130	160	35	490	BGDSS0160101	UNDEFINED	130	130	NA	NA	32000	290000
CHRYSENE	218-01-9	1/23	440		440		440	170	21	490	BGDSS0160101	UNDEFINED	440	440	NA	NA	87000	780000
DIBENZOFURAN	132-64-9	1/23	65	J	65	J	65	150	28.7	490	BGDSS0160101	UNDEFINED	65	65	NA	NA	310000	8200000
FLUORANTHENE	206-44-0	2/23	65	J	1100		580	190	35	490	BGDSS0160101	UNDEFINED	1100	1100	NA	NA	3100000	82000000
FLUORENE	86-73-7	1/23	150		150		150	160	27.1	490	BGDSS0160101	UNDEFINED	150	150	NA	NA	3100000	82000000
INDENO(1,2,3-CD)PYRENE	193-39-5	1/23	100		100		100	160	46.4	490	BGDSS0160101	UNDEFINED	100	100	NA	NA	870	7800
NAPHTHALENE	91-20-3	1/23	110	L	110	L	110	150	34.5	490	IS21SS200001	UNDEFINED	110	110	NA	NA	1600000	41000000
PHENANTHRENE[5]	85-01-8	1/23	1100		1100		1100	200	35	490	BGDSS0160101	UNDEFINED	1100	1100	NA	NA	2300000	61000000
PYRENE	129-00-0	2/23	120	J	880		500	180	35	490	BGDSS0160101	UNDEFINED	880	880	NA	NA	2300000	61000000
Explosives (ug/kg)																		
2-NITROTOLUENE	88-72-2	1/9	150	J	150	J	150	110	81.4	250	IS11SS400001	UNDEFINED	150	150	NA	NA	780000	20000000
4-NITROTOLUENE	99-99-0	1/9	210	J	210	J	210	120	87.2	250	IS11SS400001	UNDEFINED	210	210	NA	NA	780000	20000000
Pesticides/PCBs (ug/kg)																		
4,4'-DDE	72-55-9	6/20	0.23	J	10	J	2.2	1.6	1.4	4.1	BGDSS0080101	UNDEFINED	10	10	NA	NA	1900	17000
4,4'-DDT	50-29-3	4/19	0.38	J	9.4	J	3.1	2.2	2.225	4.6	BGDSS0080101	UNDEFINED	9.4	9.4	NA	NA	1900	17000
Inorganics (mg/kg)																		
ALUMINUM	7429-90-5	32/32	2010		15500	J	7540	7540	NA	NA	BGDSS0150101	LOGNORMAL	9000	19700	7000 - > 100000	NA	78000	2000000
ARSENIC	7440-38-2	30/34	0.78		**18.3**		4.3	4.0	1.6	3.8	BGDSS0190101	LOGNORMAL	5.2	14.9	<0.1 - 73	**1.1 - 7.1**	**0.43**	**3.8**
BARIUM	7440-39-3	34/34	12.5		84.8		42.5	42.5	NA	NA	S26-MW03-001	NORMAL	47.6	80.4	10 - 1500	150 - 700	5500	140000
BERYLLIUM	7440-41-7	24/34	0.05	J	1.1		0.44	0.33	0.047	0.53	BGDSS0120101-AVG	UNDEFINED	1.1	1.1	<1 -7	ND - 3	160	4100
CADMIUM	7440-43-9	12/34	0.12	J	2.5		0.4	0.2	0.06	0.57	IS25SS190001	UNDEFINED	2.5	2.5	NA	<0.01 - 5.6	78	2000
CALCIUM	7440-70-2	22/32	83.9	J	2420		504	369	98.8	275	IS13SS100001	LOGNORMAL	573	2060	100 - 280000	NA	NA	NA
CHROMIUM	7440-47-3	34/34	3.5	K	28.9	L	13.6	13.6	NA	NA	IS13SS100001	LOGNORMAL	15.9	33.4	1 - 1000	15 - 100	230	6100
COBALT	7440-48-4	34/34	0.58		15		5.4	5.4	NA	NA	S26-MW03-001	LOGNORMAL	7.5	22.3	<0.3 - 70	ND -20	1600	41000
COPPER	7440-50-8	32/34	1.8		19.4		6.7	6.5	4.5	4.6	BGDSS0120101-AVG	LOGNORMAL	8.0	20.3	<1 - 700	5 - 70	3100	82000
CYANIDE	57-12-5	4/10	0.59		0.73		0.66	0.42	0.073	1.1	IS21SS190001	UNDEFINED	0.73	0.73	NA	NA	1600	41000
IRON	7439-89-6	32/32	2770		**31800**	J	13000	13000	NA	NA	BGDSS0120101-AVG	LOGNORMAL	16000	38500	100 - > 100000	NA	**23000**	610000
LEAD	7439-92-1	32/34	3.5	J	**149**		18.7	17.9	9.4	10	BGDSS0080101	LOGNORMAL	21.7	62.5	<10 - 300	**10 - 50**	400[4]	750[4]
MAGNESIUM	7439-95-4	32/32	143	K	1990		604	604	NA	NA	IS13SS100001	LOGNORMAL	722	1620	50 - 50000	NA	NA	NA
MANGANESE	7439-96-5	32/32	17.4		882	J	227	227	NA	NA	S26-MW03-001	LOGNORMAL	388	1390	<2 - 7000	NA	1600	41000
MERCURY	7439-97-6	23/34	0.03		0.13	L	0.06	0.05	0.02	0.077	BGDSS0150101	LOGNORMAL	0.060	0.16	0.01 - 3.4	0.04 - 0.14	23	610
NICKEL	7440-02-0	34/34	1.7		14		5.4	5.4	NA	NA	IS11SS410001-AVG	LOGNORMAL	6.6	15.4	<5 - 700	ND - 30	1600	41000
POTASSIUM	09/07/40	32/32	128		2620		497	497	NA	NA	IS13SS100001	LOGNORMAL	597	1470	50 - 37000	NA	NA	NA
SELENIUM	7782-49-2	14/34	0.168	L	**1.2**		0.67	0.54	0.16	1.9	IS11SS400001	NORMAL	0.62	1.2	<0.1 - 3.9	**<0.1 - 0.5**	390	10000
SILVER	7440-22-4	9/34	0.27	L	0.84		0.6	0.29	0.06	0.92	IS11SS400001	UNDEFINED	0.84	0.84	NA	NA	390	10000
SODIUM	7440-23-5	15/32	38.5		120		64.2	65.6	19.2	407	IS11SS400001	UNDEFINED	120	120	<500 - 50000	NA	NA	NA
THALLIUM	7440-28-0	7/34	1.2		2.3	L	1.5	0.62	0.22	3	BGDSS0160101	UNDEFINED	2.3	2.3	NA	NA	5.5	140
VANADIUM	7440-62-2	34/34	9.83	L	63.7		23.3	23.3	NA	NA	BGDSS0150101	LOGNORMAL	26.7	53.3	<7 - 300	20 - 150	550	14000
ZINC	7440-66-6	34/34	6.2		42.95	J	20.2	20.2	NA	NA	BGDSS0120101-AVG	NORMAL	23.6	37.5	<5 - 2900	8 - 113	23000	610000
Miscellaneous (mg/kg)																		
AMMONIA	7664-41-7	2/2	21.9		49.9		35.9	35.9	NA	NA	S26-MW03-001	UNDEFINED	---	---	NA	NA	NA	NA
DIESEL RANGE ORGANICS	TTNUS004	4/5	4.3		47		18.4	15.1	4	4	IS11SS400001	LOGNORMAL	47.0	1350	NA	NA	NA	NA
NITRITE/NITRATE	TTNUS029	1/2	1.9		1.9		1.9	1.3	1.5	1.5	S25-MW03-001	UNDEFINED	---	---	NA	NA	NA	NA
PH (S.U.)	TTNUS002	7/7	4.5		7		5.3	5.3	NA	NA	IS13SS100001	LOGNORMAL	6.0	8.8	NA	NA	NA	NA
TOTAL ORGANIC CARBON	TTNUS003	29/29	1410	J	40100		10900	10900	NA	NA	IS11SS420001	LOGNORMAL	16800	57200	NA	NA	NA	NA
TOTAL PETROLEUM HYDROCARBONS	TTNUS001	1/1	33.7	L	33.7	L	33.7	33.7	NA	NA	S26-MW03-001	UNDEFINED	---	---	NA	NA	NA	NA
TOTAL SOLIDS (%)	TTNUS046	7/7	66		79.2		75.4	75.4	NA	NA	IS25SS180001	UNDEFINED	79.2	79.2	NA	NA	NA	NA

1 - Shacklette, Hansford T. and Josephine G. Boerngen, Element Concentrations in Soils and Other Surficial Materials of the Conterminous United States, U.S. Geological Survey Professional Paper 1270, 1984
(surface soil values are presented in table)
2 - Dragun, James, Ph.D., Elements in North American Soils. HMCRI, Green Belt, MD, 1991 (surface soil values are presented in table)
3 - EPA Region III Risk-Based Concentrations, October, 2002.
4 - EPA Regon 9 PRGs Table, October, 2002.
5 - Pyrene is used as a surrogate for Benzo(g,h,i)perylene, and Phenanthrene.
Bolded values represent exceedances of Region III RBC's or background concentrations reported in literature background references
NA - Not available
J Positive detection is qualified as an estimate.
K Positive detection is qualified as biased high.
L Positive result is qualified as biased low.
--- Upper confidence and tolerance limits cannot be calculated because of the size of the data set.
NA - Not available

TABLE 4-3

SUMMARY OF DESCRIPTIVE STATISTICS FOR CLAY-LIKE SUBSURFACE SOILS
BACKGROUND INVESTIGATION REPORT FOR SOILS
INDIAN HEAD DIVISION
NSWC INDIAN HEAD, MARYLAND

Chemical	Cas Number	Frequency of Detection	Minimum Detection	Minimum Qualifier	Maximum Detection	Maximum Qualifier	Average of Positive Detections	Average of All Detections	Minimum Nondetect	Maximum Nondetect	Location of Maximum	Distribution of Data	95% Upper Confidence Limit	95% Upper Tolerance Limit	Eastern U.S. Soils [1]	Maryland Soils [2]	Residential Risk-Based Concentration [3]	Industrial Risk-Based Concentration [3]
Volatile Organic Compounds (ug/kg)																		
TOTAL XYLENES	1330-20-7	1/4	2.4	J	2.4	J	2.4	4.7	0.82	18	IS11SB260203	NORMAL	9.4	25	NA	NA	160000000	4100000000
TRICHLOROFLUOROMETHANE	75-69-4	2/7	2.5	J	2.7	J	2.6	4.4	0.35	14	BGDSB0110101	NORMAL	6.3	13	NA	NA	23000000	610000000
Semivolatile Organic Compounds (ug/kg)																		
1,3-DINITROBENZENE	99-65-0	1/3	32	J	32	J	32	120	250	393	IS11SB260203	NORMAL	260	750	NA	NA	7800	200000
BIS(2-ETHYLHEXYL)PHTHALATE	117-81-7	3/7	77	J	120	J	94	110	76.8	450	BGDSB0160101-AVG	LOGNORMAL	120	980	NA	NA	46000	410000
Pesticides/PCBs (ug/kg)																		
4,4'-DDE	72-55-9	1/8	0.68	J	0.68	J	0.68	1.2	1.5	4.2	BGDSB0150101	UNDEFINED	0.68	0.68	NA	NA	1900	17000
4,4'-DDT	50-29-3	1/8	0.79	J	0.79	J	0.79	2.1	3.8	5.7	BGDSB0150101	NORMAL	2.5	3.9	NA	NA	1900	17000
Inorganics (mg/kg)																		
ALUMINUM	7429-90-5	11/11	6840	J	25300		16800	16800	NA	NA	BGDSB0030101	NORMAL	20400	35400	7000 - > 100000	NA	78000	2000000
ANTIMONY	7440-36-0	3/11	0.68	J	1.8	J	1.4	0.78	0.21	2.1	BGDSB0030101	UNDEFINED	1.8	1.8	<1 - 8.8	NA	31	820
ARSENIC	7440-38-2	10/11	1.9	J	**14.15**		8.1	7.6	4.5	4.5	BGDSB0160101-AVG	NORMAL	9.8	18.9	<0.1 - 73	**1.1 - 7.1**	**0.43**	**3.8**
BARIUM	7440-39-3	11/11	34.7	J	101		55.0	55.0	NA	NA	BGDSB0030101	LOGNORMAL	68.0	134	10 - 1500	150 - 700	5500	140000
BERYLLIUM	7440-41-7	9/11	0.23	J	1.1	L	0.57	0.49	0.18	0.36	BGDSB0030101	LOGNORMAL	0.96	3.3	<1 -7	ND - 3	160	4100
CADMIUM	7440-43-9	1/11	0.14	J	0.14	J	0.14	0.11	0.07	0.59	IS11SB250203	LOGNORMAL	0.14	0.61	NA	<0.01 - 5.6	78	2000
CALCIUM	7440-70-2	6/11	50.7		479	J	308	190	49.6	134	BGDSB0110101	LOGNORMAL	479	2590	100 - 280000	NA	NA	NA
CHROMIUM	7440-47-3	11/11	13.4		46.5	J	27.6	27.6	NA	NA	BGDSB0150101	NORMAL	33.9	60.1	1 - 1000	15 - 100	230	6100
COBALT[5]	7440-48-4	11/11	1.5	K	**133**		16.8	16.8	NA	NA	BGDSB0030101	UNDEFINED	133	133	**<0.3 - 70**	**ND -20**	1600	41000
COPPER	7440-50-8	11/11	5.2	L	25.9		12.0	12.0	NA	NA	BGDSB0150101	LOGNORMAL	17.9	48.6	<1 - 700	5 - 70	3100	82000
CYANIDE	57-12-5	1/3	0.68		0.68		0.68	0.84	1.2	2.5	IS11SB250203	LOGNORMAL	0.68	16.1	NA	NA	1600	41000
IRON	7439-89-6	11/11	13800	J	**61600**	J	36400	36400	NA	NA	BGDSB0150101	NORMAL	45400	83100	100 - > 100000	NA	**23000**	610000
LEAD	7439-92-1	9/11	5.4	J	27.9		13.4	12.9	12.7	28.8	BGDSB0150101	LOGNORMAL	17.4	40.5	<10 - 300	10 - 50	400[4]	750[4]
MAGNESIUM	7439-95-4	11/11	498	J	1990		943	943	NA	NA	BGDSB0030101	LOGNORMAL	1220	2640	50 - 50000	NA	NA	NA
MANGANESE	7439-96-5	11/11	15.9	J	1270	J	242	242	NA	NA	BGDSB0030101	LOGNORMAL	1150	4130	<2 - 7000	NA	1600	41000
MERCURY	7439-97-6	6/11	0.03	K	**0.18**	L	0.09	0.06	0.04	0.063	IS11SB250203	UNDEFINED	0.18	0.18	0.01 - 3.4	**0.04 - 0.14**	23	610
NICKEL	7440-02-0	11/11	1.005		18.2	L	7.8	7.8	NA	NA	BGDSB0030101	UNDEFINED	18.2	18.2	<5 - 700	ND - 30	1600	41000
POTASSIUM	09/07/40	11/11	385		1610		756	756	NA	NA	BGDSB0030101	LOGNORMAL	1050	2610	50 - 37000	NA	NA	NA
SELENIUM	7782-49-2	4/11	1.2		**2.6**		2.0	1.0	0.18	1.75	BGDSB0040101	LOGNORMAL	2.6	13.3	<0.1 - 3.9	**<0.1 - 0.5**	390	10000
SILVER[6]	7440-22-4	4/11	0.66	J	2.25	J	1.1	0.5	0.09	0.78	BGDSB0160101-AVG	LOGNORMAL	2.2	11.4	NA	NA	390	10000
SODIUM	7440-23-5	7/11	62.1		131	L	99.2	90.7	21.4	447	BGDSB0030101	NORMAL	123	258	<500 - 50000	NA	NA	NA
THALLIUM[7]	7440-28-0	5/11	0.85	L	**6.05**	L	2.9	1.6	0.3	2.2	BGDSB0160101-AVG	LOGNORMAL	5.5	21.8	NA	NA	**5.5**	140
VANADIUM	7440-62-2	11/11	23.9		127		50.1	50.1	NA	NA	BGDSB0150101	LOGNORMAL	72.7	194	<7 - 300	20 - 150	550	14000
ZINC	7440-66-6	11/11	18.4	J	70.4		29.5	29.5	NA	NA	BGDSB0030101	UNDEFINED	70.4	70.4	<5 - 2900	8 - 113	23000	610000
Miscellaneous (mg/kg)																		
AMMONIA	7664-41-7	1/1	9.5		9.5		9.5	9.5	NA	NA	S26-MW03-002	UNDEFINED	9.5	9.5	NA	NA	NA	NA
TOTAL ORGANIC CARBON	TTNUS003	9/9	261		8300		3420	3420	NA	NA	BGDSB0110101	LOGNORMAL	8300	66500	NA	NA	NA	NA
TOTAL ORGANIC HALIDES	TTNUS043	1/4	55.2		55.2		55.2	32.3	39.8	57.1	BGDSB0040101	LOGNORMAL	55.2	281	NA	NA	NA	NA
TOTAL PETROLEUM HYDROCARBONS	TTNUS001	1/1	39.1	L	39.1	L	39.1	39.1	NA	NA	S26-MW03-002	UNDEFINED	39.1	39.1	NA	NA	NA	NA

1 - Shacklette, Hansford T. and Josephine G. Boerngen, Element Concentrations in Soils and Other Surficial Materials of the Conterminous United States, U.S. Geological Survey Professional Paper 1270, 1984
(surface soil values are presented in table)
2 - Dragun, James, Ph.D., Elements in North American Soils. HMCRI, Green Belt, MD, 1991 (surface soil values are presented in table)
3 - EPA Region III Risk-Based Concentrations, October, 2002.
4 - EPA Region 9 PRGs Table, October, 2002.
5 - The maximum detection for cobalt of 133 mg/kg is a statistical outlier according to the Discordance Test. Upon removal of this result, the data set has a lognormal distribution, a 95% UCL of 9.82 mg/kg, and a 95% UTL of 33.4 mg/kg.
6 - The maximum detection for silver of 2.25 mg/kg is a statistical outlier according to the Discordance Test. Upon removal of this result, the data set has a lognormal distribution, a 95% UCL of 1.22 mg/kg, and a 95% UTL of 4.76 mg/kg.
7 - The maximum detection for thallium of 6.05 mg/kg is a statistical outlier according to the Discordance Test. Upon removal of this result, the data set has a lognormal distribution, a 95% UCL of 3.16 mg/kg, and a 95% UTL of 11.0 mg/kg.
Bolded values represent exceedances of Region III RBC's or background concentrations reported in literature background references
NA - Not available
J Positive detection is qualified as an estimate.
K Positive detection is qualified as biased high.
L Positive result is qualified as biased low.
NA - Not available

TABLE 4-4

SUMMARY OF DESCRIPTIVE STATISTICS FOR NON-CLAY-LIKE SUBSURFACE SOILS
BACKGROUND INVESTIGATION REPORT FOR SOILS
INDIAN HEAD DIVISION
NSWC INDIAN HEAD, MARYLAND

Chemical	Cas Number	Frequency of Detection	Minimum Detection	Minimum Qualifier	Maximum Detection	Maximum Qualifier	Average of Positive Detections	Average of All Detections	Minimum Nondetect	Maximum Nondetect	Location of Maximum	Distribution of Data	95% Upper Confidence Limit	95% Upper Tolerance Limit	Eastern U.S. Soils [1]	Maryland Soils [2]	Residential Risk-Based Concentration [3]	Industrial Risk-Based Concentration [3]
Volatile Organic Compounds (ug/kg)																		
ACETONE	67-64-1	1/10	1800		1800		1800	180	2.6	13	RPLSB0030101	UNDEFINED	1800	1800	NA	NA	7800000	200000000
TOLUENE	108-88-3	1/10	3.3	J	3.3	J	3.3	4.2	5	13	IS11SB230203	UNDEFINED	3.3	3.3	NA	NA	16000000	410000000
TOTAL XYLENES	1330-20-7	1/5	9	J	9	J	9.0	8.0	12	17	IS11SB240203	NORMAL	9.1	13	NA	NA	160000000	4100000000
TRICHLOROFLUOROMETHANE	75-69-4	2/10	1.8	J	2	J	1.9	4.5	5	13	BGDSB0200101	UNDEFINED	2.0	2.0	NA	NA	23000000	610000000
Semivolatile Organic Compounds (ug/kg)																		
BIS(2-ETHYLHEXYL)PHTHALATE	117-81-7	3/10	57	J	79	J	69	110	75	390	BGDSB0190101	UNDEFINED	79	79	NA	NA	46000	410000
Pesticides/PCBs (ug/kg)																		
4,4'-DDE	72-55-9	4/12	0.24	J	2.9	J	1.1	1.2	1.4	3.9	BGDSB0080101	LOGNORMAL	2.3	7.7	NA	NA	1900	17000
4,4'-DDT	50-29-3	2/12	0.58	J	2.4	J	1.5	1.8	1.8	4.75	BGDSB0080101	UNDEFINED	2.4	2.4	NA	NA	1900	17000
Inorganics (mg/kg)																		
ALUMINUM	7429-90-5	15/15	3070	J	18900		9260	9260	NA	NA	BGDSB0010101	NORMAL	11400	21400	7000 - > 100000	NA	78000	2000000
ARSENIC	7440-38-2	14/17	1.8		**9.2**		4.5	3.8	0.76	1.9	BGDSB0120101	LOGNORMAL	7.9	28.7	<0.1 - 73	**1.1 - 7.1**	**0.43**	**3.8**
BARIUM	7440-39-3	17/17	9.07		56.2	J	30.5	30.5	NA	NA	BGDSB0080101	NORMAL	36.6	66.5	10 - 1500	150 - 700	5500	140000
BERYLLIUM	7440-41-7	15/17	0.12		0.91		0.37	0.34	0.14	0.25	BGDSB0120101	LOGNORMAL	0.51	1.5	<1 -7	ND - 3	160	4100
CADMIUM	7440-43-9	7/17	0.095		0.27	K	0.18	0.13	0.06	0.511	BGDSB0080101	LOGNORMAL	0.20	0.61	NA	<0.01 - 5.6	78	2000
CALCIUM	7440-70-2	9/15	75.4	J	785	J	270	186	81	249.5	BGDSB0140101	LOGNORMAL	353	1270	100 - 280000	NA	NA	NA
CHROMIUM	7440-47-3	17/17	6.2		44.7	J	18.0	18.0	NA	NA	BGDSB0060101-AVG	LOGNORMAL	23.7	59.1	1 - 1000	15 - 100	230	6100
COBALT	7440-48-4	17/17	0.845	L	7.2		3.2	3.2	NA	NA	BGDSB0120101	LOGNORMAL	4.9	14.7	<0.3 - 70	ND -20	1600	41000
COPPER	7440-50-8	15/17	1.6		23.1		8.3	7.5	1.53	4.5	BGDSB0120101	LOGNORMAL	13.8	47.6	<1 - 700	5 - 70	3100	82000
CYANIDE	57-12-5	2/3	0.59		0.59		0.59	0.56	1.02	1.02	IS11SB240203	UNDEFINED	0.59	0.59	NA	NA	1600	41000
IRON	7439-89-6	15/15	4030	J	**31700**	J	15200	15200	NA	NA	BGDSB0140101	NORMAL	18800	35200	100 - > 100000	NA	**23000**	610000
LEAD	7439-92-1	16/17	3.1		25.5		9.8	9.3	5.3	5.3	BGDSB0080101	LOGNORMAL	13.5	38.6	<10 - 300	10 - 50	400[4]	750[4]
MAGNESIUM	7439-95-4	15/15	215	J	1720	J	741	741	NA	NA	BGDSB0120101	LOGNORMAL	1070	2940	50 - 50000	NA	NA	NA
MANGANESE	7439-96-5	15/15	16.2	J	120		62.2	62.2	NA	NA	IS11SB230203	NORMAL	78.7	155	<2 - 7000	NA	1600	41000
MERCURY	7439-97-6	11/17	0.01		0.08	L	0.04	0.03	0.03	0.059	BGDSB0140101	LOGNORMAL	0.048	0.14	0.01 - 3.4	0.04 - 0.14	23	610
NICKEL	7440-02-0	17/17	1.8		13.2		5.4	5.4	NA	NA	BGDSB0120101	LOGNORMAL	6.9	15.9	<5 - 700	ND - 30	1600	41000
POTASSIUM	09/07/40	15/15	237		2845	J	770	770	NA	NA	BGDSB0060101-AVG	LOGNORMAL	1140	3440	50 - 37000	NA	NA	NA
SELENIUM	7782-49-2	9/17	0.295	L	**2.7**	L	0.9	0.59	0.153	1	BGDSB0190101	LOGNORMAL	1.1	3.8	<0.1 - 3.9	**<0.1 - 0.5**	390	10000
SILVER	7440-22-4	5/17	0.63		1.1	J	0.79	0.29	0.06	0.4	BGDSB0190101	UNDEFINED	1.1	1.1	NA	NA	390	10000
SODIUM	7440-23-5	9/15	44.5		232.5		90.9	63.9	18.4	80.5	BGDSB0060101-AVG	LOGNORMAL	128	461	<500 - 50000	NA	NA	NA
THALLIUM	7440-28-0	5/17	0.48		2.8	L	1.3	0.57	0.225	1.2	BGDSB0190101	LOGNORMAL	1.1	4.1	NA	NA	5.5	140
VANADIUM	7440-62-2	17/17	9.78	L	61.9		27.9	27.9	NA	NA	BGDSB0140101	LOGNORMAL	38.8	102	<7 - 300	20 - 150	550	14000
ZINC	7440-66-6	17/17	7.3	J	45.9	J	17.6	17.6	NA	NA	BGDSB0120101	LOGNORMAL	22.2	49.7	<5 - 2900	8 - 113	23000	610000
Miscellaneous (mg/kg)																		
AMMONIA	7664-41-7	1/1	7.8		7.8		7.8	7.8	NA	NA	S25-MW03-002	UNDEFINED	7.8	7.8	NA	NA	NA	NA
TOTAL ORGANIC CARBON	TTNUS003	12/13	354	J	8200		2880	2660	87.5	87.5	BGDSB0190101	LOGNORMAL	17900	64300	NA	NA	NA	NA

1 - Shacklette, Hansford T. and Josephine G. Boerngen, Element Concentrations in Soils and Other Surficial Materials of the Conterminous United States, U.S. Geological Survey Professional Paper 1270, 1984
(surface soil values are presented in table)
2 - Dragun, James, Ph.D., Elements in North American Soils. HMCRI, Green Belt, MD, 1991 (surface soil values are presented in table)
3 - EPA Region III Risk-Based Concentrations, October, 2002.
4 - EPA Region 9 PRGs Table, October, 2002.
Bolded values represent exceedances of Region III RBC's or background concentrations reported in literature background references
NA - Not available
J Positive detection is qualified as an estimate.
K Positive detection is qualified as biased high.
L Positive result is qualified as biased low.
NA - Not available

SAP Worksheet #15B - Soil Reference Limits and Evaluation Background Table

CAS Number	Chemical	ORNL Risk-Based Concentration[1] Residential (mg/kg)	MDE Generic Numeric Cleanup Standards[2] Residential (mg/kg)	MDE Generic Numeric Cleanup Standards[2] Soil to Groundwater (mg/kg)	Ecological Criteria USEPA Eco-SSL (mg/kg)[4]	Ecological Criteria USEPA Region 3 BTAG (mg/kg)[5]	Ecological Criteria ORNL Plant (mg/kg)[6]	Ecological Criteria ORNL Invertebrate (mg/kg)[7]
Volatile Organic Compounds								
71-43-2	Benzene	0.11 C	12	0.005	NA	0.1	NC	NC
75-15-0	Carbon Disulfide	67 N	780	19	NA	NA	NA	NA
67-66-3	Chloroform	0.03 C	100	0.005	NA	0.3	NC	NC
60-29-7	Ethyl Ether	1600 N	1600	NA	NA	NA	NA	NA
75-09-2	Methylene chloride	1.1 C	85	0.019	NA	0.3	NC	NC
108-88-3	Toluene	500 N	1600	8.8	NA	0.1	NC	NC
Explosives								
99-35-4	1,3,5-Trinitrobenzene	180 N	NA	NA	NA	NA	NA	NA
99-65-0	1,3-Dinitrobenzene	0.61 N	NA	NA	NA	NA	NA	NA
118-96-7	2,4,6-Trinitrotoluene (TNT)	1.6 C	NA	NA	NA	NA	NA	NA
121-14-2	2,4-Dinitrotoluene	12 N	16	1.7	NA	NA	NA	NA
606-20-2	2,6-Dinitrotoluene	6.1 N	7.8	1.7	NA	NA	NA	NA
2691-41-0	Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX	310 N	NA	NA	NA	NA	NA	NA
99-08-1	3-Nitrotoluene	NA	NA	NA	NA	NA	NA	NA
88-72-2	2-Nitrotoluene	78 N	NA	NA	NA	NA	NA	NA
99-99-0	4-Nitrotoluene	3 C	NA	NA	NA	NA	NA	NA
19406-51-0	4-Amino-2,6-Dinitrotoluene	12 N	NA	NA	NA	NA	NA	NA
35572-78-2	2-Amino-4,6-Dinitrotoluene	12 N	NA	NA	NA	NA	NA	NA
479-45-8	Methyl-2,4,6-trinitrophenylnitramine (Tetryl)	24 N	NA	NA	NA	NA	NA	NA
98-95-3	Nitrobenzene	3.1 N	NA	NA	NA	NA	NA	NC
121-82-4	Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX)	0.44 C	NA	NA	NA	NA	NA	NA
55-63-0	Nitroglycerin	6.1 N	NA	NA	NA	NA	NA	NA
9004-70-0	Nitrocellulose	NA	NA	NA	NA	NA	NA	NA
556-88-7	Nitroguanidine	610 N	NA	NA	NA	NA	NA	NA
14797-73-0	Perchlorate	5.5 N	NA	NA	NA	NA	NA	NA
78-11-5	PETN	NA	NA	NA	NA	NA	NA	NA
618-87-1	3,5-Dinitroaniline	NA	NA	NA	NA	NA	NA	NA
Metals								
7429-90-5	Aluminum	7700 N	7800	NA	pH < 5.5[8]	NC	NC	NC
7440-36-0	Antimony	3.1 N	12	NA	0.27	NC	NC	NC
7440-38-2	Arsenic	0.039 C	2	NA	18	NC	NC	NC
7440-39-3	Barium	1500 N	550	NA	330	NC	NC	NC
7440-41-7	Beryllium	16 N	16	NA	21	NC	NC	NC
7440-43-9	Cadmium	7 N	3.9	NA	0.36	NC	NC	NC
7440-70-2	Calcium	NA	NA	NA	NA	NA	NA	NA
7440-47-3	Chromium	12000 N	23	NA	26	NC	NC	NC
7440-48-4	Cobalt	NA	160	NA	160	NC	NC	NC
7440-50-8	Copper	310 N	310	NA	310	NC	NC	NC
7439-89-6	Iron	5500 N	2300	NA	pH<5 or >8[9]	NC	NC	NC
7439-93-2	Lithium	NA	NA	NA	NA	NA	2	NA
7439-92-1	Lead	40 N	400	NA	11	NC	NC	NC
7439-95-4	Magnesium	NA	NA	NA	NA	4400	NC	NC
7439-96-5	Manganese	180 N	160	NA	220	NC	NC	NC

CAS Number	Chemical	Risk-Based Concentration[1]	Cleanup Standards[2]		Ecological Criteria			
		Residential (mg/kg)	Residential (mg/kg)	Soil to Groundwater (mg/kg)	USEPA Eco-SSL (mg/kg)[4]	USEPA Region 3 BTAG (mg/kg)[5]	ORNL Plant (mg/kg)[6]	ORNL Invertebrate (mg/kg)[7]
7439-97-6	Mercury	2.3 N[3]	100	NA	NA	0.058	NC	NC
7440-02-0	Nickel	160 N	160	NA	38	NC	NC	NC
7440-09-7	Potassium	NA	NA	NA	NA	NA	NA	NA
7782-49-2	Selenium	39 N	39	NA	0.52	NC	NC	NC
7440-22-4	Silver	39 N	39	NA	4.2	NC	NC	NC
7440-23-5	Sodium	NA	NA	NA	NA	NA	NA	NA
7440-24-6	Strontium	4700 N	NA	NA	NA	120	NC	NC
7440-28-0	Thallium	0.51 N	2	NA	NA	0.001	NC	NC
7440-31-5	Tin	4700 N	4700	NA	NA	0.89	NC	NC
7440-62-2	Vanadium	55 N	55	NA	7.8	NC	NC	NC
7440-66-6	Zinc	2300 N	2300	NA	46	NC	NC	NC
Miscellaneous Parameters								
	Total Petroleum Hydrocarbons				NA	NA	NA	NA

Notes
C - Carcinogenic
MDE - Maryland Department of the Environment
N - Noncarcinogenic
NC - Not Considered
RBC - Risk-Based Concentration
Eco-SSL - Ecological Soil Screening Level
BTAG - Biological Technical Advisory Group
ORNL - Oak Ridge National Lab

1 - USEPA Region 3 Risk-Based Concentration Table. The noncarcinogenic values (denoted with a "N" flag) are the RBC divided by 10 to correspond to a target hazard quotient of 0.1. Carcinogenic values represent an incremental cancer risk of 1.0E-06 (carcinogens denoted with a "C" flag) (ORNL RBC, July 2008).
2 - State of Maryland, Department of the Environment, Cleanup Standards for Soil and Groundwater, August 2001, Interim Final Guidance (Update No. 1).
3 - The value for mercuric chloride have been used as a surrogate for mercury.
4 - USEPA, 2005. Guidance for Developing Ecological Soil Screening Levels. Office of Solid Waste and Emergency and Response. OSWER Directive 92857-55. February. Directive 92857-55. February. Individual Eco-SSL documents available at http://www.epa.gov/ecotox/ecossl/.
5 - USEPA Region 3, BTAG Screening Levels, January 1995. These values are considered only if EPA SSLs are not available.
6 - Efroymson, R.A., M.E. Will, G.W. Suter II, and A.C. Wooten. 1997. Toxicological Benchmarks for Screening Contaminants of Potential Concern for Effects on Terrestrial Plants: 1997 Revision. Oak Ridge National Laboratory. November. ES/ER/TM-85/R3. These values are considered only if EPA Eco-SSLs and Region 3 BTAG values are not available.
7 - Efroymson, R.A., M.E. Will, and G.W. Suter II. 1997. Toxicological Benchmarks for Contaminants of Potential Concern for Effects on Soil and Litter Invertebrates and Heterotrophic Process: 1997 Revision. Oak Ridge National Laboratory. November. ES/ER/TM-126/R2. These values are considered only if EPA Eco-SSLs, Region 3 BTAG, and ORNL Plant values are not available
8 - Aluminum is considered a COPC only when the soil pH is less than 5.5.
9 - Iron is not expected to be toxic to plants with a soil pH between 5 and 8.

SAP Worksheet #15B - Sediment Reference Limits and Evaluation Background Table

CAS Number	Chemical	ORNL RBC[1] (mg/kg)	Ecological Criteria: USEPA Region III BTAG (mg/kg)[4]	Ecological Criteria: TEC (mg/kg)[5]	Ecological Criteria: NOAA SQUIRTS (mg/kg)[6]
Volatile Organic Compounds					
71-43-2	Benzene	11 C	NA	NA	NA
75-15-0	Carbon Disulfide	6700 N	0.000851	NC	NC
67-66-3	Chloroform	3 C	NA	NA	NA
60-29-7	Ethyl Ether	160000 N	NA	NA	NA
75-09-2	Methylene chloride	110 C	NA	NA	NA
108-88-3	Toluene	50000 N	NA	NA	NA
Explosives					
99-35-4	1,3,5-Trinitrobenzene	18000 N	NA	NA	NA
99-65-0	1,3-Dinitrobenzene	61 N	NA	NA	NA
118-96-7	2,4,6-Trinitrotoluene	160 C	0.092	NC	NC
121-14-2	2,4-Dinitrotoluene	1200 N	0.0416	NC	NC
606-20-2	2,6-Dinitrotoluene	610 N	NA	NA	NA
2691-41-0	HMX	31000 N	NA	NA	NA
99-08-1	3-Nitrotoluene	NA	NA	NA	NA
88-72-2	2-Nitrotoluene	7800 N	NA	NA	NA
99-99-0	4-Nitrotoluene	300 C	4.06	NC	NC
19406-51-0	4-Amino-2,6-Dinitrotoluene	1200 N	NA	NA	NA
35572-78-2	2-Amino-4,6-Dinitrotoluene	1200 N	NA	NA	NA
479-45-8	Tetryl	2400 N	NA	NA	NA
98-95-3	Nitrobenzene	310 N	NA	NA	NA
121-82-4	RDX	44 C	0.013	NC	NC
55-63-0	Nitroglycerin	610 N	NA	NA	NA
9004-70-0	Nitrocellulose	NA	NA	NA	NA
556-88-7	Nitroguanidine	61000 N	NA	NA	NA
14797-73-0	Perchlorate	550 N	NA	NA	NA
78-11-5	PETN	NA	NA	NA	NA
618-87-1	3,5-Dinitroaniline	NA	NA	NA	NA
Metals					
7429-90-5	Aluminum	770000 N	NA	NA	NA
7440-36-0	Antimony	310 N	2	NC	NC
7440-38-2	Arsenic	3.9 C	9.8	NC	NC
7440-39-3	Barium	150000 N	NA	NA	NA
7440-41-7	Beryllium	1600 N	NA	NA	NA
7440-43-9	Cadmium	700 N	0.99	NC	NC
7440-70-2	Calcium	NA	NA	NA	NA

CAS Number	Chemical	ORNL RBC[1] (mg/kg)	Ecological Criteria: USEPA Region III BTAG (mg/kg)[4]	Ecological Criteria: TEC (mg/kg)[5]	Ecological Criteria: NOAA SQUIRTS (mg/kg)[6]
7440-47-3	Chromium (III)	1200000 N	43.4	NC	NC
7440-48-4	Cobalt	NA	50	NC	NC
7440-50-8	Copper	31000 N	31.6	NC	NC
7439-89-6	Iron	550000 N	20000	NC	NC
7439-93-2	Lithium	NA	NA	NA	NA
7439-92-1	Lead	4000 N	35.8	NC	NC
7439-95-4	Magnesium	NA	NA	NA	NA
7439-96-5	Manganese	18000 N	460	NC	NC
7439-97-6	Mercury	230 N[3]	0.18	NC	NC
7440-02-0	Nickel	16000 N	22.7	NC	NC
7440-09-7	Potassium	NA	NA	NA	NA
7782-49-2	Selenium	3900 N	2	NC	NC
7440-22-4	Silver	3900 N	1	NC	NC
7440-23-5	Sodium	NA	NA	NA	NA
7440-24-6	Strontium	470000 N	NA	NA	NA
7440-31-5	Tin	470000 N	NA	NA	NA
7440-62-2	Vanadium	5500 N	NA	NA	520
7440-66-6	Zinc	230000 N	121	NC	NC

Notes
C - Carcinogenic
N - Noncarcinogenic
NC - Not Considered
RBC - Risk-Based Concentration
TEC - Threshold Effects Concentration
BTAG - Biological Technical Advisory Group
NOAA - National Oceanic and Atmospheric Administration
ORNL - Oak Ridge National Laboratory

1 - ORNL Risk-Based Concentration Table (July 2008). The values have been multiplied by 10 for anticipated reduced exposure to sediment.
2 - 10 percent of noncarcinogenic RBC/PRG is less then the carcinogenic RBC/PRG.
3 - The value for mercuric chloride have been used as a surrogate for mercury.
4 - USEPA, 2006. Region 3 Freshwater Sediment Screening Benchmarks. August. http://www.epa.gov/reg3hwmd/risk/eco/btag/sbv/fwsed/screenbench.htm
5 - MacDonald, D.D., C.G. Ingersoll, and T.A. Berger, 2000. "Development and Evaluation of Consensus-Based Sediment Quality Guidelines for Freshwater Ecosystems." Archives of Environmental Contamination and Toxicology, Vol. 39, pp. 20-31. These values are considered only if no Region 3 BTAG values are not available.
6 - Buchman, M. F., 2006. NOAA Screening Quick Reference Tables, NOAA HAZMAT Report 99-1, Seattle, WA, Coastal Protection and Restoration Division, National Oceanic and Atmospheric Administration. http://response.restoration.noaa.gov/cpr/sediment/squirt/squirt.html These values are considered only if there are no Region 3 BTAG or TEC values available.

SAP Worksheet #15B - Groundwater Reference Limits and Evaluation Background Table

CAS Number	Chemical	ORNL RBC[1] Tap Water (ug/L)	USEPA MCL[2] (ug/L)	MDE Generic Numeric Cleanup Standards[3] (ug/L)
Volatile Organic Compounds				
71-43-2	Benzene	0.041 C	5	5
75-15-0	Carbon Disulfide	100 N	NA	100
67-66-3	Chloroform	0.019 C	80	80
60-29-7	Ethyl Ether	730 N	NA	NA
75-09-2	Methylene chloride	0.48 C	5	5
108-88-3	Toluene	230 N	1000	1000
Explosives				
99-35-4	1,3,5-Trinitrobenzene	110 N	NA	NA
99-65-0	1,3-Dinitrobenzene	0.37 N	NA	NA
118-96-7	2,4,6-Trinitrotoluene	0.22 C	NA	NA
121-14-2	2,4-Dinitrotoluene	7.3 N	NA	50
606-20-2	2,6-Dinitrotoluene	3.7 N	NA	50
2691-41-0	HMX	180 N	NA	NA
99-08-1	3-Nitrotoluene	NA	NA	NA
88-72-2	2-Nitrotoluene	37 N	NA	NA
99-99-0	4-Nitrotoluene	0.42 C	NA	NA
19406-51-0	4-Amino-2,6-Dinitrotoluene	7.3 N	NA	NA
35572-78-2	2-Amino-4,6-Dinitrotoluene	7.3 N	NA	NA
479-45-8	Tetryl	15 N	NA	NA
98-95-3	Nitrobenzene	0.34 N	NA	NA
121-82-4	RDX	0.061 C	NA	NA
55-63-0	Nitroglycerin	0.37 N	NA	NA
9004-70-0	Nitrocellulose	NA	NA	NA
556-88-7	Nitroguanidine	370 N	NA	NA
14797-73-0	Perchlorate	2.6 N	NA	NA
78-11-5	PETN	NA	NA	NA
618-87-1	3,5-Dinitroaniline	NA	NA	NA
Metals				
7429-90-5	Aluminum	3700 N	50[7]	50
7440-36-0	Antimony	1.5 N	6	6
7440-38-2	Arsenic	0.0045 C	10	50
7440-39-3	Barium	730 N	2000	2000
7440-41-7	Beryllium	7.3 N	4	4

CAS Number	Chemical	ORNL RBC[1] Tap Water (ug/L)	USEPA MCL[2] (ug/L)	MDE Generic Numeric Cleanup Standards[3] (ug/L)
7440-43-9	Cadmium	1.8 N	5	5
7440-70-2	Calcium	NA	NA	NA
7440-47-3	Chromium	5500 N	100	100
7440-48-4	Cobalt	NA	NA	73
7440-50-8	Copper	150 N	1300	1300
7439-89-6	Iron	2600 N	300[7]	300
7439-93-2	Lithium	NA	NA	NA
7439-92-1	Lead	NA	15	15
7439-95-4	Magnesium	NA	NA	NA
7439-96-5	Manganese	88 N	50[7]	50
7439-97-6	Mercury	1.1 N[6]	2	2
7440-02-0	Nickel	73 N	NA	73
7440-09-7	Potassium	NA	NA	NA
7782-49-2	Selenium	18 N	50	50
7440-22-4	Silver	18 N	100[7]	180
7440-23-5	Sodium	NA	NA	NA
7440-24-6	Strontium	2200 N	NA	NA
7440-28-0	Thallium	0.24 N	2	2
7440-31-5	Tin	2200 N	NA	2.2
7440-62-2	Vanadium	26 N	NA	50
7440-66-6	Zinc	1100 N	5000[7]	1100

Notes
C - Carcinogenic
MCL - Maximum Contaminant Level
MDE - Maryland Department of the Environment
N - Noncarcinogenic
RBC - Risk-Based Concentration

1 -ORNL Risk-Based Concentration Table. The noncarcinogenic values (denoted with a "N" flag) are the RBC divided by 10 to correspond to a target hazarc of 0.1. Carcinogenic values represent an incremental cancer risk of 1.0E-06 (carcinogens denoted with a "C" flag) (ORNL RBC, July 2008).
2 - 2006 Edition of the Drinking Water Standards and Health Advisories, August 2006.
3 - State of Maryland, Department of the Environment, Cleanup Standards for Soil and Groundwater, August 2001, Interim Final Guidance (Update No. 1).
4 - The value for acenaphthene have been used as a surrogate for acenaphthylene.
5 - The value for pyrene has been used as a surrogate for benzo(g,h,i)perylene and phenanthrene.
6 - The value for mercuric chloride have been used as a surrogate for mercury.
7 - Secondary MCL.

APPENDIX D

FIELD STANDARD OPERATING PROCEDURES

APPENDIX D

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STANDARD OPERATING PROCEDURE
SOP-01

SAMPLE LABELING

1.0 PURPOSE

This Standard Operating Procedure (SOP) describes the procedures to be used for labeling sample containers. Sample labels are used to document the sample ID, date, time, analysis to be performed, preservative, matrix, sampler, and the analytical laboratory. A sample label will be attached to each sample container.

2.0 REQUIRED FIELD FORMS AND EQUIPMENT

Writing utensil (preferably black pen with indelible ink)
Disposable medical-grade gloves (e.g. latex, nitrile)
Sample log sheets
Required sample containers: All sample containers for analysis by fix-based laboratories will be supplied and deemed certified clean by the laboratory.
Sample labels
Chain-of-custody records
Sealable polyethylene bags
Heavy-duty cooler
Ice

3.0 PROCEDURES

3.1 The following information will be electronically printed on each sample label prior to mobilizing for field activities. Additional “generic” labels will also be printed prior to mobilization to be used for field QC and backups.

- Project number (CTO 0423)
- Sample location ID
- Contract Task Order number
- Sample ID

- Matrix
- Preservative
- Analysis to be performed
- Laboratory name

3.2 Select the container(s) that are appropriate for a given sample. Select the sample-specific ID label(s), complete date, time, and sampler name, and affix to the sample container(s).

3.3 Fill the appropriate containers with sample material. Securely close the container lids without overtightening.

3.4 Place the sample container in a sealable polyethylene bag and place in a cooler containing ice.

Example of a sample label is attached at the end of this SOP.

4.0 ATTACHMENTS

1. Sample Label

ATTACHMENT 1

SAMPLE LABEL

Tetra Tech NUS, Inc. 661 Andersen Drive Pittsburgh, 15220 (412)921-7090	**Project:** **Location:** **CTO:**	
Sample No:		**Matrix:**
Date:	**Time:**	**Preserve:**
Analysis:		
Sampled by:	**Laboratory**	

STANDARD OPERATING PROCEDURE
SOP-02

SAMPLE IDENTIFICATION NOMENCLATURE

1.0 PURPOSE

The purpose of this Standard Operating Procedure (SOP) is to establish a consistent sample nomenclature system that will facilitate subsequent data management at the Naval Support Facility Indian Head Stump Neck Annex. The sample nomenclature system has been devised such that the following objectives can be attained.

- Sorting of data by site, location, or matrix
- Maintenance of consistency (field, laboratory, and database sample numbers)
- Accommodation of all project-specific requirements
- Accommodation of laboratory sample number length constraints
- Ease of sample identification

2.0 REQUIRED FIELD FORMS AND EQUIPMENT

Writing utensil (preferably black pen with indelible ink)
Sample container labels

3.0 SAMPLE IDENTIFICATION NOMENCLATURE

3.1 <u>Samples</u>

All samples will be properly labeled with a sample label affixed to the sample container. Each sample will be assigned a unique sample tracking number.

3.1.1 Sample Numbering Scheme

The sample tracking number will consist of a four- or five-segment alpha-numeric code that identifies the sample's associated Unexploded Ordnance (UXO) site, sample type, location, and for aqueous samples, where applicable, whether a sample is filtered, and/or the sample round number. For soil samples, the

final four tracking numbers will identify the depth in units of feet below ground surface (bgs) at which the sample was collected. For sediment samples, the final four tracking numbers will identify the depth in units of inches bgs at which the sample was collected.

The alphanumeric coding to be used is explained in the following diagram and subsequent definitions:

ANN	**AA**	**NNN**	**NNNN (Soils and Sediment only)**	**A (Aqueous only)**
UXO Number	Matrix	Sample Location Number	Sequential depth interval from freshly exposed surface	Only utilized if sample has been filtered

Character Type:

A = Alpha

N = Numeric

UXO Number (ANN):

X01 = UXO 01

X14 = UXO 14

Matrix Code (AA):

SS = Surface Soil Sample

SB = Subsurface Soil Sample

SD = Sediment Sample

SW = Surface Water Sample

GW = Groundwater Sample

Location Number (NNN):

Sequential number beginning with “001” for each matrix.

Depth Interval:

This code section will be used for soil and sediment samples only.

The depth code is used to note the depth bgs at which a soil or sediment sample is collected. The first two numbers of the four-number code specify the top interval, and the third and fourth specify the bottom

interval. The surface soil sample intervals will be in inches (ie: 0 to 6 inches and 6 to 24 inches); whereas, the subsurface soil samples will be in feet (ie. 2 to 4 feet and 4 to 6 feet). The interval for sediment samples will be in inches. The depths will be noted in whole numbers only; further detail, if needed, will be recorded on the sample log sheet, boring log, logbook, etc.

Filtered Aqueous Sample:

An F will be used at the end of the sample ID to indicate that sample has been filtered before collection.

3.1.2 Examples of Confirmation Sample Nomenclature

A surface soil sample collected from UXO 01, sample location 003, at the depth interval of 6 to 24 inches would be labeled as “X01SS0030624”. A subsurface soil sample collected from UXO 07, sample location 021, at the depth interval of 4 to 6 feet would be labeled as “X07SB0210406”. A sediment sample collected from UXO 14, sampling location 010, to a depth of 6 inches bgs would be labeled as “X14SD0100006”. A groundwater sample collected from UXO 02, sample location 001, that has been filtered would be labeled as “X02GW001F”.

3.2 Field Quality Assurance/Quality Control (QA/QC) Sample Nomenclature

Field QA/QC samples are described in this UFP SAP. They will be designated using a different coding system than the one used for regular field samples.

3.2.1 QC Sample Numbering

The QC code will consist of a three- to four-segment alpha-numeric code that identifies the sample QC type, the date the sample was collected, and the number of this type of QC sample collected on that date.

AA	NNNNNN	NN
QC Type	Date	Sequence Number (per day)

Character Type:

A = Alpha

N = Numeric

QC Types:

FD = Field Duplicate

RB = Rinsate Blank

SB = Source Blank

TB = Trip Blank

The sampling time recorded on the Chain-of-Custody Form, labels, and tags for field duplicate samples will be 0000 so that the samples are "blind" to the laboratory. Notes detailing the sample number, time, date, and type will be recorded on the sample log sheets and will document the location of the duplicate sample (sample log sheets are not provided to the laboratory).

3.2.2 Examples of Field QA/QC Sample Nomenclature

The first duplicate of the day at UXO 1 for a surface soil sample collected on March 24, 2008 would be designated as FD03240801.

The third duplicate of the day taken at UXO 14 of a surface soil sample collected on April 12, 2008 would be designated as FD04120803.

The first trip blank associated with samples collected on March 18, 2008 would be designated as TB03180801.

STANDARD OPERATING PROCEDURE
SOP-03

SAMPLE CUSTODY AND DOCUMENTATION OF FIELD ACTIVITIES

1.0 PURPOSE

This Standard Operating Procedure (SOP) establishes the procedures for sample custody and documentation of field sampling and field analyses activities.

2.0 REQUIRED FIELD FORMS AND EQUIPMENT

The following logbooks, forms, labels, and equipment are required.

Writing utensil (preferably black pen with indelible ink)
Site logbook
Field logbook
Sample label
Chain-of-Custody Form
Custody seals
Equipment calibration log
Soil and Sediment Sample Log Sheet
Surface Water Sample Log Sheet

3.0 PROCEDURES

This section describes custody and documentation procedures. All entries made into the logbooks, custody documents, logs, and log sheets described in this SOP must be made in indelible ink (black is preferred). No erasures are permitted. If an incorrect entry is made, the entry will be crossed out with a single strike mark, initialed, and dated.

3.1 Site Logbook

The site logbook is a hard-bound, paginated, controlled-distribution record book in which all major on-site activities are documented. At a minimum, the following activities and events will be recorded (daily) in the site logbook:

- All field personnel present
- Arrival/departure of site visitors
- Arrival/departure of equipment
- Start or completion of sampling activities
- Daily on-site activities performed each day
- Sample pickup information
- Health and safety issues
- Weather conditions

The site logbook is initiated at the start of the first on-site activity (e.g., site visit or initial reconnaissance survey). Entries are to be made for every day that on-site activities take place.

The following information must be recorded on the cover of each site logbook:

- Project name
- Project number
- Book number
- Start date
- End date

Information recorded daily in the site logbook need not be duplicated in other field notebooks but must summarize the contents of these other notebooks and refer to specific page locations in these notebooks for detailed information (where applicable). At the completion of each day's entries, the site logbook must be signed and dated by the field operations leader (FOL).

3.2 Field Logbooks

The field logbook is a separate dedicated notebook used by field personnel to document his or her activities in the field. This notebook is hardbound and paginated.

3.3 Sample Labels

Adhesive sample container labels must be completed and applied to every sample container. Information on the label includes the project name, location, sample number, date, time, preservative, analysis, matrix, sampler's initials, and the name of the laboratory performing the analysis.

3.4 Chain-of-Custody Form

The Chain-of-Custody Form (COC) is a multi-part form that is initiated as samples are acquired and accompanies a sample (or group of samples) as it is transferred from person to person. Each COC is numbered. This form must accompany any samples collected for laboratory chemical analysis. A copy of a blank COC form is attached at the end of this SOP.

The FOL must include the name of the laboratory in the upper right hand corner section to ensure that the samples are forwarded to the correct location. If more than one COC is necessary for any cooler, the FOL will indicate "Page __ of __" on each COC. The original (top) signed copy of the COC will be placed inside a sealable polyethylene bag and taped inside the lid of the shipping cooler. Once the samples are received at the laboratory, the sample custodian checks the contents of the cooler(s) against the enclosed COC(s). Any problems are noted on the enclosed COC Form (bottle breakage, discrepancies between the sample labels, COC form, etc.) and will be resolved through communication between the laboratory point-of-contact and the Task Order Manager (TOM). The COC form is signed and retained by the laboratory and becomes part of the sample's corresponding analytical data package.

3.5 Custody Seal

The custody seal is an adhesive-backed label, and it is part of the chain-of-custody process and is used to prevent tampering with samples after they have been collected in the field and sealed in coolers for transit to the laboratory. The custody seals are signed and dated by the samplers and affixed across the opening edges of each cooler (two seals per cooler) containing environmental samples. The laboratory sample custodian will examine the custody seal for evidence of tampering and will notify the Tetra Tech TOM if evidence of tampering is observed.

3.6 Equipment Calibration Log

The Equipment Calibration Log is used to document calibration of measuring equipment used in the field. The Equipment Calibration Log documents that the manufacturer's instructions were followed for calibration of the equipment, including frequency and type of standard or calibration device. An Equipment Calibration Log must be maintained for each electronic measuring device requiring calibration. Entries must be made for each day the equipment is used.

3.7 Sample Log Sheets

The Soil and Sediment Sample Log Sheets are used to document the sampling of soils and sediments (see SOPs-05, 06, and -08). The surface water sample log sheets are used to document the sampling of surface waters (see SOP-07). The groundwater sample log sheets are used to document the sampling of groundwater (see SOP-18).

4.0 ATTACHMENTS

1. Chain-of-Custody Record
2. Equipment Calibration Log
3. Soil and Sediment Sample Log
4. Surface water Sample Log
5. Groundwater Sample Log

ATTACHMENT 1
CHAIN-OF-CUSTODY RECORD

CHAIN OF CUSTODY | NUMBER | PAGE ____ OF _____

PROJECT NO:	SITE NAME:	PROJECT MANAGER AND PHONE NUMBER	LABORATORY NAME AND CONTACT:
SAMPLERS (SIGNATURE)		FIELD OPERATIONS LEADER AND PHONE NUMBER	ADDRESS
		CARRIER/WAYBILL NUMBER	CITY, STATE

STANDARD TAT ☐
RUSH TAT ☐
☐ 24 hr. ☐ 48 hr. ☐ 72 hr. ☐ 7 day ☐ 14 day

DATE YEAR ____	TIME	SAMPLE ID	MATRIX	GRAB (G) COMP (C)	No. OF CONTAINERS	CONTAINER TYPE PLASTIC (P) or GLASS (G)								COMMENTS
						PRESERVATIVE USED								
						TYPE OF ANALYSIS								

1. RELINQUISHED BY	DATE	TIME	1. RECEIVED BY	DATE	TIME
2. RELINQUISHED BY	DATE	TIME	2. RECEIVED BY	DATE	TIME
3. RELINQUISHED BY	DATE	TIME	3. RECEIVED BY	DATE	TIME

COMMENTS

DISTRIBUTION: WHITE (ACCOMPANIES SAMPLE) YELLOW (FIELD COPY) PINK (FILE COPY)

3/99
FORM NO. TINUS-001

ATTACHMENT 2
EQUIPMENT CALIBRATION LOG

Tetra Tech NUS, Inc.

EQUIPMENT CALIBRATION LOG

PROJECT NAME : _____ INSTRUMENT NAME/MODEL: _____

SITE NAME: _____ MANUFACTURER: _____

PROJECT No.: _____ SERIAL NUMBER: _____

Date of Calibration	Instrument I.D. Number	Person Performing Calibration	Instrument Settings		Instrument Readings		Calibration Standard (Lot No.)	Remarks and Comments
			Pre-calibration	Post-calibration	Pre-calibration	Post-calibration		

ATTACHMENT 3

SOIL AND SEDIMENT SAMPLE LOG SHEET

SOIL & SEDIMENT SAMPLE LOG SHEET

Page___ of ___

Project Site Name: _____
Project No.: _____

[] Surface Soil
[] Subsurface Soil
[] Sediment
[] Other: _____
[] QA Sample Type: _____

Sample ID No.: _____
Sample Location: _____
Sampled By: _____
C.O.C. No.: _____

Type of Sample:
[] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

Date:	Depth Interval	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Time:			
Method:			
Monitor Reading (ppm):			

COMPOSITE SAMPLE DATA:

Date:	Time	Depth Interval	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other

OBSERVATIONS / NOTES:

MAP:

Circle if Applicable:

MS/MSD	Duplicate ID No.:

Signature(s):

ATTACHMENT 4

SURFACE WATER SAMPLE LOG SHEET

Tetra Tech NUS, Inc. **SURFACE WATER SAMPLE LOG SHEET**

Page___ of ___

Project Site Name: _____
Project No.: _____

[] Stream
[] Spring
[] Pond
[] Lake
[] Other: _____
[] QA Sample Type: _____

Sample ID No.: _____
Sample Location: _____
Sampled By: _____
C.O.C. No.: _____

Type of Sample:
[] Low Concentration
[] High Concentration

SAMPLING DATA:

	Color	pH	S.C.	Temp.	Turbidity	DO	Salinity	ORP
Date:	Visual	Standard	mS/cm	Degrees C	NTU	mg/l	%	mV
Time:								
Depth:								
Method:								

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected

OBSERVATIONS / NOTES:

MAP:

Circle if Applicable:

MS/MSD	Duplicate ID No.:

Signature(s):

ATTACHMENT 5

GROUNDWATER SAMPLE LOG SHEET

Tetra Tech NUS, Inc.

GROUNDWATER SAMPLE LOG SHEET

Page___ of ___

Project Site Name: _____
Project No.: _____

[] Domestic Well Data
[] Monitoring Well Data
[] Other Well Type: _____
[] QA Sample Type: _____

Sample ID No.: _____
Sample Location: _____
Sampled By: _____
C.O.C. No.: _____
Type of Sample:
[] Low Concentration
[] High Concentration

SAMPLING DATA:

Date:	Color	pH	S.C.	Temp.	Turbidity	DO	Salinity	Other
Time:	(Visual)	(S.U.)	(mS/cm)	(^{0}C)	(NTU)	(mg/l)	(%)	
Method:								

PURGE DATA:

Date:	Volume	pH	S.C.	Temp.	Turbidity	DO	Salinity	Other
Method:								
Monitor Reading (ppm):								
Well Casing Diameter & Material								
Type:								
Total Well Depth (TD):								
Static Water Level (WL):								
One Casing Volume(gal/L):								
Start Purge (hrs):								
End Purge (hrs):								
Total Purge Time (min):								
Total Vol. Purged (gal/L):								

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected

OBSERVATIONS / NOTES:

Circle if Applicable:		Signature(s):
MS/MSD	Duplicate ID No.:	

STANDARD OPERATING PROCEDURE
SOP-04

DECONTAMINATION OF FIELD SAMPLING EQUIPMENT

1.0 PURPOSE

This Standard Operating Procedure (SOP) establishes the procedures to be followed when decontaminating non-dedicated field sampling equipment during the field investigations.

2.0 REQUIRED FIELD FORMS AND EQUIPMENT

Writing utensil (preferably black pen with indelible ink)
Non-latex rubber or plastic gloves
Cotton gloves
Field logbook
Potable water
Deionized water
Isoproponal (optional)
LiquiNox detergent
Brushes, spray bottles, paper towels, etc.
Container to collect and transport decontamination fluids

3.0 DECONTAMINATION PROCEDURES

3.1 Don non-latex and/or cotton gloves and decontaminate sampling equipment (in accordance with the following steps) prior to field sampling and between samples.

3.2 Rinse the equipment with potable water. Rinsing may be conducted by spraying with water from a spray bottle or by dipping. Collect the potable water rinsate into a container.

3.3 Wash the equipment with a solution of LiquiNox detergent. Prepare the LiquiNox wash solution in accordance with the instructions on the LiquiNox container. Collect the LiquiNox wash solution into a container. Use brushes or sprays as appropriate for the equipment. If oily residue has

accumulated on the sampling equipment, remove the residue with an isopropanol wash and repeat the Liquinox wash.

3.4 Rinse the equipment with potable water. Rinsing may be conducted by spraying with water from a spray bottle or by dipping. Collect the potable water rinsate into a container.

3.5 Rinse the equipment with deionized water. Rinsing may be conducted by spraying with water from a spray bottle or by dipping. Collect the deionized water rinsate into a container.

3.6 Remove excess water by air drying, shaking, or by wiping with paper towels as necessary.

3.7 Document decontamination by recording it in the field logbook.

3.8 Containerized decontamination solutions will be managed in accordance with the procedures described in SOP-09 and this UFP SAP.

STANDARD OPERATING PROCEDURE

SOP-05

SOIL CORING AND SAMPLING USING HAND AUGER TECHNIQUES

1.0 PURPOSE

This Standard Operating Procedure (SOP) describes the procedures for collecting surface and subsurface soil cores from unconsolidated overburden materials using hand augering techniques.

2.0 REQUIRED FIELD FORMS AND EQUIPMENT

Disposable medical-grade gloves (e.g., latex, nitrile)
Writing utensil (preferably black pen with indelible ink)
Indelible marker
Stainless Steel Auger Buckets
Stainless Steel Extension Rods
Cross Handle
Required decontamination materials
Bentonite pellets
Sealable polyethylene bags
Sample labels
Shipping containers (containing ice)
Disposable plastic trowels or stainless steel trowels
Stainless steel mixing bowls
Sample containers: Sample containers are certified clean by the laboratory supplying the containers.
Soil Sample Log Forms
Daily Activity Logs
Chain-of-Custody Form
Soil Boring Log

3.0 BOREHOLE ADVANCEMENT AND SOIL SAMPLING USING A HAND AUGER

Hand Augers may be employed to collect the soil cores. A hand augering system generally consists of a variety of all stainless steel bucket bits (i.e. cylinders 6-1/2" long and 2-3/4", 3-1/4", and 4" in diameter), a series of extension rods (available in 2', 3', 4' and 5' lengths), a cross handle.

3.1 The hand auger can be used in a wide variety of soil conditions. It can be used to sample soil, both from the surface, or to depths in excess of 12 feet. However, the presence or rock layers and the collapse of the borehole normally contribute to its limiting factors.

Attach a properly decontaminated bucket bit into a clean extension rod and further attach the cross handle to the extension rod.

3.2 Clear the area to be sampled of any surface debris (vegetation, twigs, rocks, letter, etc.)

3.3. Turn the hand auger sampler into the ground to a depth of 1 foot. The 0- to 1-foot depth soil interval is considered to be the surface soil. Subsurface soil samples will be collected at depths greater than 1 foot below ground surface.

3.4 After reaching the desired depth, slowly and carefully withdraw the apparatus from the borehole.

3.4 Utilizing a properly decontaminated stainless steel trowel or disposable trowel, remove the sample material from the bucket bit and place into a sealable polyethylene bag. Note in a field notebook or on a standardized data sheet any changes in the color, texture or odor of the soil.

3.5 Thoroughly homogenize the sample material and write sample ID, date, and time on the bag with an indelible marker.

3.6 Complete required information on the Soil Sample Log Sheet (copy attached at the end of this SOP). Update the Chain-of-Custody (COC) Form.

3.7 Excess soil core materials will be returned to the hole and tamped. If insufficient soil is available to fill the hole to the ground surface, then bentonite pellets mixed with the soil will be used to backfill the hole, and hydrated with potable water.

3.8 Decontaminate all soil sampling equipment in accordance with SOP-04 before collecting the next sample.

3.9 Soil samples shipped to a fixed-base laboratory for analysis will be in sample containers supplied by the laboratory. The sample labels will be completed and affixed to the sample container. The samples will then be packaged and shipped to the fixed-base laboratory in accordance with SOP-11.

4.0 ATTACHMENTS

1. Soil and Sediment Sample Log Sheet
2. Soil Boring Log Sheet

ATTACHMENT 1

SOIL AND SEDIMENT SAMPLE LOG SHEET

SOIL & SEDIMENT SAMPLE LOG SHEET

Page___ of ___

Project Site Name: _____
Project No.: _____

[] Surface Soil
[] Subsurface Soil
[] Sediment
[] Other: _____
[] QA Sample Type: _____

Sample ID No.: _____
Sample Location: _____
Sampled By: _____
C.O.C. No.: _____

Type of Sample:
[] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

Date:	Depth Interval	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Time:			
Method:			
Monitor Reading (ppm):			

COMPOSITE SAMPLE DATA:

Date:	Time	Depth Interval	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other

OBSERVATIONS / NOTES:

MAP:

Circle if Applicable:

MS/MSD	Duplicate ID No.:

Signature(s):

ATTACHMENT 2

BORING LOG

Tetra Tech NUS, Inc.

BORING LOG

Page ___ of ___

PROJECT NAME: _____ BORING No.: _____
PROJECT NUMBER: _____ DATE: _____
DRILLING COMPANY: _____ GEOLOGIST: _____
DRILLING RIG: _____ DRILLER: _____

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**

* When rock coring, enter rock brokeness.
** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Drilling Area Background (ppm): ____

Remarks: _____

Converted to Well: Yes _____ No _____ Well I.D. #: _____

STANDARD OPERATING PROCEDURE
SOP-06

BOREHOLE ADVANCEMENT AND SOIL CORING FOR SOIL SAMPLING USING DIRECT-PUSH TECHNOLOGY

1.0 PURPOSE

This Standard Operating Procedure (SOP) describes the procedures for collecting surface and subsurface soil cores from unconsolidated overburden materials using direct-push technology (DPT). For these investigations, a Geoprobe® rig with a Macrocore Sampler will be the type of DPT used.

2.0 REQUIRED FIELD FORMS AND EQUIPMENT

Cut-resistant non-latex impermeable gloves
Cotton gloves
Disposable medical-grade gloves (e.g., latex, nitrile)
Writing utensil (preferably black pen with indelible ink)
Indelible marker
Boring log sheets: A copy of this form is included in SOP-10
Geoprobe® or equivalent DPT equipment
Geoprobe® Macrocore Sampler or equivalent
Geoprobe® Sampling Kit or equivalent
Clear acetate liners: one new liner for each soil core
Required decontamination materials (see SOP-04)
Bentonite pellets

3.0 BOREHOLE ADVANCEMENT AND SOIL SAMPLING USING A GEOPROBE®

Direct-push technology (DPT) will be employed to collect soil cores. DPT refers to sampling tools and sensors that are driven directly into the ground without the use of conventional rotary drilling equipment. DPT typically utilizes hydraulic pressure and/or percussion hammers to advance the sampling tools. Geoprobe® is a manufacturer of a hydraulically powered, percussion/probing machine utilizing DPT to

collect subsurface environmental samples. This type of rig with a Macrocore Sampler will be used at the Naval Support Indian Head Stump Neck Annex to collect soil cores.

3.1 Clear the area to be sampled of any surface debris (herbaceous vegetation, twigs, rocks, litter, etc.).

3.2 Place a new clear acetate liner in the detachable Macrocore core barrel and attach coring device to the Geoprobe® rig.

3.3 Drive macrocore sampler (lined with acetate) into the ground to a specified depth using hydraulic pressure. The 0- to 1-foot depth soil interval is considered to be the surface soil. Subsurface soil samples will be collected at depths greater than 1 foot below ground surface.

3.4 Retract the sampler from the borehole and remove the acetate liner and the soil core from the Macrocore barrel.

3.5 Attach the metal trough from the Geoprobe® Sampling Kit firmly to a suitable surface.

3.6 Place the acetate liner containing the soil core in the trough.

3.7 While wearing cut-resistant gloves, cut the acetate liner through its entire length using the double-bladed knife that accompanies the Geoprobe® Sampling Kit. Then remove the strip of acetate from the trough to gain access to the collected soils. **CAUTION**: Do not attempt to cut the acetate liner while holding it in your hand.

3.8 Log the soil core on the Boring Log Sheet (see SOP-10).

3.9 Place the desired interval of the soil core in a sealable polyethylene bag, thoroughly homogenize the sample material and write sample ID, date, and time on the bag with an indelible marker.

3.10 Complete required information on the Soil Sample Log Sheet (copy attached at the end of this SOP). Update the Chain-of-Custody (COC) Form.

3.11 Repeat steps 3.2 through 3.11 for the next depth intervals, if required.

3.12 The depth water table if encountered should be recorded on the Boring Log, and the estimated moisture content of the soil and the presence or absence of water in the boring should be noted.

3.13 If readings from the PID are all at background levels below field screening criteria, then excess soil core materials will be returned to the hole and tamped. If insufficient soil is available to fill the hole to the ground surface, then bentonite pellets mixed with the soil will be used to backfill the hole, and hydrated as per manufacture recommendation.

3.14 If screening instruments indicate that contaminants may be present in the soil materials, then all excess soil core materials will be placed in a plastic bag (or drum if larger quantities). The bag will be tagged identifying the location and depths from where the soils came and the date. The bag will then be placed in a 55-gallon drum and stored on-site until laboratory analyses of the soil are completed and classification of the soil waste materials can be determined (see SOP-09).

3.15 If soil materials from the boring are suspected of being contaminated (see 3.15 above), the soil boring will be backfilled with bentonite pellets up to the ground surface.

3.16 Decontaminate all soil sampling equipment in accordance with SOP-04 prior to collecting the next sample.

3.17 Soil samples shipped to a fixed-base laboratory for analysis will be in sample containers supplied by the laboratory. The sample labels will be completed and affixed to the sample container. The samples will then be packaged and shipped to the fixed-base laboratory in accordance with SOP-11.

STANDARD OPERATING PROCEDURE
SOP-07

SURFACE WATER SAMPLING

1.0 PURPOSE

This Standard Operating Procedure (SOP) establishes the procedure for collecting surface water samples.

2.0 REQUIRED FIELD FORMS AND EQUIPMENT

Surface Water Sample Log Sheet: A copy of this form is attached at the end of this SOP.
Field logbook
Writing utensil (preferably black pen with indelible ink)
Indelible marker
Multi-parameter water-quality meter: The water-quality meter is used for the measurement of dissolved oxygen, pH, specific conductance, temperature, oxidation-reduction potential, and turbidity (see SOP-12).
LaMotte Turbidity Meter: Used to measure turbidity in the field.
Disposable sample containers: Disposable sample containers are used to fill sample containers and transport sample(s) to a pump for filtering.
Sample containers: Certified-clean sample containers will be provided by the laboratory that performs the analyses.
0.45-micron filter assembly: These are single-use filter cartridges used to filter samples scheduled for dissolved metals analyses. The filters become investigation-derived waste (IDW) after one use.
Peristaltic pump
Silicon tubing
Sealable polyethylene bags
Shipping containers (coolers)

3.0 SURFACE WATER SAMPLING PROCEDURES

3.1 Sampling will start at the downstream end of a stream and proceed to the farthest upstream location.

3.2 While standing downstream or from the bank, gently remove any floating leaves or twigs that may be present in a sample pool area in a manner that will not disturb the bottom sediment.

3.3 While standing downstream or from the bank, place the sample container in the water at the sampling location at a 45-degree angle and lower it to approximately half the sample pool depth. With the mouth of the container facing upstream, fill the container with water, being careful not to disturb the sediment.

3.4 All samples will be collected into certified-clean, pre-preserved bottles (if preservation is required for the analysis to be performed) supplied by the laboratory performing the analyses. Sample containers should not be filled completely; a small amount of air should be left at the top.

3.5 Record the date and time that the sample containers are filled on the Surface Water Sample Log Sheet, the sample labels, and the Chain-of-Custody Form.

3.6 After the sample label is completed and checked, place the sample container into a sealable polyethylene bag and place the plastic storage bag holding the sample container into a cooler containing ice.

3.7 Repeat steps 3.3 through 3.6 until all the sample bottles containing unfiltered samples have been filled.

3.8 Fill two 1-liter unpreserved polyethylene bottles. Use these bottles to transfer the sample for field filtering. Set up a peristaltic pump for filtering of the dissolved metals samples. Using new, clean, disposable silicone tubing and a 0.45-micron filter, place the intake tubing from the pump into the transfer bottle with the filter attached to the discharge end and start the pump. Pre-rinse the filter with approximately 50-mL of sample water prior to filling the sample containers.

3.9 Using the discharge from the filter cartridge, fill one 1-liter polyethylene sample bottle for dissolved metals. Repeat steps 3.8 and 3.9 for these sample containers.

3.10 Obtain measurements of dissolved oxygen, pH, specific conductance, temperature, turbidity, and oxidation-reduction potential using the multi-parameter water-quality meter and LaMotte Turbidity Meter (see SOP-12). Record the readings in the appropriate fields on the Surface Water Sample Log Sheet.

3.11 Decontaminate all equipment and load the equipment and the sample cooler in the sample vehicle for transport.

4.0 ATTACHMENTS

1. Surface Water Sample Log Sheet

ATTACHMENT 1

SURFACE WATER SAMPLE LOG SHEET

Tetra Tech NUS, Inc. **SURFACE WATER SAMPLE LOG SHEET**

Page___ of ___

Project Site Name: _____
Project No.: _____

[] Stream
[] Spring
[] Pond
[] Lake
[] Other: _____
[] QA Sample Type: _____

Sample ID No.: _____
Sample Location: _____
Sampled By: _____
C.O.C. No.: _____

Type of Sample:
[] Low Concentration
[] High Concentration

SAMPLING DATA:

	Color	pH	S.C.	Temp.	Turbidity	DO	Salinity	ORP
Date:	Visual	Standard	mS/cm	Degrees C	NTU	mg/l	%	mV
Time:								
Depth:								
Method:								

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected

OBSERVATIONS / NOTES:

MAP:

Circle if Applicable:

MS/MSD	Duplicate ID No.:

Signature(s):

STANDARD OPERATING PROCEDURE
SOP-08

SEDIMENT SAMPLING

1.0 PURPOSE

This Standard Operating Procedure (SOP) establishes the procedure for sediment sampling in streams and other waterways.

2.0 REQUIRED FIELD FORMS AND EQUIPMENT

The following field forms and equipment are required for sediment sampling.

Sediment Sample Log Forms: A copy of this form is attached at the end of this SOP.
Writing utensil (preferably black pen with indelible ink)
Indelible marker
Bound field logbook
Disposable plastic trowels
Survey stakes and flagging: Used to mark sampling locations after completion of sampling.
Labeled sample containers: See SOP-01 for sample identification procedures. Sample containers are certified clean by the laboratory supplying the containers.
Sealable polyethylene bags
Shipping containers (containing ice)
Disposable medical-grade gloves (e.g., latex, nitrile)
Chain-of-Custody Form

3.0 SEDIMENT SAMPLE LOCATION SELECTION

In general, sediments composed of fine-grained materials with greater surface area available for adsorption are more desirable for sample selection. The fined-grained materials may act as a sink or reservoir for adsorbing heavy metals and organic contaminants even if surface runoff concentrations are below detection limits. Therefore, it is important to locate the specific sampling points where the sediment has the greatest percentage of fine particles. The sampling personnel will determine specific sampling locations with these goals in mind.

4.0 SEDIMENT SAMPLING PROCEDURES

4.1 The sampler will wear clean, disposable medical-grade gloves. Clear vegetative matter or debris, if present, from the sample location using a disposable sampling trowel or spoon. Use the trowel to dig up and homogenize the sediment in an 18-inch-diameter circular area that is 6 inches deep. Stir the sediment within the circular area; do not move the sediment outside the circle. Also, do not dig or stir sediment that is deeper than 6 inches below the ground surface, until the next depth interval is sampled.

- Use the same trowel to scoop the homogenized sediment into the requisite labeled sample container(s).

4.2 Record the sample time (using military time) on the Sediment Sample Log Form and sample container labels. Record all other information required on the labels as specified by SOP-01.

4.3 Place the labeled sample container into a sealable polyethylene bag and then place the bag holding the sample container into a cooler containing ice.

4.4 Record date, sampling site, site conditions, location map, and other information (e.g., presence and flow rate of water in channel) on the Sediment Collection Log Sheet. Enter the sample information onto the Chain-of-Custody Form in accordance with SOP-03.

4.5 Using an indelible marker, write the sample identification on a survey stake, and drive the stake into the ground at the sample location. Tack a piece of brightly colored flagging to the stake. In addition, tie a piece of flagging to an overhead tree branch or other eye-level object to improve the ability to relocate the sampling site in the future.

5.0 ATTACHMENTS

1. Soil and Sediment Sample Log Sheet

ATTACHMENT 1

SOIL AND SEDIMENT SAMPLE LOG SHEET

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Page___ of ___

Project Site Name: _____
Project No.: _____

[] Surface Soil
[] Subsurface Soil
[] Sediment
[] Other: _____
[] QA Sample Type: _____

Sample ID No.: _____
Sample Location: _____
Sampled By: _____
C.O.C. No.: _____

Type of Sample:
[] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

Date:	Depth Interval	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Time:			
Method:			
Monitor Reading (ppm):			

COMPOSITE SAMPLE DATA:

Date:	Time	Depth Interval	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other

OBSERVATIONS / NOTES:

MAP:

Circle if Applicable:

MS/MSD	Duplicate ID No.:

Signature(s):

STANDARD OPERATING PROCEDURE
SOP-09

MANAGEMENT OF INVESTIGATION-DERIVED WASTE

1.0 PURPOSE

This Standard Operating Procedure (SOP) describes how investigation-derived waste (IDW) will be collected, segregated, classified, and managed during the field investigations at the NSF Indian Head - Stump Neck Annex facility. The following types of IDW will be generated during this investigation:

- Decontamination solutions
- Personal protective equipment and clothing (PPE)
- Miscellaneous trash and incidental items

2.0 REQUIRED FIELD FORMS AND EQUIPMENT

Health and safety equipment (with PPE)
Decontamination equipment
Field logbook
Writing utensil (preferably black pen with indelible ink)
Plastic sheeting and/or tarps
55-gallon drums with sealable lids
IDW labels for drums
Plastic garbage bags

3.0 PROCEDURES

Management of IDW includes the collection, segregation, temporary storage, classification, final disposal, and documentation of the waste-handling activities if necessary.

3.1 Liquid Wastes

Liquid wastes that will be generated during the site activities include decontamination solutions from sampling equipment. These wastes will be collected and containerized in a central location at Indian Head Stump Neck Facility for proper disposal.

3.2 Solid Wastes

Solid wastes that may be generated during the site activities include collection of bullets and lead shot from surface soil samples. This waste will be containerized and handed over to the base point of contact at the conclusion of field activities.

3.3 PPE and Incidental Trash

All PPE wastes and incidental trash materials (e.g., wrapping or packing materials from supply cartons, waste paper) will be decontaminated (if contaminated), double bagged, securely tied shut, and placed in a designated waste receptacle at Naval Support Indian Head Stump Neck Annex.

STANDARD OPERATING PROCEDURE
SOP-10

BOREHOLE AND SOIL SAMPLE LOGGING

1.0 PURPOSE

This Standard Operating Procedure (SOP) describes the standard procedures and technical guidance on the logging of soil cores.

2.0 FIELD FORMS AND EQUIPMENT

Knife
Ruler (marked in tenths and hundredths of feet)
Boring Log: An example of this form is attached.
Writing utensil (preferably black pen with indelible ink)

3.0 RESPONSIBILITIES

A field geologist or engineer is responsible for supervising all boring activities and assuring that each borehole is properly and completely logged.

4.0 PROCEDURES FOR BOREHOLE AND SAMPLE LOGGING

To maintain a consistent classification of soil, it is imperative that the field geologist understands and accurately uses the field classification system described in this SOP. This identification is based on visual examination and manual tests.

4.1 <u>USCS Classification</u>

Soils are to be classified according to the Unified Soil Classification System (USCS). This method of classification is detailed in Figure 1 (attached to this SOP).

This method of classification identifies soil types on the basis of grain size and cohesiveness.

Fine-grained soils, or fines, are smaller than the No. 200 sieve and are of two types: silt (M) and clay (C). Some classification systems define size ranges for these soil particles, but for field classification purposes, they are identified by their respective behaviors. Organic material (O) is a common component of soil but has no distinguishable size range; it is recognized by its composition. The careful study of the USCS will aid in developing the competence and consistency necessary for the classification of soils.

Coarse-grained soils will be divided into categories: rock fragments, sand, or gravel. The terms "sand" and "gravel" not only refer to the size of the soil particles but also to their depositional history. To insure accuracy in description, the term "rock fragments" will be used to indicate angular granular materials resulting from the breakup of rock. The sharp edges that are typically observed indicate little or no transport from their source area; and therefore, the term provides additional information in reconstructing the depositional environment of the soils encountered. When the term "rock fragments" is used, it will be followed by a size designation such as "(1/4 inchΦ-1/2 inchΦ)" or "coarse-sand size" either immediately after the entry or in the remarks column. The USCS classification would not be affected by this variation in terms.

4.2 Color

Soil colors will be described utilizing a single color descriptor preceded, when necessary, by a modifier to denote variations in shade or color mixtures. A soil could therefore be referred to as "gray" or "light gray" or "blue-gray." Because color can be utilized in correlating units between sampling locations, it is important for color descriptions to be consistent from one boring to another.

Colors must be described while the sample is still moist. Soil samples will be broken or split vertically to describe colors. Samplers tend to smear the sample surface, creating color variations between the sample interior and exterior.

The term "mottled" will be used to indicate soils irregularly marked with spots of different colors. Mottling in soils usually indicates poor aeration and lack of good drainage.

4.3 Relative Density and Consistency

To classify the relative density and/or consistency of a soil, the geologist is to first identify the soil type. Granular soils contain predominantly sands and gravels. They are non-cohesive (particles do not adhere well when compressed). Finer-grained soils (silts and clays) are cohesive (particles will adhere together when compressed).

Granular soils are given the USCS classifications GW, GP, GM, SW, SP, SM, GC, or SC (see Figure 1).

The consistency of cohesive soils is determined by performing field tests and identifying the consistency as shown in the following table.

CONSISTENCY FOR COHESIVE SOILS

Consistency	Standard Penetration Resistance (Blows per Foot)	Unconfined Compressive Strength (Tons/Sq. Foot by pocket penetration)	Field Identification
Very soft	0 to 2	Less than 0.25	Easily penetrated several inches by fist.
Soft	2 to 4	0.25 to 0.50	Easily penetrated several inches by thumb.
Medium stiff	4 to 8	0.50 to 1.0	Can be penetrated several inches by thumb with moderate effort.
Stiff	8 to 15	1.0 to 2.0	Readily indented by thumb but penetrated only with great effort.
Very stiff	15 to 30	2.0 to 4.0	Readily indented by thumbnail.
Hard	Over 30	More than 4.0	Indented with difficulty by thumbnail.

Cohesive soils are given the USCS classifications ML, MH, CL, CH, OL, or OH (see Figure 1).

The consistency of cohesive soils is determined by hand by determining the resistance to penetration by the thumb. The thumb determination methods are conducted on a selected sample of the soil, preferably the lowest 0.5 foot of the sample. The sample will be broken in half and the thumb pushed into the end of the sample to determine the consistency. Do not determine consistency by attempting to penetrate a rock fragment. If the sample is decomposed rock, it is classified as a soft decomposed rock rather than a hard soil. One of the other methods will be used in conjunction with it. The designations used to describe the consistency of cohesive soils are shown in the above-listed table.

4.4 Weight Percentages

In nature, soils are consist of particles of varying size and shape and are combinations of the various grain types. The following terms are useful in the description of soil:

Terms of Identifying Proportion of the Component	Defining Range of Percentages by Weight
Trace	0 - 10 percent
Some	11 - 30 percent
Adjective form of the soil type (e.g., sandy)	31 - 50 percent

Examples:

- Silty fine sand: 50 to 69 percent fine sand, 31 to 50 percent silt.
- Medium to coarse sand, some silt: 70 to 80 percent medium to coarse sand, 11 to 30 percent silt.
- Fine sandy silt, trace clay: 50 to 68 percent silt, 31 to 49 percent fine sand, 1 to 10 percent clay.
- Clayey silt, some coarse sand: 70 to 89 percent clayey silt, 11 to 30 percent coarse sand.

4.5 Moisture

Moisture content is estimated in the field according to four categories: dry, moist, wet, and saturated. In dry soil, there appears to be little or no water. Saturated samples obviously have all the water they can hold. Moist and wet classifications are somewhat subjective and often are determined by the individual's judgment. A suggested parameter for this would be calling a soil wet if rolling it in the gloved hand or on a porous surface liberates water (i.e., dirties or muddies the surface). Whatever method is adopted for describing moisture, it is important that the method used by an individual remains consistent throughout an entire field activity.

4.6 Classification of Soil Grain Size for Chemical Analysis

To determine the gross grain size classification (e.g., clay, silt, and sand) from the USCS classification described above, the following table will be used.

Gross Soil Grain Size Classification	USCS Abbreviation	Description
Clay	CL	inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays,.
	CH	inorganic clays of high plasticity, fat clays.
	OH	organic clays of medium to high plasticity, organic silts.
Silt	ML	inorganic silts and very fine sands, rock four, silty or clayey fine sands with slight plasticity.
	OL	organic silts and organic silty clays of low plasticity..
	MH	inorganic silts, micaceous or diatomaceous fine sand or silty soils.

Gross Soil Grain Size Classification	USCS Abbreviation	Description
Sand	SW	well graded sands, gravelly sands, little or no fines.
	SP	poorly graded sands, gravelly sands, little or no fines.
	SM	silty sands, sand-silt mixtures.
	SC	clayey sands, sand-clay mixtures.

4.7 Summary of Soil Classification

In summary, soils will be classified in a similar manner by each geologist/engineer at a project site. The hierarchy of classification is as follows:

- Density and/or consistency
- Color
- Plasticity (optional)
- Soil types
- Moisture content
- Other distinguishing features
- Grain size
- Depositional environment

4.0 ATTACHMENTS

1. Figure 1 - Unified Soil Classification System
2. Boring Log

ATTACHMENT 1

FIGURE 1 - UNIFIED SOIL CLASSIFICATION SYSTEM

Unified Soil Classification System

Coarse Grained Soils (more than half of soil > No. 200 sieve)	Gravels (More than half of coarse fraction > no. 4 sieve size)	GW	Well graded gravels or gravel-sand mixtures, little or no fines
		GP	Poorly graded gravels or gravel-sand mixtures, little or no fines
		GM	Sandy gravels, gravel-sand-silt mixtures
		GC	Clayey gravels, gravel-sand-silt mixtures
	Sands (More than half of coarse fraction < no. 4 sieve size)	SW	Well graded sands or gravelly sands, little or no fines
		SP	Poorly graded sands or gravelly sands, little or no fines
		SM	Silty sands, sand-silt mixtures
		SC	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity
Fine Grained Soils (more than half of soil < No. 200 sieve)	Silts and Clays LL = < 50	ML	Inorganic silts and very fine sands, rock flour, silty fine sands or clayey silts with slight plasticity
		CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, lean clays
		OL	Organic silts and organic silty clays of low plasticity
	Silts and Clays LL = > 50	MH	Inorganic silts, micaceous or diatomaceous fine sand or silty soils, elastic silts
		CH	Inorganic silts of high plasticity, fat clays
		OH	Organic clays of high plasticity, organic silty clays, organic silts
Highly Organic Soils		Pt	Peat and other highly organic soils

Grain Size Chart

Classification	Range of Grain Sizes	
	U.S. Standard Sieve Size	Grain Size In Millimeters
Boulders	Above 12"	Above 305
Cobbles	12" to 3"	305 to 76.2
Gravel	3" to No. 4	76.2 to 7.76
coarse	3" to 3/4"	76.2 to 4.76
fine	3/4"to No.4	19.1 to 4.76
Sand	No. 4 to No. 200	4.76 to 0.074
coarse	No.4 to No. 10	4.76 to 2.00
medium	No. 10 to No. 40	2.00 to 0.420
fine	No. 40 to No. 200	0.420 to 0.074
Silt and Clay	Below No. 200	Below 0.074

Relative Density (SPT)

SANDS AND GRAVELS	BLOWS/FOOT
VERY LOOSE	0 – 4
LOOSE	4 – 10
MEDIUM DENSE	10 – 30
DENSE	32 – 50
VERY DENSE	OVER 50

Consistency (SPT)

SILTS AND CLAYS	BLOWS/FOOT
VERY SOFT	0 – 2
SOFT	2 – 4
MEDIUM STIFF	4 – 8
STIFF	8 – 16
VERY STIFF	16 – 22
HARD	OVER 32

ATTACHMENT 2

BORING LOG

Tetra Tech NUS, Inc.

BORING LOG

Page ___ of ___

PROJECT NAME: _____ BORING No.: _____
PROJECT NUMBER: _____ DATE: _____
DRILLING COMPANY: _____ GEOLOGIST: _____
DRILLING RIG: _____ DRILLER: _____

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**

* When rock coring, enter rock brokeness.
** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Drilling Area Background (ppm): ____

Remarks: _____

Converted to Well: Yes _____ No _____ Well I.D. #: _____

STANDARD OPERATING PROCEDURE
SOP-11

SAMPLE PRESERVATION, PACKAGING, AND SHIPPING

1.0 PURPOSE

This Standard Operating Procedure (SOP) describes the procedures for sample preservation, packaging, and shipping to be used in handling soil, sediment, and aqueous samples.

2.0 REQUIRED FIELD FORMS AND EQUIPMENT

Shipping labels
Custody seals
Chain-of-custody (COC) form(s)
Sample containers with preservatives: All sample containers for analysis by fixed-base laboratories will be supplied, with preservatives added (if required) and deemed certified clean by the laboratory.
Sample shipping containers (coolers): All sample shipping containers are supplied by the laboratory.
Packaging material: Bubble wrap, sealable polyethylene bags, strapping tape, etc.

3.0 PROCEDURES FOR SAMPLE PRESERVATION, PACKAGING, AND SHIPPING

3.1 The laboratory provides sample containers with preservative already included (as required) for the analytical parameter for which the sample is to be analyzed. All samples will be held, stored, and shipped at 4°C. This will be accomplished through refrigeration (used to hold samples prior to shipment) and/or ice.

3.2 The sampler shall maintain custody of the samples until the samples are relinquished to another custodian or to the common carrier.

3.3 Check that each sample container is properly labeled, the container lid is securely fastened, and the container is sealed in a polyethylene bag.

3.4 If the container is glass, place the sample container into a bubble-out shipping bag and seal the bag using the self-sealing, pressure sensitive tape supplied with the bag.

3.5 Inspect the insulated shipping cooler. Check for any cracks, holes, broken handles, etc. If the cooler has a drain plug, make certain it is sealed shut, both inside and outside of the cooler. If the cooler is questionable for shipping, the cooler must be discarded.

3.6 Line the cooler with large plastic bag, and line the bottom of the cooler with a layer of bubble wrap. Place the sample containers into the shipping cooler in an upright position (containers will be upright, with the exception of any 40-ml vials). Continue filling the cooler with ice until the cooler is nearly full and the movement of the sample containers is limited.

3.7 Wrap the large plastic bag closed and secure with tape.

3.8 Place the original (top) signed copy of the COC form inside a sealable polyethylene bag. Tape the bag to the inside of the lid of the shipping cooler.

3.9 Close the cooler and seal the cooler with approximately four wraps of strapping tape at each end of the cooler. Prior to wrapping the last wrap of strapping tape, apply a signed and dated custody seal to each side of the cooler (one per side). Cover the custody seal with the last wrap of tape. This will provide a tamper evident custody seal system for the sample shipment.

3.10 Affix shipping labels to each of the coolers, ensuring all of the shipping information is filled in properly. Overnight (e.g., FedEx Priority Overnight) courier services will be used for all sample shipments.

3.11 All samples will be shipped to the laboratory no more than 72 hours after collection. Under no circumstances should sample hold times be exceeded.

STANDARD OPERATING PROCEDURE
SOP-12

CALIBRATION AND CARE OF WATER QUALITY METER

1.0 PURPOSE

This Standard Operating Procedure (SOP) establishes the procedures for the calibration and maintenance of field instruments used to measure water quality and for the proper documentation of calibration and maintenance. The multi-parameter water quality meter will be used to measure pH, temperature, oxidation-reduction potential (ORP), specific conductance (SC), and dissolved oxygen (DO). A LaMotte Model 2020 turbidity meter will be used to measure turbidity in water. The water meter will have a multiprobe sensor that can be used in conjunction with a flow-through cell attached to a pump discharge tube to measure water-quality parameters in groundwater or direct measurement in a surface water body such as a stream, pond, or drainage ditch.

2.0 FIELD FORMS AND EQUIPMENT LIST

The following logbooks, forms, equipment, and supplies are required:

Site logbook
Writing utensil (preferably black pen with indelible ink)
Equipment calibration log sheet
Multi-parameter Water Quality Meter
Equipment manual
Calibration kit
Deionized water, paper towels, spray bottle, etc.
Disposable medical-grade gloves (e.g., latex, nitrile)

3.0 PROCEDURES

This section describes the general calibration procedure for the multi-parameter water quality meter. The meter will be supplied with an instruction manual. The manual will be on site and will be used as the calibration guidance document for the meter's calibration. This procedure will list requirements for frequency of calibration and checks to be performed on the meter.

The multi-parameter water-quality meter may be used to measure open water bodies (streams, ponds, springs, etc.) with the probe guard installed. The parameters to be measured by the meter for this field effort are as follows:

- DO
- SC
- Temperature
- pH
- ORP

3.1 Documentation

The Equipment Calibration Log is used to document calibration of measuring equipment used in the field. The Equipment Calibration Log documents that the manufacturer's instructions were followed for calibration of the equipment, including the frequency of calibration, type of standards used, and checks performed on calibration during the course of using the equipment. An Equipment Calibration Log must be maintained for each measuring device that requires calibration. Entries must be made for each day the equipment is used. A blank Equipment Calibration Log form is attached at the end of this SOP.

3.2 Calibration

All the parameters listed in Section 3.0 must be calibrated prior to the start of each field effort. After this initial calibration, the meter will be checked each day that it is used. If the check shows any out-of-specification readings, the specific probe will be recalibrated. Meter specifications can be found in the equipment manual. Calibration and calibration checks will be documented in the field logbook and on the Equipment Calibration Log. The name, lot number, and expiration date for all calibration buffers and standards used will be recorded on the Equipment Calibration Log. The meter's model, serial number, and name of rental company will also be recorded on the equipment calibration form.

3.3 Tips for Good Calibration

- The DO calibration is a water-saturated air calibration. Make certain to loosen the calibration cup seal to allow pressure to equilibrate before calibrating.

- Make certain that sensors are completely submersed in solution and readings are stable when calibration values are entered.

- Use a small amount of calibration solution (previously used solution may be used, then discarded for this purpose) to pre-rinse the sonde.

- Fill a bucket with ambient temperature water to rinse the sonde between calibration solutions.

- Make sure to rinse and dry the probe between calibration solutions. This will reduce carry-over contamination and increase the accuracy of the calibration.

4.0 MAINTENANCE

The water quality meter will be rented for the duration of each brief field effort. Therefore, little field maintenance will be required. For any maintenance other than the routine cleaning, calibrating, or battery charging, the instrument should be returned to the vendor and a replacement sent immediately to the job site.

4.1 Meter Storage

For this field effort, the meter storage will be short term, [i.e. over night or between work shifts (2-day break)]. During these breaks, the meter will be charged. One-half inch of tap or distilled water will be placed in the meter calibration cup and the cup threaded onto the sonde. The key for short-term storage of probes is to use a minimal amount of water so the calibration cup will remain at 100 percent humidity. The water level must be low enough so that none of the probes are actually immersed. Proper storage of the sonde between usage will extend its life and will also ensure that the unit is ready for use as quickly as possible for the next application.

Multi-parameter short term storage key points:

- Use enough water to provide humidity but not enough to cover the probe surfaces.
- Make sure the storage vessel is sealed to minimize evaporation.
- Check periodically to make certain that water is still present.

4.2 Probe Cleaning

- Rinse the probe thoroughly with potable water.
- Wash the probe in a mild solution of Liquinox and water and wipe with paper towels and/or cotton swabs.
- Rinse and soak the probe in deionized water.
- If stronger cleaning is required, consult the equipment manual.

Note: Reagents that are used to calibrate and check the water quality meter may be hazardous. Review the health and safety plan, appropriate Appendix of the equipment manual, and Material Safety Data Sheets (MSDSs), all of which are on file in the field trailer.

5.0 ATTACHMENTS

1. Equipment Calibration Log

ATTACHMENT 1
EQUIPMENT CALIBRATION LOG

Tetra Tech NUS, Inc.

EQUIPMENT CALIBRATION LOG

PROJECT NAME : _____ INSTRUMENT NAME/MODEL: _____

SITE NAME: _____ MANUFACTURER: _____

PROJECT No.: _____ SERIAL NUMBER: _____

Date of Calibration	Instrument I.D. Number	Person Performing Calibration	Instrument Settings		Instrument Readings		Calibration Standard (Lot No.)	Remarks and Comments
			Pre-calibration	Post-calibration	Pre-calibration	Post-calibration		

STANDARD OPERATING PROCEDURE
SOP-13

MEASUREMENT OF WATER LEVELS IN MONITORING WELLS

1.0 PURPOSE

This Standard Operating Procedure (SOP) establishes procedures for determining water levels in monitoring wells.

2.0 REQUIRED FIELD FORMS AND EQUIPMENT

The following equipment and field forms are required for determining water levels in monitoring wells.

Ground Water Level Measurement Form: A copy of the Ground Water Level Measurement Form is attached.
Bound field logbook
Well key
Writing utensil
Electronic water-level indicator: The water-level indicator must have a cable of sufficient length to reach the water surface and be capable of measurements of 0.01 foot.
Decontamination supplies: SOP-04 describes decontamination procedures including decontamination supplies.

3.0 WATER-LEVEL MEASUREMENT PROCEDURES

3.1 Check the operation of the electronic water-level indicator or interface meter.

3.2 Record the well identification (ID), date, and time (using military time) on the Ground Water-Level Measurement Form.

3.3 Unlock the well and remove the well cap.

3.4 Place the well cap on a clean piece of plastic.

3.5 Ensure that the water-level indicator probe has been decontaminated before use, in accordance with the procedures outlined in SOP-04.

3.6 Slowly lower the probe into the well riser pipe until an audible and/or visible signal is produced, indicating contact with the water surface.

3.7 Read the ground water-level measurement from the top of the inner casing at the surveyed reference point to the nearest 0.01 foot.

3.10 Record the water-level measurement on the Ground Water Level Measurement Form.

3.11 Wind the meter cable measuring tape back onto the spool.

3.12 Replace the well cap and lock.

3.13 Decontaminate the meter's probe and cable following the procedures outlined in SOP-04.

3.13 Containerize any decontamination fluids and PPE in accordance with the procedures described in SOP-09.

4.0 ATTACHMENTS

1. Ground Water Level Measurement Sheet

ATTACHMENT 1

GROUND WATER LEVEL MEASUREMENT SHEET

Tetra Tech NUS, Inc.

GROUNDWATER LEVEL MEASUREMENT SHEET

Project Name: _____ **Project No.:** _____
Location: _____ **Personnel:** _____
Weather Conditions: _____ **Measuring Device:** _____
Tidally Influenced: Yes ___ No ___ **Remarks:** _____

Well or Piezometer Number	Date	Time	Elevation of Reference Point (feet)*	Total Well Depth From TOC (feet)*	Water Level Indicator Reading (feet)*	Groundwater Elevation (feet)*	Comments

* All measurements to the nearest 0.01 foot

Page ____ of ____

STANDARD OPERATING PROCEDURE
SOP-14

INSPECTION OF EXISTING MONITORING WELLS

1.0 PURPOSE

This Standard Operating Procedure (SOP) establishes procedures for the inspection and repair of existing monitoring wells at the NSF Indian Head – Stump Neck Annex facility.

2.0 REQUIRED FIELD FORMS AND EQUIPMENT

The following equipment and field forms are required for inspection of existing monitoring wells.

Monitoring well inspection form: A copy of the monitoring well inspection form is attached.
Writing utensil with indelible ink
Bound field logbook
Well keys
Disposable medical-grade gloves (e.g., latex, nitrile)
Electronic water-level indicator
Steel rod (about 1 inch in diameter with eye bolt at one end)
100 feet of nylon rope
Internal pipe cutter
File, v notch

3.0 INSPECTION PROCEDURES

3.1 Record the well identification information (ID), date, and time on the Monitoring Well Inspection Form.

3.2 Record the condition of the well ID tag. Is the tag in place and legible? If not, note the discrepancies on the Monitoring Well Inspection Form.

3.3 Record the condition of the protective casing, caps, and lock. Has the casing, cap, and/or lock been tampered with or damaged? Has the well been damaged in any way or does it show signs of deterioration?

3.4 Record the condition of the concrete or gravel pads, if a pad is present. Check the condition of the pad (or the area around the well if no pad exists) and note any abnormalities. Are concrete pads cracking or heaving? If a gravel pad is present, is there any erosion or plant growth in the pad area?

3.5 Record the condition of the cement seal surrounding the protective casing. Has the seal cracked or pulled away from the protective casing? Record any visible signs of deterioration in the area of the seal.

3.6 Record the presence of depressions and/or standing water around the casing or pad.

3.7 Unlock the well cap and open the protective cover, if one exists.

3.8 Inspect and record the condition of the polyvinyl chloride (PVC) riser pipe and the surveyed reference point. The surveyed reference point is a V-notch on the top of the PVC riser pipe.

3.9 Measure the height of the protective casing and riser pipe above the ground surface. Record these readings on the inspection form to the nearest 0.01foot.

3.10 Check the existing well log to verify the total original depth of the monitoring well being inspected.

3.11 Lower the electronic water-level indicator probe down the well casing. If an obstruction is encountered, record the depth of the obstruction and whether the obstruction is partial or complete.

3.12 If no obstruction is encountered, continue lowering the water-level indicator down the well casing until ground water is encountered. Measure the depth to water to the nearest 0.01 foot (see SOP-13) and record the depth on the Inspection Log.

3.13 Continue lowering the indicator probe down the casing until a solid bottom is reached or an obstruction is encountered. Record the depth to the bottom of the well (from top of casing) on the Inspection Log.

3.14 If an obstruction is encountered in the casing before the well bottom is reached, record the depth of obstruction on the Inspection Log and whether the obstruction is partial or complete.

3.15 Remove the water-level indicator from the well.

3.16 If an obstruction was encountered during steps 3.11 or 3.13, lower a heavy steel rod slowly down the well casing until the obstruction is encountered. Attempt to loosen the obstruction by raising and dropping the steel rod, letting it hit the obstruction with gradually increasing force. Record whether the obstruction could be loosened.

3.17 If step 3.16 is performed, remove the steel rod from the well and measure the depth to the obstruction. If the obstruction has been knocked loose and settles to the bottom, then the well shall be redeveloped (see SOP-15) prior to ground water sampling.

3.18 Close the well cap and lock, if lock is present.

3.19 Decontaminate the water-level indicator and steel rod, if used, per SOP-04.

3.20 Make recommendations on the Inspection Log, if necessary, for repair of the monitoring well. Replace lock, if needed, as soon as possible.

3.21 Perform repair of well as soon as possible.

4.0 Field Repairs to Monitoring Wells

Field repairs to monitoring wells, for the most part, will be limited to the repair of the PVC riser (inter case). If a monitoring well is damaged beyond the repair capabilities of the field crew and the monitoring well integrity is believed to be compromised then the TtNUS project manager and NSF Indian Head Environmental personnel will be notified regarding the condition of the well. A decision will be made to either repair or replace the well using a drilling contractor.

5.0 ATTACHMENTS

1. Monitoring Well Inspection Sheet

ATTACHMENT 1

MONITORING WELL INSPECTION SHEET

MONITORING WELL INSPECTION SHEET

Well ID: _____

Time: _____ **Date:** _____ **Inspector's Name:**

Inspection Item	Types of Problems	Status		Observation
		S	U	
Well Tag	Is it in-place, legible			
Well security	Condition protective case, cap, lock			
Well pad	Concrete or gravel & condition			
Well seal	Condition of…			
Area Immediately around well pad	Record any evidence of/or standing water in area of well			
Dedicated sampling equipment	Condition of…			
PVC Riser	Condition of riser & survey reference point			

Comments:

Signature(s)_____

Note: S= Satisfactory, U= Unsatisfactory
Check one, if unsatisfactory explain

NSB-NLON
Field Form
Revision: 1
January: 1999

STANDARD OPERATING PROCEDURE
SOP-15

MONITORING WELL DEVELOPMENT

1.0 PURPOSE

This procedure provides general guidance and information pertaining to proper development of new and existing monitoring wells. The methods described herein are specific for monitoring wells located at the NSF Indian Head and the NSF Indian Head – Stump Neck Annex facility.

2.0 RESPONSIBILITIES

The drilling contractor or TtNUS personnel shall provide adequate and operable equipment, sufficient quantities of materials, and an experienced and efficient labor force capable of developing monitoring wells. The field personnel must have all the health and safety training required to perform the work, as specified in the health and safety plan (HASP).

3.0 REQUIRED EQUIPMENT/ITEMS

The following list includes equipment and items required for monitoring well development:

Health and safety equipment as required by the HASP and the site safety officer.

Well development equipment with associated materials (supplied by the driller or TtNUS).

Hydrogeologic equipment (water-level indicator, electronic calculator, clipboard, paint and ink marker for marking existing monitoring wells, well development forms, and a field notebook).

4.0 WELL DEVELOPMENT METHODS

The development of new monitoring wells will not occur until at least 48 hours after the well has been installed and grouted. This time is required so that the grout in the annulus can set and harden. The purpose of well development is to stabilize and increase the permeability of the sand pack and the well screen and to restore the permeability of the formation that may have been reduced by drilling operations.

Existing wells may need to be developed pending well inspection (see SOP-14). Wells are typically developed until all fine material and drilling water, if any, is removed from the well. Wells will be developed by bailing and surging, and/or by pumping and surging, as determined by the TtNUS field geologist. The subcontractor may provide the surge block and pump used during development. The wells will be developed until the discharge water is visibly clear or as determined by the TtNUS field geologist. The TtNUS field geologist will obtain field parameters, such as pH, temperature, conductivity, and turbidity during development. All development water will be containerized in 55-gallon drums in accordance with the master plans.

A surge block or a stainless steel bailer that is approximately the same diameter as the well casing may be used to agitate the water, causing it to move in and out of the screens. This movement of water pulls fine materials into the well, where they may be removed by any of several methods, and prevents bridging of sand particles in the gravel pack.

Development should proceed until the following criteria are met:

- The well water is clear to the unaided eye.
- When field parameters become stable +/- 10%.

or

- A minimum removal of five times the standing water volume in the well (to include the well screen and casing plus saturated borehole annulus, assuming 30% annular porosity).

If for any reason the above criteria cannot be met, the site geologist should document the event in writing and consult with the Task Order Manager regarding an alternate plan of action.

Well development must be completed at least 24 hours before well sampling. The intent of this hiatus is to provide time for the groundwater surrounding the newly developed well to sufficiently equilibrate to static conditions.

5.0 TEMPORARY WELL DEVELOPMENT

Development of the temporary wells will be accomplished using a peristaltic pump and PE tubing.

5.1 Insert the intake end of a length of PE tubing to the bottom of the screen point and attach a length of silicon tubing (approximately 1 foot) to the discharge end of the PE tubing. The silicon tubing will be threaded around the rotor of the pump and out of the pump.

5.2 The PE tubing will be lifted and lowered slightly while the pump is operating. The maximum pump rate will be approximately 2 liters per minute during development. However, the yield of the formation will dictate the pumping rate.

5.3 Measurement of pH, specific conductance, turbidity, dissolved oxygen, ORP, and temperature shall be recorded every 5 to 10 minutes during the development process using a water quality meter and flow-through cell.

5.4 The temporary monitoring well will be pumped until discharge water is visibly clear, the turbidity readings do not improve over time, or the well screen goes dry.

5.5 Sampling will commence as per SOP-18

6.0 ATTACHMENTS

1. Monitoring Well Development Record

ATTACHMENT 1
MONITORING WELL DEVELOPMENT RECORD

Tetra Tech NUS, Inc.

MONITORING WELL DEVELOPMENT RECORD

Page ___ of _____

Well: _____ Depth to Bottom (ft.): _____ Responsible Personnel: _____
Site: _____ Static Water Level Before (ft.): _____ Drilling Company: _____
Date Installed: _____ Static Water Level After (ft.): _____ Project Name: _____
Date Developed: _____ Screen Length (ft.): _____ Project Number: _____
Dev. Method: _____ One Well Volume (gal/L): _____ PID Readings: Bore Hole_____ppm
Pump Type: _____ Casing ID (in.): _____ PID Readings: Breathing Zone_____ppm

Time	Cumulative Water Volume (Gal.)	Flow Rate (mL/min.)	Water Level Readings (Ft. below TOC)	Temperature (Degrees C)	pH	Specific Conductance (Units _____)	Turbidity (NTU)	Remarks (odor, color, etc.)

STANDARD OPERATING PROCEDURE
SOP-16

TEMPORARY MONITORING WELL INSTALLATION

1.0 PURPOSE

This procedure provides general guidance and information pertaining to proper design and installation of temporary groundwater monitoring wells. The methods described herein are specific for temporary monitoring well construction at NSF Indian Head and the NSF Indian Head – Stump Neck Annex facility.

2.0 RESPONSIBILITIES

Driller - The driller provides adequate and operable equipment, sufficient quantities of materials, and an experienced and efficient labor force capable of performing all phases of proper monitoring well installation and construction. The drilling contractor personnel must have all the health and safety training required to perform the work, as specified in the health and safety plan. All well drilling activities shall be performed under the direct supervision of a driller licensed in the State of Maryland. The driller is also responsible for obtaining, in advance, any required permits for drilling and monitoring well installation and construction for the State of Maryland.

Field Geologist - The field geologist supervises and documents well installation and construction performed by the driller and ensures that the screen interval for each monitoring well is properly placed to provide representative groundwater data from the monitored interval. Geotechnical engineers, field technicians, or other suitable trained personnel may also serve in this capacity.

Site Safety Officer – The site safety officer is responsible for clearing the drill site for underground and overhead utilities or other potentially hazardous obstructions.

3.0 REQUIRED EQUIPMENT/ITEMS

The following list includes equipment and items required for monitoring well installation:

Health and safety equipment as required by the HASP and the site safety officer.

Well drilling and installation equipment with associated materials (typically supplied by the driller). Wells can be installed using either hollow-stem auger (HSA) or Direct push techniques (DPT) drilling methods. The preferred method is DPT.

Hydrogeologic equipment (weighted engineer's tape, water-level indicator, retractable engineer's rule, electronic calculator, clipboard, mirror and flashlight for observing downhole activities, paint and ink marker for marking monitoring wells, sample jars, well installation forms, boring logs, soil sample log forms, chain-of-custody records, sample coolers with ice, and a field notebook).

4.0 WELL DESIGN, CONSTRUCTION, AND ABANDONMENT

Wells can be installed using either hollow-stem auger (HSA) or direct push techniques (DPT) drilling methods. The preferred method is DPT. The following SOP provides procedures for both methods.

Temporary wells shall be constructed using nominal 1-inch ID, PVC riser and nominal 1-inch ID, PVC factory slotted screen (.010 slot). Clean silica sand of U.S. Standard Sieve Size No. 20 to 40 will be used for the sand pack, 100 percent certified pure sodium bentonite will be used for the seal above the sand pack and hydrated. The depths of backfill materials will be constantly monitored, if possible, during well installation using a weighted stainless-steel or fiberglass tape measure. The well boring will be abandoned using cement bentonite grout.

If the water table is encountered deeper that 25 feet below the ground surface, then the temporary well(s) shall be constructed with 2-inch PVC riser and factory slotted screen material and installed using HSA drilling methods.

DIRECT PUSH TECHNIQUES

The following procedures will be used for DPT installation. The temporary well will be installed by driving a nominal 2-inch ID drill casing (with an expendable tip) to the desired depth. After the casing has been advanced to approximately 8 to 9 feet below the water table or to the first water bearing zone, a 10-foot-long screen attached to the riser pipe will be lowered to the bottom through the casing. The casing will then be withdrawn from the ground, exposing the PVC screen to the formation material. The saturated formation material may collapse around the screen, and the remaining annular space around the screen will be filled with silica sand to at least 1 to 2 feet above the screen. A bentonite seal will then be installed to the ground surface completing the temporary well construction.

HOLLOW-STEM AUGER DRILLING

The following procedures shall be used for hollow-stem auger drilling for well installation. Nominal 3½ or 4½-inch ID hollow-stem augers will be used to install the well borings. All hollow-stem auger drilling will include continuous split-spoon sampling [according to American Society for Testing Materials] to the bottom of the boring as per SOP-10. Once the boring reaches the desired depth, the screen and the riser pipe are in place, the annulus of the boring will be backfilled with clean silica sand filter pack from the bottom of the boring to 2 to 3 feet above the top of the well screen. As the filter pack is being installed, the level of sand will be several inches up inside of the augers to ensure that an adequate filter pack is installed around the well screen. A bentonite seal will be installed above the filter pack to the ground surface or approximately 5 linear feet which ever is the smaller length. The depths of the backfill materials will be constantly monitored during the monitoring well installation with a weighted stainless steel or plastic tape. The exact depth and thickness of backfill materials will be determined in the field by the TtNUS representative.

The Subcontractor shall be responsible for measuring backfill placement in the wells to the satisfaction of the TtNUS representative. The annular space at the ground surface will be covered with plastic sheeting around the riser if needed to prevent infiltration of surface runoff or rainwater into the annulus. The riser pipe will be capped to prevent rain water from entering into the well and will remain in place until the point is abandoned.

Once the well has been sampled by TtNUS personnel, the Subcontractor shall abandon the well in accordance with State of Maryland regulations COMAR 26.04.04.11. This requires that the PVC screen and riser be removed from the boring and the boring backfilled with cement/bentonite grout from the bottom up using a tremie pipe.

5.0 DOCUMENTATION OF FIELD ACTIVITIES

A critical part of monitoring well installation is recording of significant details and events in the site logbook, on field forms, and in a field logbook. Details of borehole logging are contained in SOP-10.

6.0 ATTACHMENTS

1. Overburden Monitoring Well Sheet

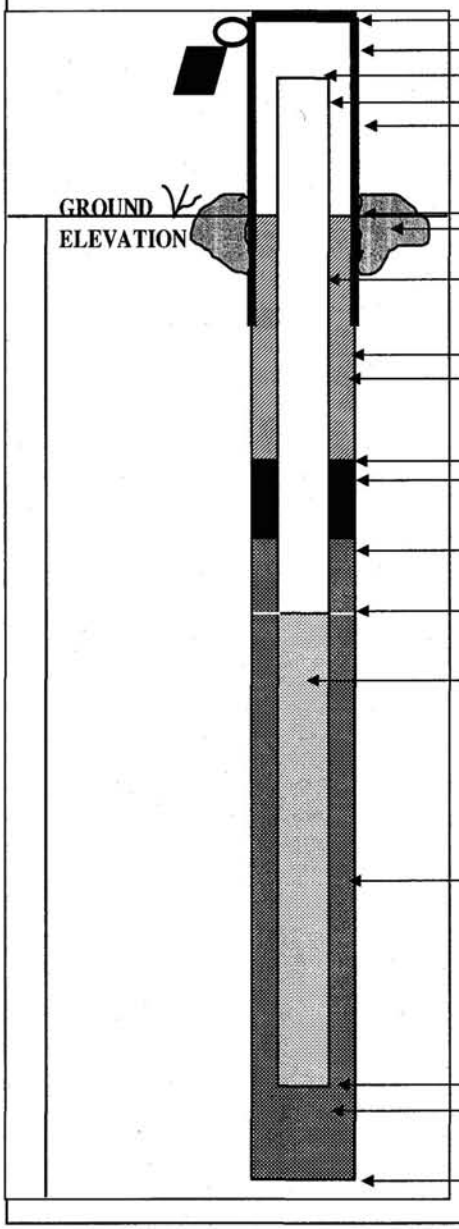
ATTACHMENT 1

OVERBURDEN MONITORING WELL SHEET

BORING NO.: _____

Tetra Tech NUS, Inc. **TEMPORARY OVERBURDEN MONITORING WELL SHEET**

PROJECT:		DRILLING Co.:		BORING No.:	
PROJECT No.:		DRILLER:		DATE COMPLETED:	
SITE:		DRILLING METHOD:		NORTHING:	
GEOLOGIST:		DEV. METHOD:		EASTING:	



ELEVATION OF TOP OF SURFACE CASING: _____
STICK -UP TOP OF SURFACE CASING: _____
ELEVATION OF TOP OF RISER PIPE: _____
RISER STICK-UP ABOVE GROUND SURFACE: _____
I.D. OF SURFACE CASING: _____
TYPE OF SURFACE CASING: _____

GROUND ELEVATION: _____
TYPE OF SURFACE SEAL: _____

RISER PIPE I.D.: _____
TYPE OF RISER PIPE: _____

BOREHOLE DIAMETER: _____
TYPE OF SEAL: _____

ELEVATION / DEPTH OF SEAL: ___ / ___
TYPE OF SEAL: _____

ELEVATION / DEPTH TOP OF FILTER PACK: ___ / ___

ELEVATION / DEPTH TOP OF SCREEN: ___ / ___

TYPE OF SCREEN: _____

SLOT SIZE X LENGTH: _____

I.D. OF SCREEN: _____

TYPE OF FILTER PACK: _____

ELEVATION / DEPTH BOTTOM OF SCREEN: ___ / ___
ELEVATION / DEPTH BOTTOM OF FILTER PACK: ___ / ___
TYPE OF BACKFILL BELOW WELL: _____
ELEVATION / DEPTH OF BOREHOLE: ___ / ___

STANDARD OPERATING PROCEDURE
SOP-17

LOW-FLOW WELL PURGING AND STABILIZATION

1.0 PURPOSE

This Standard Operating Procedure (SOP) establishes the procedure for well purging and stabilization utilizing low-flow techniques.

2.0 REQUIRED FIELD FORMS AND EQUIPMENT

The following field forms and equipment are required for low-flow purging.

Low-Flow Purge Data Sheet: A copy of this form is attached at the end of this SOP.
Ground Water Sample Log Sheet: A copy of this form and instructions for its completion are included in SOP-18.
Bound field logbook
Writing utensil
Well key
Electronic water-level indicator: The water-level indicator must have a cable of sufficient length to reach the water surface and be capable of measurements of 0.01 foot (see SOP-13).
Submersible Bladder Pump: QED Sample Pro or equivalent using twin bonded ¼-inch PE tubing.
Electronic Programmable Controller, MP-10: This controller regulates air flow in a bladder pump.
Cylinder of compressed nitrogen with regulator: Compressed gas serves as the power source for the bladder pump.
Peristaltic Pump: Using siliclastic tubing and ¼-inch PE tubing
Multiple parameter water-quality meter: This unit measures and displays field parameters measured in the field including pH, dissolved oxygen, oxidation-reduction potential (ORP), temperature, and specific conductance (see SOP-12).
Flow-through cell adapter for water-quality meter
LaMotte Turbidity Meter: Used to measure turbidity (see SOP-12).
Purge water containers
Graduated cylinder and stopwatch: Used to calculate flow rate.

Decontamination supplies: SOP-04 describes required decontamination supplies.

Disposable medical-grade gloves (e.g., latex, nitrile)

3.0 PROCEDURES FOR WELL PURGING

3.1 Prior to mobilizing to the site, clean, check for proper operation, and calibrate above equipment in accordance with manufacturer requirements as necessary.

3.2 Follow the steps outlined in SOP-13 to obtain a static water-level measurement of the well to be purged. Record the information on the Groundwater Sample Log Sheet (see SOP-18) and the Low-Flow Purge Data Sheet. Leave the water-level meter suspended in the well casing.

3.3 Calculate saturated screen length well casing volume as follows:

1. Obtain the total depth of the well by measurement.

2. Using the static water level determined in Step 3.2 of this SOP, the total depth of the well and the screen length, calculate the saturated screen length well casing volume using the following formula:

$$\mathbf{V = (0.163)(T)(r^2)}$$

where:

V	=	Static casing volume of well (in gallons).
T	=	Vertical height of water column (linear feet of water) across the screen interval.
0.163	=	A constant conversion factor that compensates for the conversion of the casing radius from inches to feet, the conversion of cubic feet to gallons, and pi.
r	=	Inside radius of the well casing (in inches).

Note: For wells of 1-inch radius (2-inch diameter), V = 0.163 gallons per foot of water column. The minimum purge volume should be two saturated screen lengths.

3.4 Wells shall be purged using either a submersible bladder pump or surface peristaltic pump. For wells with a nominal ID of 1-inch the peristaltic pump will be used to purge and sample the well.

If the depth to water level exceeds the capacity (about 25 ft to water) of the peristaltic pump then a submersible bladder pump will be used to purge and sample the well. Follow steps 3.5 through 3.9 for bladder pump procedures skip to 3.10 for peristaltic pump procedures.

3.5 Connect the pump controller to the well pump air supply (at the well cap) by following the instructions in the pump control manual. The pump controller must be turned off when it is being connected.

3.6 Connect the nitrogen cylinder to the pump controller. The nitrogen cylinder valve must be closed and the regulator line pressure set at zero pounds per square inch (psi) when it is being connected.

3.7 Following the instructions found in the water-quality meter manual, connect the flow-through cell to the pump discharge line (at the well cap).

3.8 Place the discharge tubing from the flow-through cell to direct the purge water discharge into the graduated cylinder or purge water container.

3.9 Following the instructions in the pump controller manual, start pumping water from the well.

3.10 Peristaltic pump will also be used to purge and sample groundwater monitoring wells. Attach well tubing to the input side of the pump via the siliclastic tubing and the out from the pump to the input side of the flow through cell.

3.11 Start with the initial pump rate set at approximately 0.1 liters per minute. Use the graduated cylinder and stopwatch to measure the pumping rate. Adjust pumping rates as necessary to prevent drawdown from exceeding 0.3 foot during purging. If no drawdown is noted, the pump rate may be increased (to a max of 0.5 liters per minute) to expedite the purging and sampling event. The pump rate will be reduced if turbidity is greater than 10 NTUs after all other field parameters have stabilized. Slow recovering wells will be identified and purged at the beginning of the workday. If possible, samples will be collected from these wells within the same 8-hour workday and no later than 24 hours after the start of purging.

The time to sample any given well will vary greatly due to the many variables associated with low flow purging and sampling:

- Stabilization of parameters
- Possible drawdown
- Variable pump rates

Normally, the time from the start of purging to the end of sampling will be between 1 and 4 hours.

3.12 Measure the well water level using the water-level meter every 5 minutes. Record the well water level on the Low-Flow Purge Data Form (attached at the end of this SOP).

3.13 Every 5 to 10 minutes, record on the Low-Flow Purge Data Form the water-quality parameters (pH, specific conductance, temperature, turbidity, oxidation-reduction potential, and dissolved oxygen) measured by the water-quality meter and turbidity meter. If the cell needs to be cleaned during purging operations, continue pumping (allow the pump to discharge into a container) and disconnect the cell. Rinse the cell with distilled water. After cleaning is completed, reconnect the flow-through cell and continue purging. Document the cell cleaning on the Low-Flow Purge Data Form.

3.14 Measure the flow rate using a graduated cylinder. Remeasure the flow rate any time the pump rate is adjusted.

3.15 During purging, check for the presence of bubbles in the flow-through cell. The presence of bubbles is an indication that connections are not tight. If bubbles are observed, check for loose connections.

3.16 Stabilization is achieved and sampling can begin when a minimum of two saturated screen lengths volume has been removed and three consecutive readings, taken at 5- to 10-minute intervals, are within the following limits:

- pH $\pm$ 0.1 standard units
- Specific conduct $\pm$ 5%
- Temperature $\pm$ 10%
- Turbidity less than 10 NTUs
- Dissolved oxygen $\pm$ 10%

If the above conditions have still not been met after the well has been purged for 4 hours, purging will be considered complete and sampling can begin. For the temporary wells, if the above condition(s) have not been met after three well point volumes have been removed, this will be recorded on the field sample form and the groundwater sample collection can commence.

Record the final well stabilization parameters from the Low-Flow Purge Data From onto the Groundwater Sample Log Form.

If there is a need to leave a well during purging, there are two options:

- One, if the sampler must move for 30 minutes or less but still has a clear line of sight to the well, the sampler may leave the pump running and watch the well from a distance until he or she is able to return to the well.

- Two, if for whatever reason, the sampler must stop purging for an extended period of time or a clear line of sight cannot be maintained, the pump and cell will be shut down. All equipment and supplies will be loaded into the sample vehicle, and the well will be secured before the sampler departs.

In both cases, the time purging was stopped and restarted will be noted on the Low-Flow Purge Data Form.

3.17 Rinse the flow-through cell, the water-quality meter probes, and the turbidity cell with analyte-free water and pack the cell and meters for transport.

4.0 ATTACHMENTS

1. Low-Flow Purge Data Sheet

ATTACHMENT 1

LOW-FLOW PURGE DATA SHEET

Tetra Tech NUS, Inc.

LOW FLOW PURGE DATA SHEET

PROJECT : _____ **WELL ID.:** _____
PROJECT NUMBER: _____ **DATE:** _____
PROJECT SITE NAME: _____ **WEATHER:** _____

Time (Hrs.)	Water Level (Ft. below TOC)	Volume (gal/L)	Flowrate (mL/min)	pH (S.U.)	Cond. (mS/cm)	Turb. (NTU)	DO (mg/L)	Temp. (Celsius)	ORP (mV)	Comments

Water Quality Meter (S/N) _____ Pump Intake Depth _____
Control Box Type (S/N) _____
Turbidity Meter (S/N) _____

SIGNATURE(S): _____ **PAGE___OF___**

STANDARD OPERATING PROCEDURE
SOP-18

GROUNDWATER SAMPLING

1.0 PURPOSE

This Standard Operating Procedure (SOP) establishes the procedure for collecting groundwater samples from permanent and temporary monitoring wells. Low-flow sampling techniques will be used for groundwater sampling at the NSF Indian Head and the NSF Indian Head – Stump Neck Annex facility.

2.0 REQUIRED FIELD FORMS AND EQUIPMENT

The following field forms and equipment are required for low-flow sampling of monitoring wells:

Writing utensil (preferably black ink)

Stainless steel Geoprobe Screen Point Groundwater Sampler (or equivalent)

Groundwater Sample Log Form: A copy of this form is attached at the end of this SOP

Low Flow Purge Data Sheet: A copy of this form is attached at the end of SOP-17

Bound field log book

Chain-of-Custody Form

Bladder pump: With accessories: twin bonded PE ¼-inch tubing, MP-10 control box, nitrogen gas cylinder, and nitrogen regulator.

Peristaltic pump: Silicon and ¼-inch PE tubing.

Required sample containers with appropriate preservative: All sample containers for analysis by fixed-base laboratories will be supplied and deemed certified clean by the laboratory.

Surgical gloves

Water-level indicator

0.45-micron filter cartridge: If the metal analysis requires field filtering.

Bucket: to collect development/purge water

Calculator, wristwatch, and timer

Stainless steel clamps

Plastic storage bags

Shipping containers with ice

3.0 SAMPLING PROCEDURES FOR MONITORING WELLS

3.1 Groundwater sampling may be initiated when the monitoring well has been purged and stabilized in accordance with SOP-17.

3.2 Record the sample start time (using military time) on the Groundwater Sample Log Sheet. Record the field measurements for pH, oxidation-reduction potential (ORP), specific conductance, temperature, dissolved oxygen, and turbidity.

3.3 With the pump continuing to run, disconnect the flow-through cell from the pump discharge tube and immediately start filling sample bottles directly from the pump discharge. All sample containers will be supplied by the laboratory, and the laboratory will pre-preserve all sample containers, where appropriate.

3.4 Allow the pump discharge to flow gently down the inside of the container with minimal turbulence when filling sample containers. Avoid immersing the discharge tube into the sample as the sample container is being filled. Sample containers for volatile constituents (VOCs) must be completely filled so that no headspace exists in the container. The VOC vials will be filled to the top so that a convex meniscus is formed. Gently secure the cap, turn the vial upside down, and check to see if any air has been trapped inside the vial. If so, open the cap, reform the meniscus,

and attempt again to secure the lid without trapping air in the sample. All other sample containers can have air space included when the container lid is secured.

3.5 Cap each container immediately after filling.

3.6 Record the sample time on the Groundwater Sample Log Form, the sample label, and the sample label.

3.7 Place the tagged sample container into a plastic storage bag and then into a cooler containing ice.

3.8 Enter the proper information on the Chain-of-Custody Form for each sample container (see SOP-03).

3.9 Repeat steps 3.3 through 3.9 for each sample container collected.

3.10 The pump rate should not be adjusted after sampling has commenced. If it becomes necessary to adjust the pump rate, document the change on the Groundwater Sample Log Form.

3.11 All samples will be collected into pre-preserved bottles (if required) supplied by an approved laboratory. All samples will be collected in the following sequence (where applicable):

- Volatile organic compounds (VOCs)
- Other organics
- Metals
- Other Inorganics
- Filtered Metals

3.12 Filtered aliquots of groundwater may be collected and analyzed for dissolved metals. Without turning off the pump, attach a disposable, inline, 0.45-um filter cartridge at the end of the discharge tube. Fill sample containers marked for dissolved metals so that the laboratory knows that these aliquots are distinct sample fractions and that the results should be reported as dissolved analytes.

3.13 Repeat steps 3.5 through 3.9 for the filtered sample containers.

3.14 After completion of sample collection, remove the bladder pump (if bladder pump is used for sampling) from the well and decontaminate the pump following the procedures in SOP-04. Leave dedicated tubing inside the well for possible future sampling events.

3.15 Replace the outer protective well cap and lock the well.

3.16 All equipment should be cleaned and packed into the sample vehicle, along with the sample cooler for transport. Disposable gloves and other equipment should be placed in a plastic trash bag and handled as investigation-derived waste (SOP-09).

4.0 SAMPLING PROCEDURES FOR TEMPORARY MONITORING WELLS

4.1 Groundwater samples shall be collected from temporary monitoring wells. Temporary monitoring wells shall be constructed as per SOP-16.

4.2 The temporary monitoring wells shall be developed as per SOP-15 prior to purging.

4.3 The temporary monitoring wells shall be purged as per SOP-17.

4.4 Samples will be collected using the peristaltic pump following procedures in Section 3.0 of this SOP.

4.5 Proceed to abandon the temporary well as per SOP-16.

5.0 ATTACHMENTS

1. Groundwater Sample Log Sheet
2. Low Flow Purge Data Sheet

ATTACHMENT 1

GROUNDWATER SAMPLE LOG SHEET

Tetra Tech NUS, Inc.

GROUNDWATER SAMPLE LOG SHEET

Page___ of ___

Project Site Name: _____
Project No.: _____

[] Domestic Well Data
[] Monitoring Well Data
[] Other Well Type: _____
[] QA Sample Type: _____

Sample ID No.: _____
Sample Location: _____
Sampled By: _____
C.O.C. No.: _____
Type of Sample:
[] Low Concentration
[] High Concentration

SAMPLING DATA:

Date:	Color	pH	S.C.	Temp.	Turbidity	DO	Salinity	Other
Time:	(Visual)	(S.U.)	(mS/cm)	(°C)	(NTU)	(mg/l)	(%)	
Method:								

PURGE DATA:

Date:	Volume	pH	S.C.	Temp.	Turbidity	DO	Salinity	Other
Method:								
Monitor Reading (ppm):								
Well Casing Diameter & Material								
Type:								
Total Well Depth (TD):								
Static Water Level (WL):								
Ore Casing Volume(gal/L):								
Start Purge (hrs):								
End Purge (hrs):								
Total Purge Time (min):								
Total Vol. Purged (gal/L):								

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected

OBSERVATIONS / NOTES:

Circle If Applicable:

MS/MSD	Duplicate ID No.:

Signature(s):

STANDARD OPERATING PROCEDURE
NUMBER SOP-19

COMPOSITE SAMPLING FOR SOIL AND SEDIMENT

1.0 PURPOSE

This Standard Operating Procedure (SOP) establishes the procedure for collecting composite surface soil and sediment samples using the hand auger technique to support the field investigations at NSF Indian Head and the NSF Indian Head – Stump Neck Annex facility.

The basis of rationale for collecting composite surface soil and sediment samples is to limit the variability of analytical data that is expected to be caused by the heterogeneous nature of explosives releases to soil.

2.0 REQUIRED FIELD FORMS AND EQUIPMENT

The following field forms and equipment are required for composite soil and sediment sampling.

Disposable medical-grade gloves (e.g., latex, nitrile)

Indelible marker

Stainless steel auger buckets

Stainless steel extension rods

Cross handle

Plastic storage bags

Sample tags

Shipping containers (containing ice)

Disposable plastic trowels or Stainless steel trowels

Stainless steel mixing bowls

Sample containers: Sample containers are certified clean by the laboratory supplying the containers.

Field Forms: Soil and Sediment Sample Log (SOP-05 and 08), Soil Boring Log (SOP-10).

Electronic label maker

3.0 SAMPLING PROCEDURES

Hand augering will be employed to collect soil cores (see SOP-05). The sampler will wear clean, disposable, medical-grade gloves.

3.1 SOIL COMPOSITE SAMPLING PROCEDURES

3.1.1 Clear the area to be sampled of any surface debris (herbaceous vegetation, twigs, rocks, litter, etc.).

3.1.2 Turn the hand auger sampler into the ground to a depth of 2 feet. The 0- to 2-foot depth soil interval is considered to be the surface soil.

3.1.3 Log the soil core on the Boring Log Sheet (see SOP-10).

3.1.4 Repeat steps 3.1.1–3.1.3 in the designated sampling area for a specific sample until four discrete soil cores are collected.

3.1.5 Place equal amounts of the soil cores for a given sample in a stainless-steel mixing bowl and homogenize using a disposable dedicated plastic trowel. Alternatively, mix the samples in a large disposable Ziploc bag. Place the composite soil sample into the laboratory supplied sampling container, print, and affix electronically printed label.

3.1.6 For samples that are to be submitted for laboratory analysis, place the labeled sample container into a plastic storage bag and then place the plastic storage bag holding the sample container into a cooler containing ice.

3.1.7 Complete the required information on the electronic Soil and Sediment Sample Log Sheet (copy attached at the end of this SOP). Note the location of each aliquot in the "OBSERVATIONS/NOTES" section of the Soil and Sediment Sample Log Sheet. Only the notes added within the sample analysis block on the Soil and Sediment Sample Log Sheet will be visible on the Chain-of-Custody (COC) Form for review by laboratory personnel.

3.1.8 Decontaminate the hand auger bucket and the bowl and spoon, if employed, in the field between each composite sample location.

3.2 SEDIMENT COMPOSITE SAMPLING PROCEDURES

3.2.1 Clear the area to be sampled of any surface debris (herbaceous vegetation, twigs, rocks, litter, etc.).

3.2.2 Remove sediment sample from a depth of 0- to 6-inches.

3.2.3 Repeat steps 3.2.1–3.2.2 in the designated sampling area for a specific sample until four discrete sediment sample locations are collected.

3.2.4 Place equal amounts of the sediment for a given sample in a stainless-steel mixing bowl and homogenize using a decontaminated stainless steel spoon or dedicated disposable towel. Alternatively, mix the samples in a large disposable Ziploc bag. Place the composite sediment sample into the laboratory supplied sampling container, print, and affix electronically printed label.

3.2.5 For samples that are to be submitted for laboratory analysis, place the labeled sample container into a plastic storage bag and then place the plastic storage bag holding the sample container into a cooler containing ice.

3.2.6 Complete the required information on the electronic Soil and Sediment Sample Log Sheet (copy attached at the end of this SOP). Note the location of each aliquot in the "OBSERVATIONS/NOTES" section of the Soil and Sediment Sample Log Sheet. Only the notes added within the sample analysis block on the Soil and Sediment Sample Log Sheet will be visible on the COC Form for review by laboratory personnel.

3.2.7 Decontaminate the hand auger bucket and the bowl and spoon, if employed, in the field between each composite sample location.

4.0 ATTACHMENTS

1. Soil and Sediment Sample Log Sheet

ATTACHMENT 1

SOIL AND SEDIMENT SAMPLE LOG SHEET

SOIL & SEDIMENT SAMPLE LOG SHEET

Page___ of ___

Project Site Name: _____
Project No.: _____

[] Surface Soil
[] Subsurface Soil
[] Sediment
[] Other: _____
[] QA Sample Type: _____

Sample ID No.: _____
Sample Location: _____
Sampled By: _____
C.O.C. No.: _____

Type of Sample:
[] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

Date:	Depth Interval	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Time:			
Method:			
Monitor Reading (ppm):			

COMPOSITE SAMPLE DATA:

Date:	Time	Depth Interval	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other

OBSERVATIONS / NOTES:

MAP:

Circle if Applicable:

MS/MSD	Duplicate ID No.:

Signature(s):

STANDARD OPERATING PROCEDURE

SOP-20

CALIBRATION AND USE OF PHOTOIONIZATION DETECTOR

1.0 PURPOSE

This Standard Operating Procedure (SOP) establishes procedures for the maintenance, calibration, and use of a photoionization detector (PID). The Photovac 2020 Photoionization Air Monitor will be used at the NSF Indian Head and the NSF Indian Head – Stump Neck Annex facility. The procedures for its use are discussed in detail in the following sections.

2.0 GLOSSARY

Electron-volt (eV) - A unit of energy equal to the energy acquired by an electron when it passes through a potential difference of 1 volt in a vacuum.

Intrinsically Safe (I.S.) - Based on wiring, configuration, design, operation, gasketing, construction, this instrument may be employed within locations where flammable gases and/or vapors may exist.

Ionization Potential (I.P.) - The energy required to remove an electron from a molecule yielding a positively charged ion and a negatively charged free electron. The instrument measures this energy level.

Photoionization Detector (PID) - Photoionization detector is employed as the general reference to air monitors of this type. PID's detection method employs ultraviolet (UV) radiation as an energy source. As air and contaminants are drawn through the ionization chamber, the UV light source causes the contaminant with ionization potentials equal to or less than the UV source to break into positive and negatively charge ions. The created ions are subjected to an electrostatic field. The voltage difference is measured in proportion to the calibration reference and the concentration of the contaminant.

Ultraviolet Radiation (UV) Lamp - Ultraviolet radiation is the energy source employed by the instrument to ionize collected sample gas streams. The UV lamp source is required to be equal to or greater than the ionization potential of the substance drawn through the instrument in order to create separate ionized species.

3.0 REQUIRED EQUIPMENT

Pen

Equipment Calibration Form

Photoionization detector

Isobutylene calibration gas (i.e., span gas)

Regulator

4.0 PROCEDURES

4.1 Principle of Operation

The Photovac portable photoionizer detects many organic (and a few inorganic) species. The basis for detection of this instrument is the ionization of components in gaseous streams. The incoming gas molecules are subjected to ultraviolet (UV) radiation, which is energetic enough to ionize many compounds associated with industrial activities. Molecules are transformed into charged-ion pairs, creating a current between two electrodes. Each molecule has a characteristic ionization potential, which is the energy required to remove an electron from the molecule, yielding a positively charged ion and a free electron. The instrument measures this energy level.

This instrument measures the concentration of airborne photoionizable gases and vapors and automatically displays and records these concentrations. It does not distinguish between individual substances. Readings displayed represent the total concentration of all photoionizable chemicals present in the sample. This instrument is factory-set to display concentration in units of ppm or mg/m^3. The meter display updates itself once per second.

The 2020 also performs short-term exposure limit (STEL), time-weighted average (TWA), and PEAK calculations. Any of these results can be viewed, but only one mode may be viewed at a time.

The 2020 has six keys for alphanumeric entry and for accessing multiple functions. The keys are used to set up and calibrate 2020. They allow the user to manipulate the concentration data in various ways.

All information entered with the keys and stored in the 2020's memory is retained when the instrument is switched off. The clock and calendar continue to operate and do not need to be set each time the 2020 is turned on.

4.1.1 Displays

The 2020 has a meter display for reporting detected concentration and a display used for status/ information to guide you through configuration options. All functions of the 2020 will be controlled or reported using one of these displays.

4.1.1.1 Meter Display

The meter display is four digits. It will always be used for reporting detected concentration. When the detector and pump are off, the meter display will be blank.

In order to accommodate the range of concentrations the 2020 can detect, the meter reading will be reported using one of two resolutions. A resolution of 0.1 will be used for concentrations below 100 ppm, and a resolution of 1 will be used for concentrations above 100 ppm.

4.1.1.2 Status Display

The status display is a two- line by 16-character display. The top line is used to display status information and prompts the user for inputs. The bottom line is used for soft key names. Up to three names can be displayed for the three soft keys. If a name does not appear for a soft key, then the soft key has no associated function.

4.1.2 Keys

4.1.2.1 Fixed Keys

The three round keys below the soft keys each have a fixed function. The first key is the ON/OFF key, the middle key is the EXIT key, and the last key is the ENTER key.

The ON/OFF key is used to both turn power on and off. To turn on the 2020, press the ON/OFF key. To turn the power off, press the ON/OFF key and hold it down for 2 seconds, and then release it. This is done to prevent accidental power off.

The EXIT key provides a way of returning to the default display. In the functional map, the soft keys allow the user to advance and the EXIT key provides a way to go back. If the user is at the initial entry of the menu, EXIT will return you to the default display.

The ENTER key has a context sensitive function. When the user is operating or navigating through the function map, the ENTER key is used to exit the functions and return to the default display. When entering data such as a name, number, date, or time, ENTER is used to confirm the entry.

4.1.2.2 Soft Keys

The three soft keys on the 2020 are located directly below the status display. Each key has varying functions for configuring the 2020, editing the data logger, and controlling the display. Because only three soft keys are available, each function is broken down into a path.

4.1.2.3 Entering Text with the Soft Keys

For all information that is entered, the left, center, and right soft keys correspond to the up, down, and right arrow.

The up and down arrows are used to change the character highlighted by the cursor. The right arrow is used to advance the cursor to the next character on the right. When the cursor is advanced past the right most character, it wraps around to the first character again. To accept the changes, press the ENTER key. To ignore the change, press EXIT.

Formatting characters, such as the colon (:) in the time, the decimal (.) in a concentration, and the slash (/) in the date, are skipped when advancing the cursor.

All inputs are an eight-character input, which is displayed on the right side of the top line of the status display. The prompt, describing the input, occupies the left half of the top line. The soft keys are defined on the bottom line of the status display.

4.2 Default Display

The meter display shows the detected concentration. The resolution of the display changes with the magnitude of the reading. A reading of 0 to 99.9 will be displayed with a resolution of 0.1 ppm. A reading greater than 99.9 will be shown with a resolution of 1 ppm or 1 mg/m^3. The meter will display concentrations up to 2000 ppm or 2(99) mg/m^3.

The status display is used to display the instrument status, date, time, units, and active soft keys.

The default display provides the following information: instrument status, current detected concentration, time, date, and measurement units. The status display toggles between showing time and units and then the date.

When the display mode is MAX, the date and time correspond to the date and time the MAX concentration was recorded. In TWA mode, the time represents the number of hours and minutes during which the TWA has been accumulating. For PEAK and STEL monitoring, the date and time correspond to the current date and time.

4.3 Monitoring

4.3.1 Instrument Status

The instrument status is shown on the left of the first line of the status display and on the Table and Graph outputs. Each status has a priority assigned to it. If more than one status is in effect, then the status with the highest priority is displayed until the condition is corrected or until the option is turned off.

4.3.2 Alarms

While operating the instrument, any one of three alarm conditions can occur. To accurately identify the source of the alarm, each type of alarm has been given a unique status.

In addition to the status, the 2020 also has an audible alarm and a visual alarm LED. To conserve power, the 2020 alternates between these two alarm indicators, rather than operating both concurrently. Different alarms are identified by the frequency at which the 2020 alternates as follows: PEAK alarm, 5 times per second; STEL alarm, 2.5 times per second; and TWA alarm, 1.25 times per second.

The left soft key is used for acknowledging alarms, and is labeled "Ack." If no alarm exists, then the "Ack" key is not shown. To clear the alarm, press the "Ack" key. Once acknowledged, the alarm indicators are cleared. The alarm status will remain until the alarm condition clears.

The 2020 updates the peak concentration once every second. Following every update, the peak concentration is compared to the peak alarm level, and, if exceeded, an alarm is triggered.

If a 15-minute average concentration exceeds the selected STEL, a STEL alarm is generated.

The TWA alarm is generated when the current average concentration over an 8-hour period, since the TWA was last cleared, has exceeded the TWA exposure limit.

During calibration, all alarms are disabled. Once the calibration is complete, the alarms are re-enabled.

4.4 STEL, TWA, MAX, and PEAK Operation

The 2020's meter display can be configured to show one of four values: STEL, TWA, PEAK, and MAX.

4.4.1 Short-term Exposure Limit Mode

The STEL mode displays the concentration as a 15-minute moving average. The 2020 maintains 15 samples, each representing a 1-minute averaging interval.

Once every minute, the oldest of the 15 samples is replaced with a new 1-minute average. This moving average provides a 15-minute average of the last 15 minutes with a 1-minute update rate. Because the average is calculated using 15 one-minute averages, the meter display will only update once every minute.

The STEL is set to zero each time the instrument is turned on. Because STEL is a 15-minute moving average, there is no need to clear or reset the STEL.

STEL calculations are always being performed by the 2020. The user can display the results of the calculations by selecting “STEL” as the Display mode.

4.4.2 Time-weighted Average (TWA) Mode

The TWA accumulator sums concentrations every second until 8 hours of data have been combined. If this value exceeds the TWA alarm setting, a TWA alarm is generated. The TWA is not calculated using a moving average. Once 8 hours of data have been summed, the accumulation stops. In order to reset the TWA accumulator, press the "Clr" key.

This sum will only be complete after 8 hours, so the meter displays the current sum divided by 8 hours. While in TWA mode, the time on the status display will show the number of minutes and hours of data that TWA has accumulated. When this reaches 8 hours, the 2020 stops accumulating data and the TWA is complete.

TWA calculations are always being performed by the 2020. The user can display the results of the calculations by selecting TWA as the Display mode.

4.4.3 MAX Mode

The MAX mode displays the maximum signal, with the date and time that it was recorded. The 2020 continues to log data according to the selected averaging interval, but only the maximum detected concentration is displayed on the meter display.

The right soft key is used to clear the meter when displaying MAX. The "Clr" key only affects the reading that the meter is displaying. For example, if the MAX reading is displayed, and "Clr" is pressed, only the MAX value is cleared. The TWA is still accumulating in the background.

4.4.4 PEAK Mode

The PEAK mode displays the current detected concentration. The reading is updated once a second. In the background, the 2020 data logger is sampling the concentration and measuring minimum, maximum, and average concentrations for the selected averaging interval. At the end of every interval, one entry is placed in the data logger until the data logger is full. Operation within the other specialized modes is the responsibility of the SSO.

4.5 Set Functions

Set functions are used to set up the 2020. Three functions can be set on the 2020: Pump, Clock, and Calibration.

4.5.1 Pump

The Pump function is used to control the pump. After selecting “Set Pump,” the 2020 responds by displaying the new pump status.

The detector is also turned off when the pump is turned off. This prevents the detector from being damaged when there is no sample flowing through the detector.

When the pump and the detector are off, the meter display will be blank. Turn the pump and detector off when concentration measurements are not necessary, and the 2020 will only be used for reviewing data

or generating reports. By operating the instrument with the pump and detector off when they are not needed, the lives of the battery and ultraviolet (UV) lamp will be conserved.

To set the pump:

1. Press the ENTER key. The top line of the status display changes to "Select?" The bottom line displays three soft key names: "Set," "Log," and "Disp."

2. Press the soft key below "Set."

3. The names of the soft keys change to reflect the Set options. The display now shows three devices that can be set: "Clock," "Pump," and "Cal." Press the "Pump" key.

4. The 2020 turns the pump off. If the pump was off, pressing "Pump" will turn the pump on.

5. A message will be displayed to show the status of the pump. The 2020 reverts back to the previous menu after a few seconds.

6. To return to the default display, press the ENTER key.

4.5.2 Clock

The Clock function is used to set both the current date and time.

To set the clock:

1. Press the ENTER key.

2. Press the "Set" key.

3. When the names of the soft keys change, press the "Clock" key.

   The up and down arrows are used to change the character underlined by the cursor. The right arrow is used to advance the cursor to the next character on the right. When the cursor is advanced past the right-most character, it wraps around to the first character again.

Formatting characters, such as the colon (:) in the time and the slash (/) in the date are skipped when advancing the cursor.

4. Use the "arrow keys" to enter the correct time. The time is formatted as Hour:Minute:Second.

5. Press the ENTER key to confirm the time and move to the date option.

6. When setting the date, the 2020 prompts for the current date formatted as Year/Month/Day. Use the "arrow keys" to enter the correct date.

7. Press the ENTER key to confirm the date and return to the Set options. Wait for the display to timeout or press ENTER to return to the default display.

4.5.3 Calibration (Cal)

“Cal” allows the user to set up and calibrate the 2020. There are three options under the Cal function: "Zero," “Span," and "Mem."

A calibration memory consists of a name, a response factor, and PEAK, TWA, and STEL alarm levels.

The "Zero" and "Span" keys are covered in detail in the manufacturer's operations manual for the instrument.

To edit the calibration memory, select "Mem" and then "Chng." The 2020 prompts the user with two new soft keys: "User" and "Lib."

4.5.4 Library (Lib)

Library selections simplify Cal Memory programming and provide standard response factors for approximately 70 applications. "Lib" allows the user to select an entry from a pre-programmed library. The name, response factor, and three alarm levels are all set from the library. To select a library entry to program the selected Cal Memory:

1. Select "Set," "Cal," "Mem," "Chng," and "Lib."
2. Use the "Next" and "Prev" keys to scroll through the list. See the manufacturer's manual Appendix 8.7 for a list of the library entries.

4.6 Preparing for Field Operation of the Photovac 2020

Turning The 2020 On

1. Turn the 2020 on by pressing the ON/OFF key.

2. The 2020 will display the software version number. Wait for the 2020 to proceed to the default display.

3. Allow 10 minutes for the instrument to warm up and stabilize.

4. Press the Enter Key. The default display will provide three soft key selections, "Set," "Log," and "Display."

5. Press "Set." From this option, three other soft key selections will be offered: "Pump," "Clock," and "Cal."

6. Press "Cal." This will begin the calibration sequence. The first selection is to zero the instrument.

7. Press Enter; zeroing will begin. (Note: When employing zero gas, attach and activate zero gas supply at this time.)

8. The next selection offered will be Span. Press Enter, at which time the concentration will be requested. The isobutylene calibration gas employed under general service will be marked on the side of the container. Use the soft keys to toggle into position and to log the concentration. Once the concentration is logged, press "Enter." The direction on the status display will indicate spanning. At this time, hook up the span gas with a regulator to the Photovac 2020 and open it to supply enough flow to elevate the flow rate indicator to the green indicator line (1/8 inch from the rest position).

9. Once spanning is complete, the alarms, which have been disabled during calibration, will activate, indicating that calibration is complete.

10. Document this calibration procedure using a Document of Calibration form (included in Appendix A).

This instrument is ready for general purpose application.

Calibration is to be performed daily or prior to each use, in accordance with this section.

4.7 Maintenance and Calibration Schedule

Function	Frequency
Routine Calibration	Prior to each use.
Factory Inspection and Calibration	Once a year, or when malfunctioning.
Wipe Down the Outer Casing of the Unit	After each use.
Clean UV Light Source	Every 24 hours of operation.
Sample Inlet Filter	Change on a weekly basis or as required by level of use.
Battery charging	After each use.
Clean ionization chamber	Monthly.

4.7.1 Cleaning the UV Light Source Window

1. Turn the FUNCTION switch to the OFF position. Use the 2020 multi-tool and remove the lamp housing cover. CAUTION: The UV lamp is delicate and expensive; handle carefully.

2. Tilt the lamp housing with one hand over the opening; slide the lamp out of the housing.

3. The lamp window may now be cleaned with any of the following compounds using lens paper:
   a. 11.7 eV Lamp - Dry Aluminum Oxide Powder (3.0 micron powder)
   b. All other lamps-HPLC Grade Methanol

4. Following cleaning, reassemble by first sliding the lamp back into the lamp housing. Replace the o-ring as necessary, reinstall the lamp housing cover, and tighten it using the 2020 multi-tool. (Do not over tighten.)

5. Recalibrate the instrument as per Section 4.6.

4.7.2 Cleaning the Ionization Chamber

1. Turn the FUNCTION switch to the OFF position and remove the lamp housing cover and lamp as per Section 4.7.1.

2. Using a gentle jet of compressed air, gently blow out any dust or dirt.

3. Following cleaning, reassemble by first sliding the lamp back into the lamp housing. Replace the o-ring as necessary, reinstall the lamp housing cover, and tighten it using the 2020 multi-tool. (Do not over tighten.)

4. Recalibrate the instrument as per Section 4.6.

4.8 Instrument Advantages

The Photovac 2020 is easy to use in comparison to many other types of monitoring instrumentation. Its detection limit range is in the low parts-per-million range. Response rapidly reaches 90 percent scale of the indicated concentration (less than 3 seconds for benzene). This instrument's automated performance covers multiple monitoring functions simultaneously, incorporating data logging capabilities.

4.9 Limitations of the Photovac 2020 Photoionization Monitor

- Because the 2020 is a nonspecific total gas/vapor detector, it cannot be used to identify unknown chemicals; it can only quantitate them in relationship to a calibration standard (relative response ratio).

- For appropriate application of the 2020, ionization potentials of suspected contaminants must be known.

- Because the types of compounds that the 2020 can potentially detect are only a fraction of the chemicals possibly present at a hazardous waste site or incident, a background or zero reading on this instrument does not necessarily signify the absence of air contaminants.

- The 2020 instrument can only monitor certain vapors and gases in air. Many nonvolatile liquids, toxic solids, particulates, and other toxic gases and vapors cannot be detected.

- PIDs are generally not specific. Their response to different compounds is relative to the calibration gas used. This is referred to as relative response ratio. Instrument readings may be higher or lower than the true concentration. This can be an especially serious problem when monitoring for total contaminant concentrations if several different compounds are being detected at once.

- The 2020 is a small, portable instrument that cannot be expected to yield results as accurately as laboratory instruments.

4.9.1 Variables Affecting Monitoring Data

Monitoring a hazardous waste site environment can pose a significant challenge in assessing airborne concentrations and the potential threats to site personnel. Several variables may influence both dispersion and the instrument's ability to detect actual concentrations. Some of the variables, which may impact these conditions, are as follows:

- Temperature - Changes in temperature or pressure will influence volatization and affect airborne concentrations. Additionally, an increase or decrease in temperature ranges may have an adverse effect on the instrument's ability to detect airborne concentrations.

- Humidity - Excessive levels of humidity may interfere with the accuracy of monitoring results.

- Rainfall - Through increased barometric pressure and water, rainfall may influence dispersion pathways affecting airborne emissions.

- Electromagnetic interference - High voltage sources, generators, other electrical equipment may interfere with the operation and accuracy of direct-reading monitoring instruments.

5.0 TROUBLESHOOTING

5.1 <u>Fault Messages</u>

When the "Fault" status is displayed, the 2020's operation is compromised.

Fault 1: Signal from zero gas is too high.

Cause: If another fault occurred while the 2020 was setting its zero point, then this fault is displayed.
Action: Ensure no faults are occurring and calibrate the 2020 again.

Cause: Contamination of sample line, sample probe, or fittings before the detector.

Action: Clean or replace the sample line, sample probe, or the inlet filter.

Cause: Span gas and zero air are switched.

Action: Ensure clean air is used to zero the 2020. If you are using gas bags, mark the calibration and zero gas bags clearly.

Cause: Ambient air is contaminated.

Action: If you are unsure about the quality of ambient air, use a supply of commercial zero grade air to zero the 2020.

Fault 2: Signal from span gas is too small.

Cause: Operator may have switched the span gas and zero air.

Action: Ensure clean air is used to zero the 2020. If you are using gas bags, mark the calibration and zero gas bags clearly.

Action: Ensure the span gas is of a reliable concentration.

Cause: UV lamp window is dirty.

Note: Do not remove the detector lamp in a hazardous location.

Action: Clean the UV lamp window.

Cause: UV lamp is failing.

Note: Do not remove or replace the detector lamp in a hazardous location.

Action: Install a new UV lamp.

Cause: Incompatible application.

Action: The concentration and sample gas are incompatible for use with the 2020.

Fault 3: UV lamp fault. UV lamp has not started.

Cause: The UV lamp has not started immediately.

Action: This fault may be seen momentarily when 2020 is first turned on. Allow 30 to 60 seconds for the UV lamp to start and the fault to clear.

Cause: The UV lamp serial number label is blocking the photocell.

Note: Do not remove or replace the detector lamp in a hazardous location.

Action: If you have a UV lamp with a white serial number label, it is possible that the label is blocking the photocell. Rotate the lamp approximately 90 degrees and then try to start the 2020 again. If the fault persists, replace the lamp.

Cause: the UV lamp is not installed.

Note: Do not remove or replace the detector lamp in a hazardous location.

Action: Install a UV lamp.

Cause: The UV lamp has failed.

Note: Do not remove or replace the detector lamp in a hazardous location.

Action: Install a new UV lamp.

Cause: Electronic problem.

Action: If a new UV lamp still generates this fault, then contact the Photovac Service Department.

Fault 4: Pump current too low or too high.

Cause: If the pump sounds labored, then the pump is operating beyond normal operating parameters.

Action: Check for an obstruction in the sample line. Make sure sample line, sample probe, or inlet filter are not plugged.

Note: Do not replace the inlet filter in a hazardous location.

Action: Replace the inlet filter.

Action: Ensure the sample outlet, located on the underside of the 2020, is not obstructed.

Cause: The UV lamp is too wide, causing flow to be restricted.

Note: Do not remove or replace the detector lamp in a hazardous location.

Action: If you have a UV lamp with a white serial number label, it is possible that the lamp is too wide for the lampholder. Contact the TtNUS equipment manager.

Cause: The 2020 has been exposed to a solvent that can pass through the inlet filter and liquid has been aspirated.

Action: Contact the TtNUS equipment manager.

Cause: The pump has failed.

Action: Contact the TtNUS equipment manager.

5.2 Specific Problems

Problem: Very low or no instrument response detected, yet compounds are known to be present.

Cause: The 2020 has not been calibrated properly.

Action: Ensure the calibration gas is of a reliable concentration and then calibrate the instrument as outlined in Section 4.6 of the User's Manual. After the instrument has been calibrated, sample the bag of calibration gas. A reading equivalent to the calibration gas should be displayed. If not, contact the TtNUS equipment manager.

Note: Do not remove or recharge the battery pack in a hazardous location.

Action: Disconnect the battery charger before calibrating the 2020.

Cause: Calibration memories have not been programmed correctly.

Action: Program all the calibration memories you require for your application. You must use the correct calibration gas and concentration for each Cal Memory.

Cause: The response factor has been set to zero.

Action: Enter the correct response factor. Refer to Appendix 8.6 for a list of response factors. If the compound is not listed in Appendix 8.6 or you are measuring gas mixtures, then enter a value of 1.0. See User's Manual provided by the manufacturer.

Cause: You are not using the correct Cal Memory.

Action: Select the correct Cal Memory for your application.

Note: It does not matter which Cal Memory is selected or which response factor is entered. The 2020's response is not specific to any one compound. The reading displayed represents the total concentration of all ionizable compounds in the sample.

Cause: Detector is leaking. A decrease in sensitivity may be due to a leak in the detector.

Note: Do not remove or replace the detection lamp in a hazardous location.

Action: Ensure the UV lamp has been installed correctly.

Action: Ensure the lamp cover has been tightened down. Do not overtighten the cover.

Action: Ensure the o-ring seal on the lamp cover is positioned correctly.

Cause: The UV lamp is too long, causing flow to be restricted.

Note: Do not remove or replace the detector lamp in a hazardous location.

Action: If you have a UV lamp with a white serial number label, it is possible that the lamp is too long for the lampholder. Replace the lamp and contact the TtNUS equipment manager.

Cause: UV lamp is too wide, causing flow to be restricted.

Note: Do not remove or replace the detector lamp in a hazardous location.

Action: If you have a UV lamp with a white serial number label, it is possible that the lamp is too wide for the lampholder. Contact the TtNUS equipment manager.

Cause: The sampling environment is extremely humid.

Action: Water vapor is not ionized by the PID, but it does scatter and absorb the light and results in a lower reading. The 2020 detector has been designed to operate under high humidity conditions. Under extreme conditions, you may notice decreased response due to humidity.

Cause: The UV lamp is failing.

Note: Do not remove or replace the detector lamp in a hazardous location.

Action: High concentration of non-ionizable compounds. Chemical compounds, such as methane, with IPs greater than the 10.6 eV scatter and absorb the UV light. Sensitivity may be decreased significantly. Application with high backgrounds of such materials may be incompatible with the 2020. Contact the Photovac Applications Group for more information.

Problem: Erroneously high readings.

Cause: Sampling environment is extremely humid.

Action: Water vapor may contain mineral salts, which carry a charge. The water vapor becomes an electrolytic solution, which becomes ionized when it enters the detector. Atmospheric water in areas around the sea or stagnant water may produce a response in the absence of contaminants. The same effect may be seen when conducting ground water investigations in areas where the water is hard because it contains a significant concentration of minerals.

Cause: The 2020 has not been calibrated properly.

Action: Ensure the calibration gas is of a reliable concentration and then calibrate the instrument as outlined in Section 4.6. After the instrument has been calibrated, sample the bag of calibration gas. A reading equivalent to the calibration gas should be displayed. If not, contact the TtNUS equipment manager.

Cause: Cal Memories have not been programmed correctly.

Action: Program all the Cal Memories you require for your application. You must use the correct calibration gas and concentration for each Cal Memory. See Section 3.4 of the User's Manual.

Cause: You are not using the correct Cal Memory.

Action: Select the correct Cal Memory for your application. See Section 3.2.2 or 3.3.2 of the User's Manual.

Note: It does not matter which Cal Memory is selected or which response factor is entered. The 2020's response is not specific to any one compound. The reading displayed represents the total concentration of all ionizable compounds in the sample.

Cause: The detector has been short circuited by foreign matter in the detector cell.

Note: Do not service the 2020 in a hazardous location.

Action: Do not touch the wire grid inside the detector cell. Use a gentle jet of compressed air to remove any dust in the detector cell.

Warning: Do not insert any object, other than the UV lamp, into the lampholder.

Cause: There is an undetermined problem.

Action: Contact the TtNUS equipment manager.

Problem: Date and time settings are not retained.

Cause: The battery pack was removed before the 2020 was turned off.

Note: Do not remove or recharge the battery pack in a hazardous location.

Action: Replace the battery pack and reset the time and date. Ensure that the 2020 has been turned off before removing the battery pack.

Cause: The 2020 has not been used for 3 months or more and the internal battery (not the external battery pack) has discharged.

Note: Do not remove or recharge the battery pack in a hazardous location.

Action: Connect the 2020 to the AC adapter and turn the 2020 on. Turn the pump off. While the 2020 is running, the internal battery is charging. Leave the instrument running for approximately 24 hours.

Problem: Instrument status shows "Over."

Cause: High concentrations of gases and vapors will cause a rapid change in signal level. The detector and associated electronics may become temporarily saturated.

Action: Wait a few seconds for the status to return to normal. PIDs are designed to detect relatively low concentrations of gases and vapors. Exposure to very high concentrations may result in a very high or maximum response.

Cause: The detector has become saturated.

Action: Move the 2020 to a location where it can sample clean air. Sample clean air until the reading stabilizes around 0.

Cause: Detector has been short circuited by foreign matter in the detector cell.

Note: Do not service the 2020 in a hazardous location.

Action: Do not touch the wire grid inside the detector cell. Use a gentle jet of compressed air to remove any dust or dirt in the detector cell.

Warning: Do not insert any object, other than the UV lamp, into the lampholder.

Cause: There is an undetermined problem.

Action: Contact the TtNUS equipment manager.

Problem: Display is blank.

Cause: Battery pack is critically low.

Note: Do not remove or recharge the battery pack in a hazardous location.

Action: Replace the battery pack or connect the 2020 to the AC adapter.

Cause: The battery pack is not connected to the instrument correctly.

Action: Ensure the battery pack connector is securely attached to the connector on the 2020.

Cause: There is an undetermined problem.

Action: Reset the 2020. You must leave the instrument on while you disconnect the battery pack. This will reset the instrument. Reconnect the battery pack and close the battery hatch. Turn on the 2020, set the time and date, and program all the calibration memories that you are using.

Action: Contact the TtNUS equipment manager.

Problem: Sample flow rate is less than 300 ml/min.

Cause: The inlet filter is plugged.

Note: Do not replace the inlet filter in a hazardous location.

Action: Replace the inlet filter.

Cause: The inlet filter has not been installed properly.

Action: Ensure that the inlet filter has been installed correctly.

Cause: The UV lamp is too long, causing flow to be restricted.

Note: Do not remove or replace the detector lamp in a hazardous location.

Action: If you have a UV lamp with a white serial number label, it is possible that the lamp is too long for the lampholder. Replace the lamp and contact the TtNUS equipment manager.

Cause: The UV lamp is too wide, causing flow to be restricted.

Action: If you have a UV lamp with a white serial number label, it is possible that the lamp is too wide for the lampholder. Contact the TtNUS Equipment Manager.

Cause: The 2020 has been exposed to a solvent that can pass through the inlet filter and liquid has been aspirated.

Action: Contact the TtNUS equipment manager.

Cause: Sample outlet is obstructed.

Action: Ensure the sample outlet is not obstructed in any way.

Cause: Pump has been damaged.

Action: Contact the TtNUS equipment manager.

Problem: Liquid has been aspirated.

Cause: The 2020 has been exposed to a solvent that can pass through the inlet filter.

Action: Contact the TtNUS equipment manager.

Problem: Corrosive gases and vapors have been sampled.

Cause: The 2020 has been exposed to corrosive gases and vapors.

Action: Corrosive gases and vapors can affect the electrodes within the detector as well as the lamp window. Prolonged exposure to corrosive materials may result in permanent fogging or etching of the window. If the 2020 is exposed to corrosive material, contact the TtNUS equipment manager.

6.0 SHIPPING

The Photovac may be shipped as cargo or carried on as luggage if there is no calibration gas cylinder accompanying the kit. When shipping or transporting the calibration gas, a Hazardous Airbill must be completed.

7.0 REFERENCES

Photovac 2020 Photoionization Monitor User's Manual, 1995.

8.0 ATTACHMENTS

1. Equipment Calibration Log

ATTACHMENT 1
EQUIPMENT CALIBRATION LOG

Tetra Tech NUS, Inc.

EQUIPMENT CALIBRATION LOG

PROJECT NAME : _____ INSTRUMENT NAME/MODEL: _____

SITE NAME: _____ MANUFACTURER: _____

PROJECT No.: _____ SERIAL NUMBER: _____

Date of Calibration	Instrument I.D. Number	Person Performing Calibration	Instrument Settings		Instrument Readings		Calibration Standard (Lot No.)	Remarks and Comments
			Pre-calibration	Post-calibration	Pre-calibration	Post-calibration		

STANDARD OPERATING PROCEDURE
SOP-21

MEC MANAGEMENT AND ACCOUNTABILITY

A. SCOPE AND APPLICABILITY

This document is designed to set a standard operating procedure (SOP) for the management and accountability of Munitions and Explosives of Concern (MEC) encountered during activities performed under the Munitions Response Program (MRP).

B. BACKGROUND

MEC activities will be performed in accordance with all local, State, and federal regulations and will include all applicable DoD requirements. Generally, MEC will be encountered during the performance of Unexploded Ordnance (UXO) detector-aided surface sweep operations, subsurface geophysics investigations and UXO Escort operations. UXO detector-aided surface sweep operations may be used as a stand-alone method for site survey and assessment or in preparation for geophysical survey and other operations. UXO escort operations may be required during site visits (initial site assessments, planning, and stakeholders meetings), geophysical operations, construction support during subsurface activities, and MC sampling operations.

C. PERSONNEL QUALIFICATIONS

UXO personnel shall be graduates of a military Explosive Ordnance Disposal (EOD) School of the United States, Canada, Great Britain, Germany, or Australia or a graduate of a formal training course of instruction or EOD assistant course as stated in DDESB TP-18.

D. MEC MANAGEMENT AND ACCOUNTABILITY OPERATIONS

<u>UXO Detector-Aided Surface Sweep</u>

If suspect MEC is encountered, its location will be recorded and/or marked using a GPS, tape measure, or other grid coordinate location system. The UXO Team will attempt to determine its condition without moving or disturbing the item prior to proceeding with the surface sweep. Each item will be marked with engineer flagging and given a unique ID number. ID numbers will start with a letter(s) corresponding to

the site or grid in which the item is located. This will be followed by the transect number of the site or grid specific to the location of the item. Lastly, a number will be assigned to the individual items within the transect. These numbers will start at 01 and run consecutively. For example:

*The site name is **O**pen **B**urn **P**it. The first transect within the Open Burn Pit is **A1**. The first item encountered in transect A1 is item **01**. The ID number assigned to the item is **OBP-A1-01.***

All available information about the item will be recorded in the logbook/MEC Tracking Log as presented in Attachment 1 to this SOP, including suspect MEC location, identification, and ID number. A digital photograph will be taken of each item. The UXO Team will not move or otherwise disturb the item in an attempt to collect information. After all available information is recorded; the UXO Team will resume the detector-aided surface sweep.

Every effort will be made to identify each suspect MEC item located. Under no circumstances will any suspect MEC be moved in an attempt to make a definitive identification. The MEC item will be visually examined for markings and other external features such as shape, size, and external fittings. Prior to any documentation being developed on an MEC item, all fusing will be definitively identified if it is possible to safely do so visually without disturbing the ordnance item. This identification will consist of fuse type by function and condition (armed or unarmed) and the physical state/condition of the fuse, i.e., burned, broken, parts exposed/sheared, etc.

Only UXO-qualified personnel will perform MEC identification procedures. As an exception, a UXO Technician I may assist in the performance of MEC identification procedures when under the supervision of a UXO Technician III or higher. All personnel engaged in field operations will be thoroughly trained and capable of recognizing the specific hazards of the procedures being performed. To ensure that these procedures are performed to standards, all field personnel will be under the direct supervision of a UXO Technician III or higher. All suspect MEC items will be recorded following the requirements of this SOP, the site-specific Work Plan/QAPP, the project site-specific HASP, applicable ordnance operations procedural safety guidelines, and industry-accepted safe work practices and procedures.

Detector-Aided Surface Sweep for Geophysical Survey

The UXO Technician will conduct a detector-aided surface sweep of the grid or transect to be surveyed and record the location of each MEC item discovered, if any. Each item will be marked and recorded as described above. UXO avoidance will be practiced during the geophysical survey.

Explosive Safety Submission (ESS)

When allowed by the conditions of the Explosive Safety Submission (ESS) determination, any non-munitions debris may be moved to facilitate a more effective surface sweep and/or geophysical survey. Non-munitions debris may be collected and stockpiled in a designated area within the boundaries of the site. The facility must agree to take possession of this non-munitions debris and arrange the proper disposition of the material before any items may be moved or disturbed.

UXO Escort Operations

One UXO Technician, qualified as a UXO Technician II or higher, will be required to support each field team engaged in operations in areas that might contain MEC. If any MEC is encountered, the item will be avoided during this phase of the project.

The UXO Technician will not attempt to identify the type or condition of the ordnance during escort operations. Any area with visible ordnance or MEC will be clearly marked, and the area will be avoided. The location of visible ordnance or MEC will be recorded and noted in the field logs. If more senior level personnel are present on site, MEC findings will be reported to the UXO Team Leader. No ordnance, munitions, explosives, or ordnance-related materials will be moved, removed, or disposed of during UXO Escort duties.

Quality Control

The UXOQC will review the definable features of work prior to the start of work each day. A new definable feature of work will receive a preparatory phase QC inspection prior to the start of work. This insepction is recorded on the attached Quality Control Surveillance Report. Work started on a new definable feature of work will receive an initial phase QC inspection. During MEC management and accountability the UXOQC, or Senior UXO Technician if there is no UXOQC, will recheck 25-percent of the first four units of work (grids or transects). If quality requirements are not met on any unit, that unit will be rejected and the UXO Team will rework the entire unit. The initial phase QC inspection will be documented on the attached Quality Control Surveillance Report. Once quality requirements are met for four units in a row, the UXOQC, or Senior UXO Technician if there is no UXOQC, may reduce the level of rechecks to 10-percent of each unit (grids or transects). If at any time a unit fails the quality control check, the complete unit will be reworked and the rechecks will be increased to 25-percent until four units in a row pass the recheck. These follow up phase QC inspections will be recorded on the attached Quality Control Surveillance Report. All work will be conducted in accordance with the MEC SAP and the SOPs attached to that MEC SAP. All requested changes to the approved MEC SAP will be documented

on the attached Record-of-Change Form and submitted to the PM and UXO Manger for action/approval. The UXOQC will prepare the attached Daily Quality Control Report for each day worked summarizing the definable features or work inspected, the phase of work, the locations, and personnel at the work site.

E. NOTIFICATIONS IF MEC IS ENCOUNTERED

Any MEC item discovered during a detector-aided surface sweep, geophysical survey, or UXO escort operation will be left in place and will not be moved. Should MEC be encountered, the following scenarios should be addressed as follows:

(1) If a complete MEC item or ordnance related material is encountered that is believed to pose a hazard, is unexpectedly encountered at a given site, is encountered outside of the current established site boundaries, or is unknown, the UXO Team Leader, with support by UXO Technicians on site as necessary, will document the following information, as provided on Attachment 1, for notification purposes:

- Site Name
- Date/Time Encountered
- Name and UXO category of Person providing Notification
- Location of Item (provide coordinates)
- Type of Item (provide digital photograph)
- Apparent Fuze Condition (armed or unarmed)
- Physical Condition (burned, broken, parts exposed/sheared, etc)
- Physical Appearance (buried, staged, etc.)
- Activity in Progress

The UXO Team Leader will attempt to identify the type and/or condition of the ordnance and its location, as described above, and will immediately report this information to the client point of contact at the facility and the Tetra Tech UXO Manager. Prior to any documentation being performed on a suspect MEC item, all fuzing will be definitively identified only if it is possible to safely do so visually without disturbing the item. If directed by the point of contact at the facility, UXO personnel may take emergency non-invasive action such as securing the area until the appropriate exclusion and safety zones have been determined.

The Navy point of contact at the facility will be responsible for notifying appropriate EOD personnel or for designating this notification task to the Tetra Tech UXO Team Leader. The notification to EOD

personnel should be immediate if a live MEC item is encountered which could be a hazard to personnel, or if the item is unknown so that arrangements may be made through the facility for proper disposition of the item(s). If the facility initiates an emergency response or disposal action, follow-up documentation should be obtained to detail the date and method of disposition. This information is also needed to ascertain the actual type and condition of the item (live or inert filled) to aid in future classification of the site.

(2) If the MEC item cannot be identified by type as a conventional munition, and/or if in the unlikely event that the MEC is suspected to be potential Chemical Warfare Material (CWM), personnel will withdraw upwind from the area, assemble at a pre-designated rally point, secure the site, and immediately request assistance from the point of contact at the facility and notify the Tetra Tech UXO Manager. If so directed, UXO personnel will take emergency non-invasive actions such as covering the item with plastic sheeting and securing the area until the appropriate exclusion and safety zones have been determined.

(3) If Hazardous, Toxic, or Radiological Waste (HTRW) is encountered on-site, the work site will be evacuated until the Tetra Tech Project Health and Safety Officer, with concurrence of the client point of contact at the facility, identifies and implements appropriate protective measures.

For any of the scenarios, upon receiving notification from the Tetra Tech UXO Team Leader, the Tetra Tech UXO Manager will then immediately inform the Tetra Tech Project Manager, who will then immediately inform the client Project Manager. Tetra Tech Program Management personnel will then be notified. The client Project Manager will then make all other necessary notifications within the client's organization.

The following table lists contacts information.

Position	Name	Organization	Direct Dial Phone	Cell Phone
Project Manager	Ralph Basinski	Tetra Tech	412.921.8308	412.251.9736
UXO Manager	Ralph Brooks	Tetra Tech	770.413.0965 x231	404.661.4916
Indian Head POC	Jeffrey Bossart	NSF Indian Head	301.744.4705	
Navy Remedial Project Manager	Joe Rail	NAVFAC Washington	202.685.3105	

ATTACHMENT 1

MEC TRACKING LOG

NSF INDIAN HEAD – STUMP NECK ANNEX, MD

SITE:_____

ID #	ITEM IDENTIFICATION	UXO TECH NAME	ITEM COORDINATES	DATE/TIME FOUND	DIGITAL PHOTGRAPH NUMBER	ARMED / UNARMED	PHYSICAL CONDITION / APPEARANCE	DATE DESTROYED

TETRA TECH NUS, INC.

QUALITY CONTROL SURVEILLANCE REPORT		Report Number:	
Project Name:		Contract No:	
Client:		Project Manager:	
1 - Activity			
☐ Project Readiness UFP-SAP Review	☐ Pre-Operational Team Training Review	☐ Mobilization/Site Preparation	☐ Brush Cutting and Vegetation Clearance
☐ Pre-Survey ITS Review	☐ Daily Function Test	☐ UXO Detector-Aided Surface Sweeps/Quality Control Check	☐ UXO Detector-Aided Surface Sweep Field Data Collection &Transcription
☐ Geophysical Survey	☐ Geophysical Survey Field Data Collection and Transcription	☐ GPS Data	☐ Demobilization
☐ Other:	☐ Other:	☐ Other:	☐ Other:
2 - Phase			
☐ Preparatory	☐ Initial	☐ Follow up	
3 - References(1)			
4 – Observed Condition/Activities and Comments(1)			
5 – Results of Surveillance			
☐ Acceptable	☐ Unacceptable	Deficiency #: NCR #:	
Conducted By:	Signature:	Date:	
6 – Project Manager Review			
☐ Concur ☐ Non-Concur	Signature:	Date:	
7 - Distribution			
☐ PM ☐ FOL ☐ SUXOS ☐ UXO Manager ☐ Safety ☐ Other:			

(1) Add/reference continuation sheets as necessary.

TETRA TECH NUS, INC.

DAILY QUALITY CONTROL REPORT		
Contract Number:	Project:	
Report Number:	Location:	Date:

Phase	List Definable Features of Work, Locations, and List Personnel Present	
Preparatory		
Initial		Inspection Performed
Follow up		Inspection Performed

Rework Items Identified Today (Not Corrected by Close of Business)	Rework Items Corrected Today

Remarks

On behalf of the contractor, I certify that this report is complete and correct and the equipment and material used and work performed during this reporting period is in compliance with the contract drawings and specifications to the best of my knowledge except as noted in this report.	Project Quality Control Officer	Date

Client Quality Assurance

Quality Assurance Representative Remarks and/or Exceptions to the Report

Client QA Representative | Date

RECORD-OF-CHANGE FORM

PROJECT NAME:	**PROJECT NO.**	
TO:	**LOCATION:**	**DATE:**
RE: Worksheet #/SOP # _____ Title: _____ Specific Sections: _____		
1. DESCRIPTION (items involved(1):		
2. REASON FOR CHANGE(1):		
3. RECOMMENDED ACTION(1) _____ Minor Change _____ Major Change (Impacts Cost, Schedule)		
4. DISPOSITION: (Approval Required by Client Representative) _____ Not Approved (give reason). _____ Considered minor change – APPROVED per recommended disposition – Documents will not be formally revised. Field office to maintain as –built records. _____ Considered major change – Client approval required via contract modification process		
Prepared by (Signature)	**Date:**	
TtNUS Project Manager (Signature)	**Date:**	
Point of Contact / Client Representative (Signature)	**Date:**	

(1) Attach continuation sheets, sketches, etc., as applicable.

STANDARD OPERATING PROCEDURE

SOP-22

GLOBAL POSITIONING SYSTEM

1.0 PURPOSE

The purpose of this Standard Operating Procedure (SOP) is to provide the Field Technicians with basic instructions for operating a handheld Global Positioning System (GPS) unit, allowing them to set GPS parameters in the receiver, record GPS positions on the field device, and update existing Geographic Information System (GIS) data. This SOP is specific to GIS quality data collection for Trimble-specific hardware and software.

If possible, the Trimble GeoXM or GeoXH Operators Manual should be downloaded onto the operator's personal computer for reference before or while in the field. The manual can be downloaded at http://trl.trimble.com/docushare/dsweb/Get/Document-311749/TerraSyncReferenceManual.pdf

Unless the operator is proficient in the setup and operation of the GPS unit, the Project Manager (or designee) should have the GPS unit shipped to the project-specific contact listed below in the Pittsburgh, Pennsylvania office at least five working days prior to field mobilization so project-specific shape files, data points, background images, and correct coordinate systems can be uploaded into the unit.

Tetra Tech NUS, Inc.
Attn: John Wright
661 Anderson Drive, Bldg #7
Pittsburgh, PA 15220

2.0 REQUIRED EQUIPMENT

The hardware and software identified in this section should be utilized for locating and establishing GPS points in the field.

2.1 Required GPS Hardware

The following hardware are required for the GPS:

- Hand-held GPS unit capable of sub-meter accuracy (i.e. Trimble GeoXM or Trimble GeoXH); this includes the docking cradle, power adapter, stylus, and universal serial bus (USB) cable for data transfer

  Optional Accessories:
  - External antenna
  - Range pole
  - Hardware clamp (for mounting GPS unit to range pole)
  - GeoBeacon
- Indelible marker
- Non-metallic pin flags for temporary marking of positions

2.2 Required GPS Software

The following software is required to transfer data from the handheld GPS unit to a personal computer:

- Trimble TerraSync Version 2.6 or later (pre-loaded onto GPS unit from vendor)

- Microsoft ActiveSync Version 4.2 or later. Download to personal computer from: http://www.microsoft.com/windowsmobile/en-us/downloads/eulas/eula_activesync45_1033.mspx?ProductID=76

- Trimble Data Transfer Utility (freeware version 2.1 or later). Download to personal computer from: http://www.trimble.com/datatransfer.shtml

3.0 START-UP PROCEDURES

Prior to utilizing the GPS in the field, ensure the unit is fully charged. The unit may come charged from the vendor, but an overnight charge is recommended prior to fieldwork.

The Geo-series GPS units require a docking cradle for both charging and data transfer. The Geo-series GPS unit is docked in the cradle by first inserting the far domed end in the top of the cradled, then gently seating the contact end into the latch. The power charger is then connected to the cradle at the back end using the twist-lock connector. Attach a USB cable as needed between the cradle (B end) and the laptop/PC (A end).

It is recommended that the user also be familiar and check various Windows Mobile settings. One critical setting is the Power Options. The backlight should be set as needed to conserve power when not in use.

Start Up:

1) Power on the GPS unit by pushing the small green button located on the lower right front of the unit.

2) Utilizing the stylus that came with the GPS unit, launch **TerraSync** from the Windows Operating System by tapping on the start icon located in the upper left hand corner of the screen and then tap on **TerraSync** from the drop-down list.

3) If the unit does not default to the Setup screen, tap the Main Menu (uppermost left tab, just below the Windows icon) and select Setup.

4) If the unit was previously shipped to the Pittsburgh office for setup, you can skip directly to Section 4.0. However, to confirm or change settings, continue on to Section 3.1.

3.1 Confirm Setup Settings

Use the Setup section to confirm the TerraSync software settings. To open the Setup section, tap the Main Menu and select Setup.

1) Coordinate System
   a. Tap on the Coordinate System.
   b. Verify the project specs are correct for your specific project by scrolling through the various settings. Edit as needed and then tap OK; otherwise, tap Cancel to return to Setup Menu. **Note:** It is always best to utilize the Cancel tab rather than the OK tab if no changes are made since configurations are easily changed by mistake.
   c. Tap on the Units.
   d. Verify the user preferences are correct for your specific project by scrolling through the various settings. Edit as needed and then tap OK; otherwise, tap Cancel to return to Setup Menu.
   e. Tap Real-time Settings.

f. Verify the Real-time Settings are correct for your specific project by scrolling through the various settings. Edit as needed and then tap OK; otherwise, tap Cancel to return to Setup Menu.

g. The GPS unit is now configured correctly for your specific project.

4.0 ANTENNA CONNECTION

1) If a connection has been properly made with the internal antenna, a satellite icon along with the number of usable satellites will appear at the top of the screen next to the battery icon. If no connection is made (e.g.: no satellite icon), tap on the GPS tab to connect antenna.
2) At this point the GPS unit is ready to begin collecting data.

5.0 COLLECTING NEW DATA IN THE FIELD

1) From the Main Menu select Data.
2) From the Sub Menu (located below the Data tab) select New which will bring up the New Data File menu.
3) An auto-generated filename appears and should be edited for your specific project. If the integral keyboard does not appear, tap the small keyboard icon at the bottom of the screen.
4) After entering the file name, tap Create to create the new file.
5) Confirm antenna height if screen appears. Antenna height is the height that the GPS unit will be held from the ground surface (Typically 3 to 4 feet).
6) The Choose Feature screen appears.

5.1 Collecting Features

1) If not already open, the Collect Feature screen can be opened by tapping the Main Menu and selecting Data. The Sub Menu should default to Collect.
2) **Do not begin the data logging process until you are at the specific location for which you intend to log the data.**
3) A known reference or two should be shot at the beginning and at the end of each day in which the GPS unit is being used. This allows for greater accuracy during post-processing of the data.
4) Upon arriving at the specific location, tap on Point_generic as the Feature Name.
5) Tap Create to begin data logging.
6) In the Comment Box enter sample ID or location-specific information.

7) Data logging can be confirmed by viewing the writing pencil icon in the upper part of the screen. Also, the logging counter will begin. As a Rule of Thumb, accumulate a minimum of 20 readings on the counter, per point, as indicated by the logging counter before saving the GPS data.
8) Once the counter has reached a minimum number of counts (i.e. 20), tap on OK to save the data point to the GPS unit. Confirm the feature. All data points are automatically saved within the GPS unit.
9) Repeat steps 2 through 8, giving each data point a unique name or number.

Note: If the small satellite icon or the pencil icon is blinking, this is an indication the GPS unit is not collecting data. A possible problem may be too few satellites. While still in data collection mode, tap on Main Menu in upper left hand corner of the screen and select Status. Skyplot will display as the default showing the number of available satellites. To increase productivity (number of usable satellites) use the stylus to move the pointer on the productivity and precision line to the left. This will decrease precision, but increase productivity. The precision and productivity of the GPS unit can be adjusted as the number of usable satellites changes throughout the day. To determine if GPS is correctly recording data, see Section 5.2.

5.2 Viewing Data or Entering Additional Data Points to the Current File

1) To view the stored data points in the current file, tap on the Main Menu and select Map. Stored data points for that particular file will appear. Use the +/- and <-/-> icons in lower left hand corner of screen to zoom in/out and to manipulate current view.
2) To return to data collection, tap on the Main Menu and select Data. You are now ready to continue to collect additional data points.

5.3 Viewing Data or Entering Data Points from an Existing File

1) To view data points from a previous file, tap on Main Menu and select Data, then select File Manager from the Sub Menu.
4) Highlight the file you want to view and select Map from the Main Menu.
5) To add data points to this file, tap on Main Menu and select Data. Continue to collect additional data points.

6.0 NAVIGATION

This section provides instructions on navigating to saved data points in an existing file within the GPS unit.

1) From the Main Menu select Map.
2) Using the Select tool, pick the point on the map to where you want to navigate.
3) The location you select will have a box placed around the point.
4) From the Options menu, choose the Set Nav Target (aka set navigation target).
5) The location will now have double blue flags indicating this point is you navigation target.
6) From the Main Menu select Navigation.
7) The dial and data on this page will indicate what distance and direction you need to travel to reach the desired target.
8) Follow the navigation guide until you reach the point you select.
9) Repeat as needed for any map point by going back to Step 1.

7.0 PULLING IN A BACKGROUND FILE

This section provides instructions on pulling in a pre-loaded background file. These files are helpful in visualizing your current location.

1) From the Main Menu select Map, then tap on Layers, select the background file from drop down list.
2) Select the project-specific background file from the list of available files.
3) Once the selected background file appears, the operator can manipulate the screen utilizing the +/- and <-/-> functions at the bottom of the screen.
4) In operating mode, the operator's location will show up on the background file as a floating "x".

8.0 DATA TRANSFER

This section provides instructions on how to transfer stored data on the handheld GPS unit to a personal computer. Prior to transferring data from the GPS unit to a computer, Microsoft ActiveSync and Trimble Data Transfer Utility software must be downloaded to the computer from the links provided in Section 2.2 (Required GPS Software). If a leased computer is utilized in which the operator can not download files, see the note at the end of Section 8.0.

1) See Attachment A at the end of this SOP for instructions on how to transfer data from the GPS to a personal computer.

Note: If you are unable to properly transfer data from the GPS unit to a personal computer, the unit should be shipped to the project-specific contact listed in Section 1.0 where the data will be transferred and the GPS unit then shipped back to the vendor.

9.0 SHUTTING DOWN

This section provides instruction for properly shutting down the GPS unit.

1) When shutting down the GPS unit for the day, first click on the “X” in the upper right hand corner.
2) You will be prompted to ensure you want to exit TerraSync. Select Yes.
3) Power off the GPS unit by pushing the small green button located on the bottom face of the unit.
4) Place the GPS unit in its cradle to recharge the battery overnight. Ensure the green charge light is visible on the charging cradle.

ATTACHMENT A

How to Transfer Trimble GPS Data between Data Collector and PC
original 11/21/06 (5/1/08 update) – John Wright

Remember – Coordinate System, Datum, and Units are critical!!!

Trimble Data Collection Devices:
Standard rental systems include the Trimble ProXR/XRS backpack and the newer handheld GeoXT or GeoXH units. Some of the older backpack system may come with either a RECON "PDA-style" or a TSCe or TSC1 alpha-numeric style data collector.

The software on all of the above units should be Trimble TerraSync (v 2.53 or higher – current version is 3.20) and to the user should basically look and function similar. The newer units and software versions (which should always be requested when renting) include enhancements for data processing, real-time display functions, and other features.

Data Transfer:
Trimble provides a free transfer utility program to aid in the transfer of GIS and field data. The Data Transfer Utility is a standalone program that will run on a standard office PC or laptop.

To connect a field data collector such as a RECON, GeoXM, GeoXT, GeoXH, or ProXH, you must first have Microsoft ActiveSync installed to allow the PC and the data collector to talk to one another. A standard USB cable is also needed to connect the two devices.

A CD or USB drive is provided with the data collector for use in data transfer. If needed, these programs are also available without charge via the web at:

• **Trimble Data Transfer Utility** (v 1.38) program to download the RECON or GeoXH field data to your PC: http://www.trimble.com/datatransfer.shtml

• **ActiveSync** from Microsoft to connect the data collector to the PC. The latest version (v4.5) can be found at: http://www.microsoft.com/windowsmobile/activesync/default.mspx
(see page 2 for data transfer instructions)

To Transfer Data Collected in the Field:

• Install the Data Transfer and ActiveSync software installed on your PC
• Connect the RECON or GeoXH to your PC via an A/B USB cable (blade end and square end type "HP printer" style)
• ActiveSync should auto-detect the connection and recognize the data collector
• Make sure the data file desired is CLOSED in TerraSync prior to transfer
• Connect via ActiveSync as a guest (not a partnership)
• Run the Trimble Data Transfer Utility program on your PC
• Select "***GIS Datalogger on Windows CE***" or similar selection
• Hit the green connect icon to the right - the far right area should say "***Connected to ....***" if successful
• Select the "***Receive***" data tab (under device)
• Select "***Data***" from file types on the right
• Find the file(s) needed for data transfer. You can sort the data files by clicking on the date/time header
• Select or browse to a C-drive folder you can put this file for emailing
• When the file appears on the list, hit the "***Transfer All***"
• Go to your Outlook or other email, send a message to: John.Wright@tetratech.com (or GIS department)
• Attach the file(s) you downloaded from your C-drive. For each TerraSync data file created you should have a packet of multiple data files. All need to be sent as a group – make sure you attach all files (the number of files may vary – examples include: ssf, obx, obs, gix, giw, gis, gip, gic, dd, and car)

To Transfer GIS Data from PC to the Field Device (must be converted in Pathfinder Office):

• Obtain GIS file(s) desired from GIS Department and have converted to Trimble extension
• Contact John Wright (John.Wright@tetratech.com) if needed for file conversion and upload support
• The GIS file(s) can be quickly converted if requested and sent back to the field user in the needed "Trimble xxx.imp" extension via email – then quickly downloaded from Outlook to your PC for transfer
• Install the Data Transfer and ActiveSync software installed on your PC
• Connect the RECON or GeoXH to your PC via an A/B USB cable (blade end and square end type "HP printer" style)
• ActiveSync should auto-detect the connection and recognize the data collector
• Connect via ActiveSync as a guest (not a partnership)
• Run the Trimble Data Transfer Utility program on your PC
• Select "***GIS Datalogger on Windows CE***" or similar selection
• Hit the green connect icon to the right - the far right area should say "***Connected to ....***" if successful
• Select the "**Send**" data tab (under device)
• Select "**Data**" from file types on the right (you can also send background files)
• Browse to the location of the data on your PC (obtain the file from Pathfinder Office or from the person who converted the data for field use)
• Select the options as appropriate for the name and location of the data file to go on the data collector (usually you can choose main memory or a data storage card)
• When the file(s) appears on the list, hit the "***Transfer All***"
• Run TerraSync on the field device and open the existing data files. Your transferred file should appear (make sure you have selected Main Memory, Default, or Storage Card as appropriate)

APPENDIX E

LABORATORY STANDARD OPERATING PROCEDURES

Laboratory Standard Operating Procedures (SOPs)
Analytical Laboratory Service, Inc. and DataChem Laboratories, Inc.
Naval Support Facility, Indian Head-Stump Neck Annex

Document Title	Method (Revision)	Date
Analytical Laboratory Service, Inc. (ALSI)		
Waste Disposal	19 – Waste Disposal (rev 1)	November 2, 2006
Mercury by Cold-Vapor Atomic Absorption Using an Automated Continuous-Flow Vapor Generator	03-Hg (rev 13)	November 15, 2007
Microwave Assisted Acid Digestion of Sediments, Sludges, Soils, and Oils	09-3051 (rev 0)	June 1, 2007
Volatile Organic Compounds by Gas Chromatography/Mass Spectrometry (GC/MS): Capillary Column Technique	02-8260B (rev 10)	November 12, 2007
Sample Preparation for the Determination of Mercury in Drinking Water Samples	09-PD-Hg (rev 10)	October 22, 2007
Closed-System Purge-and-Trap and Extraction for Volatile Organics in Soil Waste Samples	02-5035 (rev 1)	June 13, 2008
Analysis of Total Metals by Inductively Coupled Plasma Using the TJA IRIS ICP	03-6010-IRIS (rev 5)	February 4, 2008
Microwave Assisted Acid Digestion of Aqueous Samples and Extracts for Total Metals Analysis by ICP or ICP-MS Spectroscopy	09-3015 (rev 9)	February 5, 2008
Analysis of Total Metals by Inductively Coupled Plasma Using the TJA Trace ICP	03-6010 (rev 13)	February 4, 2008
Ultrasonication of Solids for the Analysis of Explosives by EPA Method 8330B (HPLC)	09-8330B Soil (rev 0)	April 14, 2008
Standard Operating Procedure for Sample Receipt/Sample Handling	19-Rec/Han (rev 12)	January 29, 2008
Solid Phase Extraction of Water for the Analysis of Explosives by EPA Method 8330A (HPLC)	09-8330W (rev 3)	January 29, 2008
Standard Operating Procedure for Chain of Custody Entry	19-COC (rev 4)	November 22, 2006
Nitroaromatics and Nitroamines by HPLC with Ultraviolet Detection	1B-8330 (rev 7)	April 14, 2008
Sample Preparation for the Determination of Mercury in Aqueous	19-PDS-HG (rev 4)	November 15, 2007

Document Title	Method (Revision)	Date
and Soil Samples		
Method 6020 – Determination of Trace Elements in Water and Waste by Inductively Coupled Plasma – Mass Spectrometry	03-6020 (rev 3)	April 3, 2006
Control Limits	NA	NA
DataChem Laboratories, Inc.		
The Determination of Perchlorate in Water, Soil and Biota by Liquid Chromatography/Mass Spectrometry	LC/MS-CL04 (rev 5)	February 15, 2008
Sample Receipt and Log-In (Environmental)	QS-DC-001 (rev 14)	October 2, 2006
Chain-of-Custody and Laboratory Tracking	XX-DC-006 (rev 6)	December 1, 2002
Hazardous Waste Handling and Disposal	LAB-004 (rev 3)	October 31, 2005

Document Title: Waste Disposal

Document Control Number: _____

Organization Title: ANALYTICAL LABORATORY SERVICE, INC. (ALSI)

Address: 34 Dogwood Lane
Middletown, PA 17057

Phone: (717) 944-5541

Approved by:

_____ _____
Helen MacMinn, Date
Quality Assurance Manager

_____ _____
Anna Milliken, Date
Operations Manager

Annual Review:

_____ _____
Reviewed By Date Reviewed

_____ _____
Approved By Date Approved

_____ _____
Reviewed By Date Reviewed

_____ _____
Approved By Date Approved

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Annual Review (continued):

Reviewed By	Date Reviewed
Approved By	Date Approved

Reviewed By	Date Reviewed
Approved By	Date Approved

Reviewed By	Date Reviewed
Approved By	Date Approved

Reviewed By	Date Reviewed
Approved By	Date Approved

Reviewed By	Date Reviewed
Approved By	Date Approved

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1 Scope and Application

1.1 This standard operating procedure is to be used as a guide for the control and disposal of hazardous and general laboratory waste. Waste streams are divided and segregated into different streams to facilitate disposal in an environmental friendly manner in accordance with all federal, state, and local applicable and relevant regulations.

1.2 Waste generated by ALSI can be classified into two specific categories, hazardous and non hazardous waste. It is important to determine the type of waste that needs to be handled so that it can be properly characterized and disposed of safely. When there is any doubt regarding the disposal of a material, the laboratory manager shall be contacted for guidance. Under no circumstances shall an unidentified waste be disposed of in the municipal trash unless it has been properly characterized.

1.3 It is ALSI policy to properly handle waste generated by our facility in an environmentally responsible manner. To assist ALSI, Tier, Inc of Downingtown, PA, serves as ALSI's consultant and disposal company for waste generated at our facility. Tier provides guidance and assistance on the storage, packaging, and transportation of waste from the laboratory facility.

1.4 This document states the laboratory's policies and procedures established in order to meet requirements of all certifications/accreditations currently held by the laboratory, including the most current NELAC standards.

1.5 Individual project requirements may override criteria listed in this SOP.

2 Summary of Method

2.1 Generally, wastes generated in each of the analytical sections are stored in satellite containers or in temporary storage areas. Each container shall be labeled with its contents. When satellite containers are full, they are emptied into the proper drums in the waste storage area. All solvent wastes are stored in the outside chemical cabinet. Once a sufficient amount of waste material has accumulated, Tier is contacted to remove the waste. Tier is responsible for proper drum labeling and packaging, generating the waste manifest, and the removal of the waste from the facility.

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3 Interferences

3.1 Not Applicable.

4 Safety

4.1 The toxicity or carcinogenicity of each sample, reagent, or material that needs to be disposed of may not be precisely known. As such, each material shall be handled cautiously and with care.

4.2 Chemical reagents that require disposal that are in labeled jars or containers most likely can be traced back to a Material Safety Data Sheet (MSDS). The MSDS shall be consulted for guidance when handling and disposing of all materials. ALSI maintains MSDS on all chemicals used. MSDS are available to all staff and located in the QA office.

4.3 For sample containers that have the laboratory identification number present, the Laboratory Information Management System (LIMS) can be consulted for information regarding the specific contents of the sample. Be aware that the sample may not have been tested for all of the parameters that could be present. Reasonable caution must be used when handling an unknown.

4.4 Appropriate PPE must be used when disposing of waste. At a minimum, this shall include a fully-buttoned lab coat, safety glasses, and PVC gloves. A respirator shall also be used when dealing with the disposal of solvents or solid waste material containing high solvent concentrations. Personnel using respirators shall be trained in and follow all applicable OSHA guidelines.

5 Apparatus and Materials

5.1 Gloves- usually latex gloves are sufficient when handling general laboratory waste. It is recommended that the gloves be doubled in the event that the outer glove develops a puncture or rip. Since several of the materials being handled may be unknown, doubling the gloves will provide an extra layer of protection if the material begins to degrade the glove. If degradation is noted, immediately remove both gloves and flush hands under water for 15 minutes. Upgrade the type of glove to a nitrile or silver shield as necessary. A variety of gloves is available from VWR Scientific. The part number is dependent on the type and size of glove ordered.

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5.2 Safety Glasses- Standard grade safety glasses shall always be worn when handling laboratory waste. Safety glasses can be purchased from VWR Scientific catalog #47746-188, or equivalent.

5.3 Drums- 55 gallon DOT approved steel drum, open top sealed with a drum ring. Drums are obtained from SAIC.

5.4 Drums – 55 gallon DOT approved steel drum, closed top with two bunghole openings. Drums are obtained from SAIC.

5.5 Respirator - A half face respirator is required for disposing of solvent waste. The respirator shall be equipped with organic vapor cartridges. NOTE: Only laboratory personnel that have been trained in OSHA guidelines and that have been fit tested are to use a respirator. Contact the laboratory manager for fit test information and contact personnel that are fit tested when solvent disposal is required. Respirators and cartridges can be purchased from VWR Scientific catalog #56222-944 and #56222-955, or equivalent.

5.6 Labels - A label shall be affixed to each drum describing its contents. Labels can be obtained from Tier, Inc.

5.7 Spill control material – includes spill pads, kitty litter, and adsorbent socks. Spill control materials are purchased and maintained by the ALSI safety committee. They are available from VWR Scientific.

6 Reagents

6.1 Not Applicable.

7 Instrument Calibration

7.1 Not Applicable.

8 Quality Control

8.1 It is important to keep the waste separated as indicated in the following sections. Separation of waste is required so that the waste can be properly disposed. In the event that the waste streams are mixed, the laboratory manager shall be immediately notified

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of the occurrence. The mixed waste drum will be relabeled to identify the most hazardous constituents and the drum will be manifested and removed from the laboratory under the new profile.

8.2 Tier serves as ALSI's primary consultant for waste removal. All of the typical waste streams have been classified, sampled, and profiled by Tier. Be sure to follow the guidance outlined in the procedure below so that waste is properly stored and disposed.

8.3 Any questionable classification of waste shall be brought to the attention of the laboratory manager. The laboratory manager will make the decision regarding how to classify the waste. When additional consideration is required, Tier will be consulted.

8.4 In some instances, it may be necessary to collect a sample from waste drums being removed from the site. Samples cannot be collected from the solid drums because the waste cannot be mixed sufficiently to obtain a representative sample. Therefore, samples can only be collected from the solvent waste drums. It is advisable to collect approximately 50 mL of liquid from each drum. The samples shall be archived for approximately one month and shall be analyzed as required in the event of a discrepancy between the manifest information and the actual drum contents.

8.5 All drums and waste storage containers shall be inspected for integrity before placing any waste in said container. Containers with questionable integrity (excessive rust, poor/warped lid, etc) shall not be used.

8.6 All policies and procedures in the most current revision of the ALSI QA Plan shall be followed when performing this procedure.

9 Sample Collection

9.1 When a sample from a liquid drum is required, the following procedure shall be followed

9.1.1 Carefully loosen the bunghole cap using the drum wrench. Allow the pressure and vapors to slowly escape before removing the cap completely. Avoid inhaling the vapors escaping from the drum. Carefully insert the pipette below the liquid surface and pipette approximately 40 to 50 mL of sample into the sample container. Secure the lid tightly on the container.

9.1.2 Label the container with the sample identification, drum identification, date, time and your initials. If necessary, mark an identification number on the drum with a grease pencil, such as "ALSICL01". Be sure the drums are uniquely identified and match the sample identification on the chain of custody. The grease pencil markings will be on the drum until

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ultimate, final disposal and will assist in identifying the drum at the treatment/disposal facility.

10 Procedure

Waste at ALSI have been categorized and characterized by Tier through on-site inspections and random sample collections. Generally, waste can be broken down into hazardous and non-hazardous solids and liquids. The following sections describe disposal procedure for waste encountered at ALSI.

10.1 Non-Hazardous General Waste

10.1.1 General waste accumulated throughout the laboratory is classified as non-hazardous waste and can be disposed of in the municipal trash containers. These wastes include, wrappers, packing, lunchroom waste, paper, used sample containers, used glassware, used personal protective equipment (PPE), and like items. Be sure that all sample containers disposed do not contain sample remains. PPE that may contain high levels of a hazardous material shall be segregated and the laboratory manager consulted for guidance.

10.2 Non-Hazardous Solid Waste

10.2.1 This category of waste has been profiled by Tier as "Waste filter paper and media (non-regulated), waste Approval #Q200000322A10. This waste stream consists of organic prep laboratory generated waste such as sodium sulfate cakes, filter paper and miscellaneous prep waste. This waste profile also includes the majority of used soil sample remains. The following steps shall be followed when disposing of these wastes.

10.2.2 Organic prep laboratory wastes are accumulated in satellite containers in the prep laboratory. When the container is full, transfer its contents to the waste disposal room. Identify the drum labeled "solid waste" and transfer the waste into that drum.

10.2.3 Soil samples are transferred to the waste disposal room by Sample Receiving. Soil samples are disposed of by removing the lid from the container, scraping the sample remains from the container, and transferring them to the "solid waste" drum. The sample container lid and jar can be disposed of in the municipal trash. Do not dispose of sludges in this drum. The waste classified under this profile must not contain freestanding liquids. Do not dump unopened containers or full containers

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into these drums. This creates a "container in a container" situation and hence is considered a mixed waste stream.

10.2.4 If there is no drum present or drums are full, obtain an empty, open-top drum from the drum storage area. Write on the drum lid with a grease pencil "solid waste"

10.2.5 Replace the lid on the drum and ensure that the waste storage room is locked when you leave.

10.3 Non-Hazardous Liquid Waste

10.3.1 Aqueous wastes generated in the laboratory are broken down into two waste streams - sanitary wastewater and laboratory wastewater. Since the ALSI facility is constructed to be a laboratory facility, the drains in the building have been constructed to separate sanitary waste from laboratory wastewater. All of the sanitary waste liquids (toilets and kitchen/ break area) are plumbed directly into the sanitary sewer connection. This waste liquid is not treated or controlled by ALSI. All of the laboratory sinks in the work areas in the laboratory are directed to an on-site waste treatment room. ALSI has a letter of agreement with the local wastewater treatment plant to discharge this waste stream into the sanitary sewer after pH adjustment to no lower than 6.0 and no higher than 9.0 pH units. If the treatment plant experiences any difficulties with the treatment process, ALSI and the treatment plant will work together to implement the necessary controls in our laboratory wastewater discharge. The laboratory manager and the maintenance staff at ALSI are responsible for the operation and maintenance of our treatment system.

10.3.2 The vast majority of aqueous samples received in the laboratory are from drinking water sources, ground water wells, and wastewater discharges from industries. Therefore, once these samples have been analyzed and it is time to dispose of them, they can be discharged to the treatment room without impacting our in-house treatment unit and the local treatment plant's process. The following procedure shall be used for disposing of waste aqueous samples.

10.3.3 The sample receiving department is responsible for identifying aqueous sample remains for disposal. Any aqueous sample that is a neat product, oil, sludge, or sample that has been analyzed and contains high levels of hazardous constituents shall be separated for disposal by one of the other methods outlined below. If you are not sure how to handle a sample, contact the laboratory manager for guidance.

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10.3.4 Once these samples have been identified, they shall be discharged directly into the tank in the treatment room.

10.3.5 Begin by opening the sample bottle and slowly pour the contents into the tank. Some samples have been preserved with acid and will exhibit low pH. Use caution when handling these liquids.

10.3.6 Continue until all aqueous samples have been discharged.

10.3.7 Discard the sample bottle and lid in the municipal trash.

10.4 PCB Waste

10.4.1 This waste stream has been identified as "PCB Contaminated Oils", Approval #WIP440581, and shall be handled with great care. The waste storage area will contain open-top drums identified as PCB oils.

10.4.2 PCB oils are those wastes that are oily and suspected of containing PCBs, samples sent to the laboratory specifically for PCB analysis that are known to contain high levels of PCBs from laboratory data, and GC laboratory generated PCB waste.

10.4.3 The waste material is transferred directly to the drum without being opened. This drum has been specifically profiled for this type of waste.

10.4.4 Place a layer of kitty litter in the drum to adsorb any liquids in the event of container breakage.

10.4.5 Secure the lid in place once disposal is completed.

10.4.6 In the event that a new drum is needed, follow the guidance provided above to start a new drum. Be sure to lock the waste storage room after you leave.

10.5 Autosampler Vials

10.5.1 ALSI and Tier have identified a waste stream commonly called "autosampler vials". This waste stream is comprised of unused sample extracts that remain from gas chromatography analysis and expired standard solutions.

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10.5.2 Used autosampler vials are accumulated in satellite containers located throughout the chromatography laboratories. After the sample is injected, the unused portion of the extract is transferred to the satellite container.

10.5.3 When the satellite container is full, its contents are transferred to the open-top drum located in the drum storage area labeled as “autosampler vials”. Carefully remove the container lid and avoid breathing vapors that escape from the container.

10.5.4 Transfer the contents of the satellite container directly into the autosampler vial drum.

10.5.5 Place a layer of kitty litter over the vials to adsorb any potential leakage.

10.5.6 Secure the lid.

10.5.7 If a new drum is required, follow the guidance above to start a new drum.

10.6 Solvent Waste

10.6.1 There are two type of solvent waste streams identified, chlorinated solvents, Methylene chloride waste, Approval #Q20000322A11, and non-chlorinated solvents, Approval #Q20000322A08. All liquid wastes are stored outside in the chemical cabinets. It is not permissible to store liquid waste in the area designated for solid waste. Inside the chemical cabinet, two drums will be present and marked as chlorinated and non-chlorinated waste. Liquid wastes are stored in closed top drums with two bungholes. Do not use the open top style of drum.

10.6.2 Solvent wastes are generated in several areas of the laboratory and are stored in safe areas throughout the laboratory in DOT approved containers. Once sufficient quantities of waste solvents are generated, they are transferred to the outside storage area.

10.6.3 When satellite containers require empting, contact the laboratory manager.

10.6.4 The laboratory manager shall designate a staff member who is permitted to wear a respirator to transfer the solvents to the solvent waste storage area.

10.6.5 While wearing a respirator, the waste solvent disposal designee shall carefully loosen the bunghole cap using the drum wrench. Once the vapor pressure is reduced, the cap can be removed.

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10.6.6 A grounding clip is attached to the container to be emptied, the receiving drum, and a ground. This procedure reduces the chance of a static spark, which may result in the ignition of the solvent.

10.6.7 Replace the drum cap tightly once all of the satellite containers have been emptied.

10.6.8 The following general guidance is used when disposing of solvent waste.

10.6.9 All chlorinated solvents, such as methylene chloride and freon, are transferred to the chlorinated solvent drum. All non-chlorinated solvents, such as hexane, acetone, toluene, etc are transferred to the non-chlorinated drum. The non-chlorinated drum can also be used to dispose of aqueous sample remains that are not suitable for conventional disposal. These items include, sludge samples, oil samples, paint, inks, etc. As always, if there is any question regarding the fate of a material, contact the laboratory manager.

10.7 Miscellaneous Items and Neat Chemicals and Reagents

10.7.1 From time to time there will be items that require special handling. These items include but are not limited to mercury waste, such as broken thermometers, expired pure chemicals, neat reagents, and material specifically received as hazardous materials. When these items are identified for discard, the laboratory manger shall be contacted. The laboratory manager shall contact Tier for advice and disposal information. These materials will be lab packed and disposed of by Tier in a responsible manner.

10.8 Waste Removal

10.8.1 Once a sufficient amount of waste has been accumulated, Tier is contacted by the laboratory manager to schedule a waste pick-up. Waste is removed from ALSI's laboratory facility approximately every 90 days. The numbers and types of drums to be removed are relayed to Tier.

10.8.2 When Tier arrives to pick-up waste, the laboratory manager shall be contacted.

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10.8.3 Tier and the laboratory manger will conduct an inspection of all containers that will be removed. The containers are inspected for leakage and premature ware.

10.8.4 All drum lids are secured in place and each drum is labeled by Tier. Each drum label contains the generator information, address, phone number, EPA generator ID number, the waste manifest number, approval number, and a description of the waste. Tier is responsible for generating the labels and supplying them to ALSI.

10.8.5 If necessary, the drums are placarded with hazard information. Tier is responsible for applying the necessary labels to each drum.

10.8.6 If solvent wastes are being removed, it is recommended that a sample be collected. Follow the guidance provided in the sample collection section of this SOP.

10.8.7 Tier is responsible for marking the drum lid with relevant manifest information using a grease pencil. Be sure each drum has been properly marked with the necessary information.

10.8.8 As the drums are loaded onto the truck, Tier and the ALSI will begin working on the hazardous waste manifest. Tier is responsible for preparing the manifest. All waste removed from ALSI must be documented on a manifest. The following shall be completed and reviewed on the manifest:

10.8.9 List the number and type of containers being removed.

10.8.10 Estimate the total weight of the containers and record this weight on the waste manifest.

10.8.11 Check that the identification of the containers being removed matches that of the manifest.

10.8.12 Double check the number of drums being removed against the quantity listed on the manifest.

10.8.13 Be sure that the truck driver and Tier are in agreement with all items listed on the manifest.

10.8.14 Once the manifest is completed, the laboratory manger will sign the manifest on behalf of ALSI. The transporter also needs to sign the waste

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manifest. No other person is designated to sign the manifest unless specifically designated by the laboratory manager.

10.8.15 The laboratory manager will receive a copy of the manifest.

10.8.16 Tier shall take the remaining copies to be forwarded to the state, and the disposal facilities.

10.8.17 Secure the waste storage areas and label new drums to begin the next accumulation cycle. Secure and lock the outside storage cabinet.

11 Documentation and Record Keeping

11.1 Tier will be responsible for forwarding a copy of the manifest to the state for their records.

11.2 Copies of the manifest and land ban documents (if required) are maintained by the laboratory manager.

11.3 Shortly after a disposal event occurs, the disposal facility will send a copy of the manifest indicating the acceptance of the material. This information is filed and maintained by the laboratory manager.

11.4 After the material has been accepted, the sample collected from the solvent drums can be disposed. If a discrepancy exists, the laboratory manager at his discretion will have the samples analyzed as required.

11.5 Any conflicts or rejection of waste due to the material being off the profile specifications will be worked out with the assistance of Tier.

12 Calculations

12.1 Not applicable.

13 Reporting Results

13.1 Not applicable.

14 Pollution Prevention

14.1 Not applicable.

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15 Definitions

15.1 Not applicable.

16 Troubleshooting

16.1 Not applicable.

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SOP Change History Summary

Section #	Section	Reason for Change
Revision 1: 11/02/2006		
1.5	Scope and Application	Added project requirements criteria statement
2.1	Summary of Method	Revised "liquid" to read "solvent"
4.2	Safety	Added MSDS availability
4.4	Safety	Added appropriate PPE
5	Apparatus and Materials	Added additional vendor information throughout; removed specifics on grease pencils and sampling equipment
5.3, 5.4	Apparatus and Materials	Replaced "manager" with "SAIC" for obtaining additional drums
5.5	Apparatus and Materials	Added requirement for OSHA guideline training
8.6	Quality Control	Added reference to QA Plan
9.1	Sample Collection	Removed requirement for Tier personnel to be present at sampling
10.2.2	Procedure	Added detailing for transferring solid waste
10.2.3	Procedure	Deleted reference to sample receiving performing transfer of samples
10.3.2, 10.3.4, 10.3.5, 10.3.6	Procedure	Revised discharge location from "any laboratory sink" to "the treatment room"
10.4	Procedure	Revisions made throughout section on disposal of PCB waste
12-16	Calculations, Reporting Results, Pollution Prevention, Definitions, Troubleshooting, SOP Change History Summary	Added all sections for site-wide SOP conformance

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SOP Concurrence Form
for the Distribution and Revision of Standard Operating Procedures

I have read, understood, and concurred with the Standard Operating Procedure (SOP) described above and will perform this procedure as it is written in the SOP.

Print Name	Signature	Date

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Document Title: Mercury by Cold-Vapor Atomic Absorption Using an Automated Continuous-Flow Vapor Generator

Document Control Number: _____

Organization Title: ANALYTICAL LABORATORY SERVICE, INC. (ALSI)

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Annual Review:

_____ _____
Reviewed By Date Reviewed

_____ _____
Approved By Date Approved

_____ _____
Reviewed By Date Reviewed

_____ _____
Approved By Date Approved

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Annual Review (continued):

Reviewed By	Date Reviewed
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Reviewed By	Date Reviewed
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1 Scope and Application

1.1 This method is adapted from EPA Method 245.1, Revision 3.0, May 1994; SW-846 Method 7470A, Mercury in Liquid Waste, September 1994 Revision 1; and, Method 7471B, Mercury in Solid or Semisolid Waste, January 1998 Revision 2; Method 7000 Atomic Absorption Methods, July 1992, Revision 1.

1.2 This document states the policies and procedures established in order to meet requirements of all certifications/accreditations currently held by the laboratory, including the most current NELAC standards.

1.3 This method is restricted to use by or under the supervision of analysts experienced in the use of cold vapor analysis. Each analyst must also be skilled in the interpretation of raw data, including quality control data.

1.4 This method measures total mercury (organic-inorganic) in drinking, surface, saline, and ground waters, domestic and industrial wastes, and mobility-procedure extracts. It also applies to soils, sediments, bottom deposits, and sludge-type materials.

1.5 In addition to inorganic forms of Mercury, organic materials may also be present. These organo-mercury compounds will not respond to the cold vapor atomic absorption technique unless they are first broken down and converted to mercuric ions. Potassium permanganate oxidizes many of these compounds, but recent studies have shown that a number of organic mercurials, including phenyl mercuric acetate and methyl mercuric chloride, are only partially oxidized by this reagent. Potassium persulfate has been found to give approximately 100% recovery when used as the oxidant with these compounds. Therefore, a persulfate oxidation step following the addition of the permanganate has been included to insure that organo-mercury compounds, if present, will be oxidized to the mercuric ion before measurement. A heat step is required for methyl mercuric chloride when present in or spiked to a natural system.

1.7 All samples must be digested prior to analysis.

1.8 Method Detection Limits (MDLs) are available on the ALSI network and are maintained and updated by the QA Department. The detection limits for a specific sample may differ from those listed due to the nature of interferences in a particular sample matrix.

1.8 Individual project requirements may override criteria listed in this SOP.

2 Summary of Method

2.1 The flameless AA procedure is a physical method based on the absorption of radiation

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at 253.7 nm by mercury vapor. The samples/standards and reagents are pumped into the analyzer and mixed. Argon gas is introduced into the solution stream, which flows to a mixing coil where the samples and reagents are thoroughly combined in the mixing coil. The gas and liquid stream is transferred to the gas/liquid separator where the gas and liquid phases are separated. The liquid waste is drained off and the gas is pumped to the absorption cell. The absorption cell is positioned in the light path of the mercury lamp. Absorbance (peak height) is measured as a function of mercury concentration and recorded as ppb of mercury.

3 Interferences

3.1 Possible interference from sulfide is eliminated by the addition of potassium permanganate. Concentrations as high as 20 mg/L of sulfide as sodium sulfide do not interfere with the recovery of added inorganic mercury from distilled water.

3.2 Copper has also been reported to interfere; however, copper concentrations as high as 10 mg/L had no effect on recovery of mercury from spiked samples.

3.3 Seawaters, brines, and industrial effluents high in chlorides require additional permanganate (as much as 25 mL). During the oxidation step, chlorides are converted to free chlorine, which will also absorb radiation of 253 nm. Care must be taken to assure that free chlorine is absent before the mercury is reduced and swept into the cell. This may be accomplished by using an excess of hydroxylamine hydrochloride reagent (25 mL). Both inorganic and organic mercury spikes have been quantitatively recovered from seawater using this technique.

3.4 Interference from certain volatile organic materials which will absorb at this wavelength is also possible. All positive samples must be checked for false positives due to organics by analysis without the addition of stannous chloride.

4 Safety

4.1 Operation of an atomic absorption spectrophotometer involves the use of argon gas and hazardous materials including corrosive fluids. Unskilled, improper, and careless use of equipment can create explosion hazards, fire hazards or other hazards, which can cause death, serious injury to personnel, or severe damage to equipment or property.

4.2 Caution shall be taken when handling all samples, standards, and QC material because of the acidic nature of the prepared samples as well as the possible mercury content in the samples.

4.3 ALSI maintains material safety data sheets (MSDSs) on all chemicals used in this procedure. ALSI recommends that all individuals performing this SOP familiarize

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themselves with the MSDSs associated with the procedure prior to SOP performance. MSDSs are available to all staff and are located in hard copy in the QA reference library and electronically on the ALSI server in the MSDS folder.

4.4 Lab personnel shall adhere to the rules listed in SOP 90-Chemical Hygiene Plan. The minimum PPE requirements for this method are safety glasses, a fully buttoned lab coat and chemical resistant gloves. The acidification of samples containing reactive materials may result in release of toxic gases, such as cyanides or sulfides. A fume hood shall be used during the acidification of samples. This PPE should reduce the possibility of contact to a safe level, but the analyst should not limit themselves to these PPE minimums.

5 Apparatus and Materials

5.1 Automated Mercury Analyzers

5.1.1 CETAC M-6100 Mercury Analyzer.

5.1.2 PSA Automated Mercury Analyzer.

5.2 Green-Green Santoprene tubing: P S Analytical, cat. #M025T002

5.3 Yellow-Yellow Santoprene tubing: CETAC SP5705A

5.4 Black-Black Santoprene tubing: CETAC SP5705B

5.5 Finnpipette with disposable tips: 2 mL – 10 mL VWR, cat# 53516-178 or equivalent
0.2 mL – 1 mL VWR, cat #53515-876 or equivalent
20 µL – 200 µL VWR, cat#53503-094 or equivalent

5.6 Finnpipette Digital Pipettors (20-200µL volume), Thermo Labsystems, VWR catalog #53515-020, or equivalent.

5.7 Finnpipette Digital Pipettors (200-1000µL volume), Thermo Labsystems, VWR catalog #53515-044, or equivalent.

5.8 Various Class A volumetric glassware.

5.9 Various calibrated dispensers.

5.10 40-mL VOA vials: Industrial Glassware #2795FL-PC.

5.11 25-mL graduated cylinder: Class A.

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5.12 14-mL polypropylene tubes: VWR #60818-618 or equivalent.

6 Reagents

NOTE: Unless otherwise noted in this section all chemicals are stored at room temperature and labeled with an expiration date of five years from receipt. Manufacturer's labeled expiration dates take precedent over all other expiration dates. All reagents and standard solutions in this section must be labeled and logged into appropriate laboratory logbooks. In addition, the logbook numbers must be labeled on the reagent or standard solution and on all appropriate preparation worksheets. Reagent bottles must also include the analyst's initials, preparation date, and expiration date.

6.1 Reagent water - A Filson Water Purification System is used which provides analyte-free, >16.0 megohm-cm deionized water on demand. This water is used for preparation of all reagents, calibration standards, and as dilution water.

6.2 Liquid Argon: high purity grade, MG Industries or equivalent.

6.3 Stannous Chloride ($SnCl_2$): Prepare by adding 100 g of stannous chloride crystal (VWR, catalog #EM-SX0885-1 or equivalent) to a 1000-mL volumetric flask. Add 14.0 mL conc. H_2SO_4 and stir until dissolved. Bring up to volume with reagent water. Maximum storage life for stannous chloride is approximately 12 hours.

6.4 Sulfuric Acid (H_2SO_4), conc. Baker Instra-analyzed grade: VWR, cat. #JT9673-33 or equivalent.

6.5 Sodium Chloride (NaCl.) Baker Instra-analyzed grade: VWR, cat. #JT3625-15 or equivalent.

6.6 Hydroxylamine hydrochloride decolorizing reagent ($NH_2OH{\cdot}HCl$): To prepare, dissolve 120 g Hydroxylamine hydrochloride crystals (VWR, cat. #JT2196-1 or equivalent) and 120 g NaCl in reagent water in a 1000-mL volumetric flask. Bring up to volume using reagent water. Label with an expiration date of 90 days. The amount used for decolorizing is dependent upon the type of analysis being performed. Water samples require 2.0 mL and solid sample require 6.0 mL.

7 Instrument Calibration

7.1 The instrument plots a standard calibration curve each day of use, using five standards and a blank. The calibration standards for EPA Method 245.1 and 7470 are Blank, 0.2 µg/L, 1.0 µg/L, 2.0 µg/L, 4.0 µg/L, and 10.0 µg/L. The calibration standards for EPA Method 7471 are Blank, 0.5 µg/L, 1.0 µg/L, 2.0 µg/L, 4.0 µg/L, and 10.0 µg/L. The calibration standards used for extra low level requests are 0.050 µg/L, 0.075 µg/L, 0.100 µg/L, 0.200 µg/L, and 0.500 µg/L. Starting with the blank and working toward

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the high standard, the standards are introduced into the mercury analyzer by the auto sampler. Absorbance readings are recorded by the data system.

7.2 The range of the method is 0.2-10 µg/L. The range may be extended above or below the normal range by increasing or decreasing sample size. However, the actual method detection limit and linear working range will be dependent on the sample matrix, type of instrumentation configuration, and selected operating conditions.

7.3 A calibration curve is drawn by plotting the absorbance readings on the y-axis and concentration readings on the x-axis. The software of the data system plots the curve. The calibration curve is used to calculate the concentration for the samples. The correlation coefficient must be 0.995 or greater.

7.4 A set of calibration standards is prepared per day when mercury batches are being digested. It is these standards, which must be used to prepare the calibration curve for those batches of samples.

7.4.1 If Method 245.1 and Method 7470 are being analyzed together, Method 7470 standards may be used to analyze both methods.

7.5 An Initial Calibration Verification (ICV) must be analyzed after every calibration to verify the instrument performance before analysis. The ICV is prepared from the second source standard. Analysis of the ICV immediately following calibration must verify that the instrument is within ± 5% of calibration for EPA Method 245.1, and ±10% for EPA Methods 7470/7471. Continuing calibration verifications (CCV) must be within ±10% of calibration. If outside of this range, analyze a second time. If still outside of this range, determine and correct the problem; recalibrate. Samples may not be analyzed until an acceptable ICV/CCV is analyzed.

7.6 If a point in the curve is either too high or too low it can be deleted and replaced by using a new standard. This can only be done to one point in the curve at time of calibration. This can be performed by double clicking on the point in the graph and a small window will appear indicating to inspect data. Click once and a window will appear where you will choose the point you want to replace. Click on the replacement button and analyze the new point chosen.

7.7 Laboratory Control Sample (LCS). A digested standard must be analyzed with each batch. It is prepared at 2.0 ppb from the same source as that of the calibration standards. The recovery must be within ± 15% (± 20% for soils) of the true value for the calibration. If outside of this range, determine and correct the problem and re-analyze. If necessary, recalibrate. If the LCS fails the entire batch of samples associated with it must be re-digested and re-analyzed.

7.8 If the calibration blank concentration is greater than or equal to the reporting limit

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AND is greater than $^{1}/_{10}$ the sample concentration, the source of the contamination must be investigated and measures taken to minimize or eliminate the problem and affected samples reanalyzed. If reanalysis is not possible, data shall be reported with a qualifying statement.

7.8.1 For DoD samples, if the calibration blank concentration is greater than or equal to 2x the MDL, the source of contamination must be investigated and measures taken to minimize or eliminate the problem and affected samples reanalyzed. If reanalysis is not possible, data shall be reported with a qualifying statement.

8 Quality Control

8.1 All policies and procedures in the most current revision of the ALSI QA Plan shall be followed when performing this procedure.

8.2 A demonstration of capability shall be performed before any client samples are analyzed. The DOC is determined by the analysis of four different Laboratory Control Samples (LCS). The percent recovery of the four LCSs must be 85-115% and the percent RPD must be $\leq$ 10%. If demonstration of capability fails, reanalyze. Ongoing proficiency must be established annually as specified in the QA plan, Technical Training.

8.3 Linear Dynamic Range (LDR) - The upper limit of the LDR must be established. It must determined form a linear calibration prepared form a minimum of three different concentration standards, one of which is close to the upper limit of the linear range. The LDR should be determined by analyzing succeedingly higher standard concentrations of mercury until the observed analyte concentration is no more than 10% below the stated concentration of the standard. The determined LDR must be documented and kept on file. The most current LDR data can be found on the ALSI server in the METALS DEPT folder. The LDR which may be used for the analysis of samples should be judged by the analyst from the resulting data. Determined sample analyte concentrations that are greater than 90% of the determined upper LDR limit must be diluted and reanalyzed. The LDR should be verified annually or whenever, in the judgment of the analyst, a change in analytical performance caused by either a change in instrument hardware or operating conditions would dictate they be redetermined.

Quality Control Requirements

(Specific Project Requirements may override these requirements)

Parameter	Concentration	Frequency	Acceptance Criteria	Corrective Action

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Calibration Blank (ICB/CCB)	NA	Analyzed after every ICV/CCV, and after every 10 samples.	< PQL	Re-analyzed the blank. If still out of range, the problem must be solved by preparing a new blank, recalibration, or instrument maintenance. Samples following the last acceptable blank must be rerun. See Section 7.8.
Method Blank	NA	One digested with each batch of 20 or less samples. They are analyzed with that batch of samples.	½ the Reporting Limit	Re-analyze the blank. The samples in the prep batch must be less than the reporting limit or greater than 10X the reagent blank value for the affected analyte. It not, the affected samples in that batch must be re-digested. If re-digestion is not possible, they will be reported with a qualifying comment. See Section 8.7.
Laboratory Control Sample (LCS) or Laboratory Fortified Blank (LFB)	Water: 2.0 µg/L Soil: 200 µg/kg Low detection waters: 0.10 µg/L	One digested with each batch of 20 or less samples. They are analyzed with that batch of samples.	Water: 85-115% R Soil: 80-120% R As required by the Method	Re-analyze the LCS. If the recovery is still outside the given range, the source of the problem must be identified and corrected before continuing analyses. If the problem cannot be identified, the samples in that batch must be re-digested. If re-digestion is not possible, report with a qualifying comment.
Matrix Spike (MS)*	Water: 5.0 µg/L Soil: 5.0 µg/kg Low detection waters: 0.200 µg/L	2 Matrix Spikes (MS) must be digested with every batch of 10 or more samples. If 10 or less samples in a batch one Matrix Spike is digested.	80-120% R As required by the Method	Analyze a post digestion spike (85-115%). If still out of range, a qualifying comment is noted on the final lab report.
Matrix Spike Duplicate (MSD) or Duplicate (Dup)*	Water: 5.0 µg/L Soil: 5.0 µg/kg Low detection waters: 0.200 µg/L	2 Matrix Spikes Duplicate (MSD) must be digested with every batch of 10 or more samples. If 10 or less samples in a batch one Matrix Spike Duplicate is digested.	<20% RPD As required by the Method	Re-digest the sample. If still outside of acceptable limits, report with a comment on the lab report.
Initial Calibration Verification Standard (ICV) (Second Source)	4.0 µg/L Low detection waters: 0.100 µg/L	Immediately after calibration.	Immediately after calibration ± 5%R (245.1); ± 10%R (7470/7471).	Re-analyze the ICV. If still out of range, recalibrate the instrument.
Continuing Calibration	4.00 µg/L for Methods 245.1 &	Immediately after calibration, after every ten samples, and	Immediately after calibration ± 5%R	Re-analyze the CCV. If still out of range, recalibrate the

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Verification Standard (CCV) (Same Source)	7470 and 4.0 µg/L used for Method 7471 and Low detection waters: 0.100 µg/L	after the last sample.	(245.1); ± 10%R (7470/7471). Thereafter it must be within ± 10%R.	instrument. Any samples analyzed after the last acceptable CCV must be re-analyzed.

* Samples selected for duplicate and matrix spike analysis shall be rotated among client samples so that various matrix problems may be noted and/or addressed. Poor performance in a duplicate or spike may indicate a problem with the sample composition and shall be reported to the client whose sample produced the poor recovery.

Note: See Section 11.3 for % recovery calculations.

8.4 For samples with results greater than the established LDR will be diluted and reanalyzed until the concentrations are within range.

8.5 Method detection limits are determined annually using the procedure outlined in the ALSI Quality Assurance Plan. NOTE: If **DoD samples** are to be analyzed, an MDL check sample will be used to verify the MDL. The MDL check sample is at a concentration equal to 2x the MDL. If a positive response is detected from the MDL check sample, another MDL study is not needed for that calendar year. MDL studies must be performed according to SOP-99-MDL or the reference method, whichever is more frequent.

8.5.1 Practical Quantitation Limits (PQL) or reporting limits are determined by multiplying the MDL by 3-5 times, and adding an appropriate safety factor.

8.6 If the matrix spike fails criteria, a post digestion spike is performed. If the recovery of the post digestion spike is within 85-115%, the results will be reported. If outside of this range, comment on the final report.

8.7 If the method blank concentration is greater than or equal to the reporting limit AND is greater than $^{1}/_{10}$ the sample concentration, the source of the contamination must be investigated and measures taken to minimize or eliminate the problem and affected samples reanalyzed. If reanalysis is not possible, data shall be reported with a qualifying statement.

8.7.1 For DoD samples, if the method blank concentration is greater than or equal to ½ the reporting limit AND is greater than $^{1}/_{10}$ the sample concentration, the source of the contamination must be investigated and measures taken to minimize or eliminate the problem and affected samples reanalyzed. If reanalysis is not possible, data shall be reported with a qualifying statement.

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9 Sample Collection, Preservation and Handling

9.1 Collect samples in any size plastic or glass bottle. Minimum amount required for analysis is 100 mL.

9.1.1 Aqueous samples requiring dissolved metals shall be filtered immediately on site before adding preservation for dissolved metals.

9.2 Preserve aqueous samples using HNO_3 to a pH <2. Sample preservation shall be performed immediately upon sample collection. If this is not possible, then samples shall be preserved as soon as possible when received at the laboratory. If samples are preserved in the laboratory, hold for 24 hours then check the pH. If pH is >2, sample must be re-acidified and the pH must be checked after 24 hours.

9.3 All samples must be analyzed within 28 days of collection. All samples and sample digestates shall be stored at room temperature, separated from standards.

9.4 All samples require digestion. Refer to SOP 09-PD-Hg and SOP 09-PDS-Hg for details.

10 Procedure

10.1 For P S Analytical Merlin Millennium.

10.1.1 Verify the Argon pressure is set at 40 psi and inspect the tubing. If it has flattened change all four lines and clamp.

10.1.2 Open the Avalon Software and name the folder using the date on appropriate matrix: W for waters, S for soils and LL for low detection waters.

10.1.3 Under the OPTIONS heading select SERVICE OPTIONS and check the Disable dryer gas check and also Disable the analysis gas.

10.1.4 Under the METHODS heading select ALSIW and click OK. If analyzing the low detection samples, set the range to 10. Verify that the lines are drawing liquid by using harmless food coloring and adjust the pump clamps to set the proper tension. Allow the instrument to warm up for at least 15 minutes.

10.1.5 Fill the Stannous Chloride reservoir with 10% $SnCl_2$ and insert the probe into it. Allow this to flush the system for 10 minutes.

10.1.6 Under the OPTIONS heading select MANUAL CONTROL. Adjust the reference output between 107-110 using the screw on the instrument labeled

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R. Adjust the Trans Loss by setting the range to 10 and using the screw on the instrument labeled TL set the range to 160-190.

10.1.7 Under the CALIBRATION heading select NEW CURVE and set the standards and select analyze. To each standard add Hyrdroxylamine hydrochloride. Shake until color disappears and vent. Load into spaces 1 to 6 on the autosampler. In the instrument software set the concentrations that are being used, click OK and verify that the settings are correct and click OK.

10.1.8 After the calibration is complete and acceptable, (r=0.995 or greater) under the PROGRAM heading choose the program editor and OPEN the correct autosampler table.

10.1.9 To each sample add Hydroxylamine hydrochloride. Shake until color disappears and vent. Load the samples into the autosampler tray. To begin the analysis of the samples, under the PROGRAM heading choose RUN and click OK to begin the analysis.

10.1.10 After analysis is complete, any sample that has a result above the reporting limit must be rerun without $SnCl_2$ to determine if an organic interference is present.

10.1.10.1 If the $SnCl_2$ result is greater than the reporting limit, subtract the non-stannous chloride result to get the final mercury concentration.

10.2 For the CETAC M-6100 Mercury Analyzer

10.2.1 Turn on the lamp by clicking on the Turn on/off button on the back of the instrument make sure that the auto sampler is also on. On/Off button is found also in back of auto sampler. The lamp must be warm before running any samples for at least 1 ½ hours.

10.2.2 Inspect the sample tubing and replace if needed. Yellow-Yellow (Rinse Flow) bottom, Yellow-Yellow (Waste Flow) Second bottom, Yellow-Yellow (Sample Flow) Third Middle, Black-Black (Stannous Chloride) Fourth Top clamp the first two top lines. Verify that the capillary is 0.5 mm above the Gas/liquid separator center post.

10.2.3 Once all the tubing is clamped and the gas flow is set at 60 psi. A piece of duct tape is used to secure the lines from unclamping due to tension on the clamps. Gas flow is controlled by the regulator on the wall beside the PSA Analyzer. Start the Quick Trace M-6100 software by clicking on the TRACE ICON on

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the desktop.

10.2.4 Wet the Gas/liquid separator (GLS) center post. Make sure that the upper black tubing is disconnected from the (GLS) before wetting. Once the Gas/Liquid Separator is rinsed/wet and no rinse remains in the (GLS) adjust the gas flow to 40 psi and connect the upper black tubing to the (GLS). And clamp the two bottom lines.

10.2.5 Open the proper worksheet by clicking on FILE on the toolbar and OPEN, a window will appear with the types of Matrix templates, choose the one needed and using SAVE AS name it using the date followed by W for waters; S for soils; LL for low detection. All calibration standards are already set up in each template according to its matrix. All method and instrument parameters are already preset in each matrix templates. Sample ID numbers should be typed in by clicking on the graph button and a chart window will appear to type all sample numbers that are being loaded on to the sample rack (SEE APPENDIX A-3).

10.2.6 At this point, add Hydroxylamine hydrochloride to each standard shake until color disappears and vent. Load the standards and begin the calibration. The calibration can be monitored by going to the button on the tool bar that has the CHART and click on it and a window will appear and it will show all the standards and other information needed to monitor the instrument process (SEE APPENDIX A-1). Once the calibration is complete and acceptable, (r=0.995 or greater) sample analysis can begin. If calibration is not acceptable this is where you should replace points or recalibrate the instrument to get an acceptable calibration curve. Decolorize the samples using Hydroxylamine hydrochloride shake until color disappears and vent. Load the samples into the auto-sampler tray for analysis. To load samples onto auto sampler rack start from back left corner to front left corner of rack and continue down the rack left to right in the same manner.

10.2.7 After analysis is complete, any sample that has a result above the reporting limit must be rerun without $SnCl_2$ to determine if an organic interference is present.

10.2.7.1 Pull the Stannous Chloride line and put it into a 10% HCl rinse to get rid of any Stannous Chloride in the system. Rinse for 10 minutes before attempting to run any of the samples that need Non-Stannous Chloride verification. Once the Non-Stannous Chloride samples have been run place the Stannous Chloride line back into the $SnCl_2$ to run any CCV/CCB before finishing the run.

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10.2.7.2 If the $SnCl_2$ result is greater than the reporting limit, subtract the non-$SnCl_2$ result to get the final mercury concentration.

11 Calculations

11.1 Samples results are documented directly form the readout of the instrument in ppb (from the calibration curve).

11.2 The results are converted to ppm and input into the LIMS.

11.3 **LCS Recovery**

% recovery = (Cm/Cn) x100

Cm = measured concentration of LCS

Cn = Spiking concentration

Spike Recovery

% recovery = [(Cs-Cu)/Cn] x100

Cs = measured concentration of spiked sample aliquot

Cu = measured concentration of unspiked sample aliquot

Cn = spiking concentration

Precision (RPD)

$$\% \text{ RPD} = \frac{|(R1-R2)|}{(R1+R2)/2} \times 100$$

R1 = sample or spike result

R2 = duplicate or spike duplicate result

12 Reporting Results

12.1 Horizon LIMS results are reported to three significant figures but limited to the number of decimal places in the reporting limit for the individual compound or analyte.

12.2 When entering data into the Horizon LIMS do not round off results: Horizon will automatically round off to three significant figures after all internal calculations are completed.

12.3 Report the actual result, even if it is less than the reporting limit. Any sample with a result less than the reporting limit is reported as ND (non-detectable); LIMS will automatically report the appropriate detection limit. Enter dilution factors into the appropriate field.

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12.4 DEP samples exceeding the Maximum Contaminant Level (MCL) must be reported to the Customer Service Representative immediately following determination in order to comply with the Pennsylvania Code; Title 25, Chapter 109, Section 109.810 for Reporting and Notification Requirements.

12.5 All raw data used for reporting results must be dated and initialed by the qualified laboratory personnel performing first and second review.

12.6 The following must be done to upload data into the Horizon LIMS system. It is instrument specific.

12.6.1 For data from the CETAC M-6100:

Select the REPORTS icon from the instrument software and choose the file to be uploaded. Next select EXPORT FILE. This file is to be exported to the CETAC folder located on the Desktop. Name the file so that it corresponds to the actual run and save. It is now in an EXCEL spreadsheet and shall be in the following format so that uploading can occur *SAMPLE NUMBER*SAMPLE TYPE*BATCH NUMBER*ANALYST INITIALS*DILUTION* (This is only needed if it is something other than 1.) Once all samples have this format the following shall be done to complete the process. Open the MERCURY_CETAC file and click the button called 'import.csv file'. Select the file name to be uploaded from the CETAC DATA folder on the desktop. The reports will print to NuGenesis and can be posted in the Horizon LIMS.

12.6.2 For data from the P S Analytical:

Select the FILE option and select SAVE AS TEXT. Name the file so that it corresponds to the actual run .txt (example: results.txt). Under the drivers select e:\\wmmet001\psadata. Open the spreadsheet named PSA and click 'import .txt file' Select the file name to be uploaded from the PSA data folder on the Desktop. The data shall be in the following format so that uploading can occur *SAMPLE NUMBER*SAMPLE TYPE*BATCH NUMBER*ANALYST INITALS*DILUTION* (this is only needed if it is something other than 1). Once all the sa mples have this format the following shall be done to complete the process. Click the 'send to NuGenesis' button. The reports will print to NuGenesis and can be posted in the Horizon LIMS.

13 Waste Disposal

13.1 Refer to ALSI SOP 19-Waste Disposal.

14 Pollution Prevention

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14.1 Pollution prevention encompasses any technique that reduces or eliminates the quantity or toxicity of waste at the point of generation. Numerous opportunities for pollution prevention exist in laboratory operations. Management shall consider pollution prevention a high priority. Extended storage of unused chemicals increases the risk of accidents. The laboratory shall consider smaller quantity purchases which will result in fewer unused chemicals being stored and reduce the potential for exposure by employees. ALSI tracks chemicals when received by recording their receipt in a traceable logbook. Each chemical is then labeled according to required procedures and stored in assigned locations for proper laboratory use.

15 Definitions

15.1 Refer to ALSI QA Plan under Laboratory Quality Control Checks for general definitions.

16 Troubleshooting

16.1 Refer to maintenance logs and instrument manuals for guidance in troubleshooting specific problems related to the instrumentation used in this method.

Appendix A – CETAC figure 1

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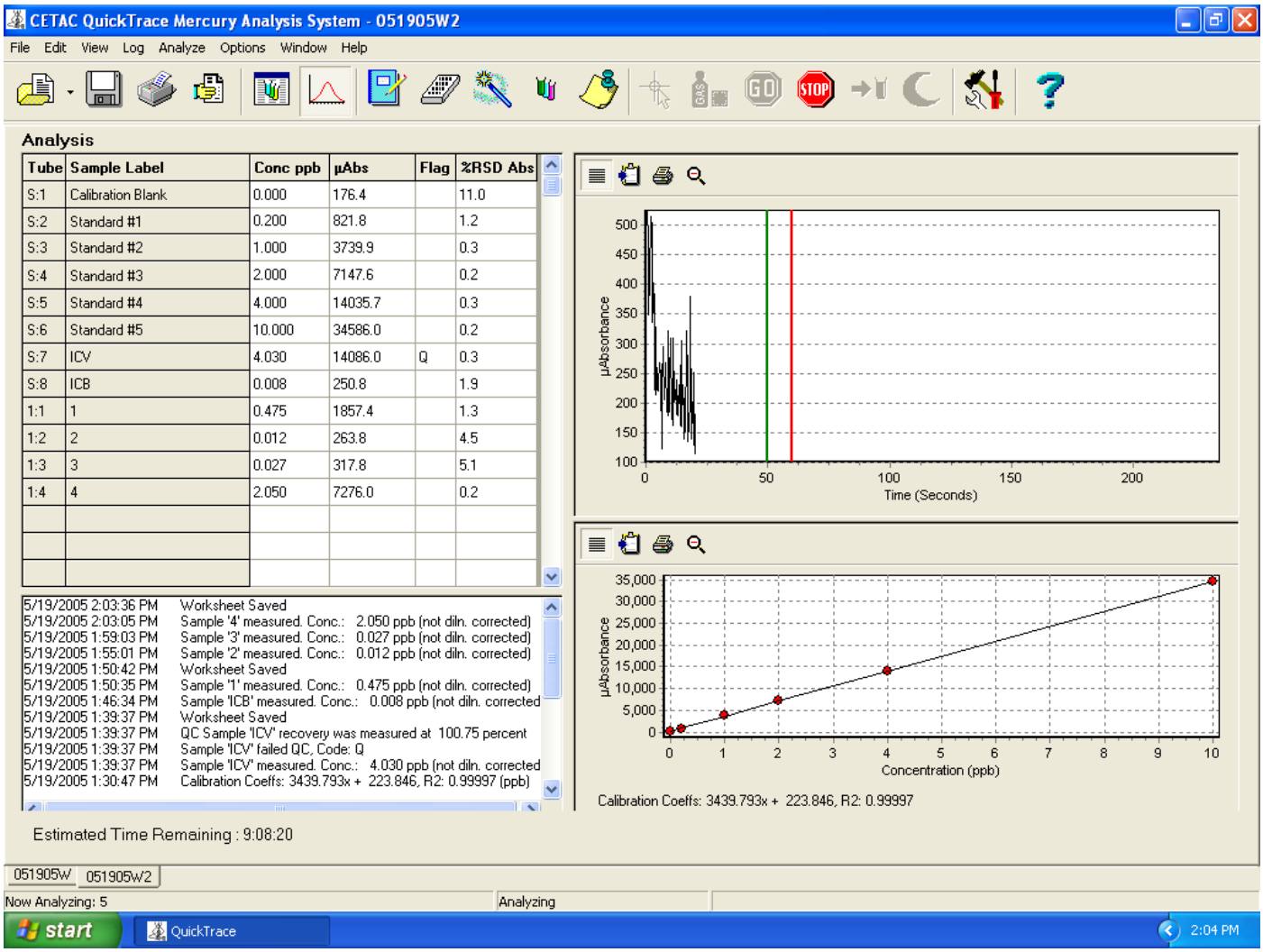

Appendix A – CETAC figure 2

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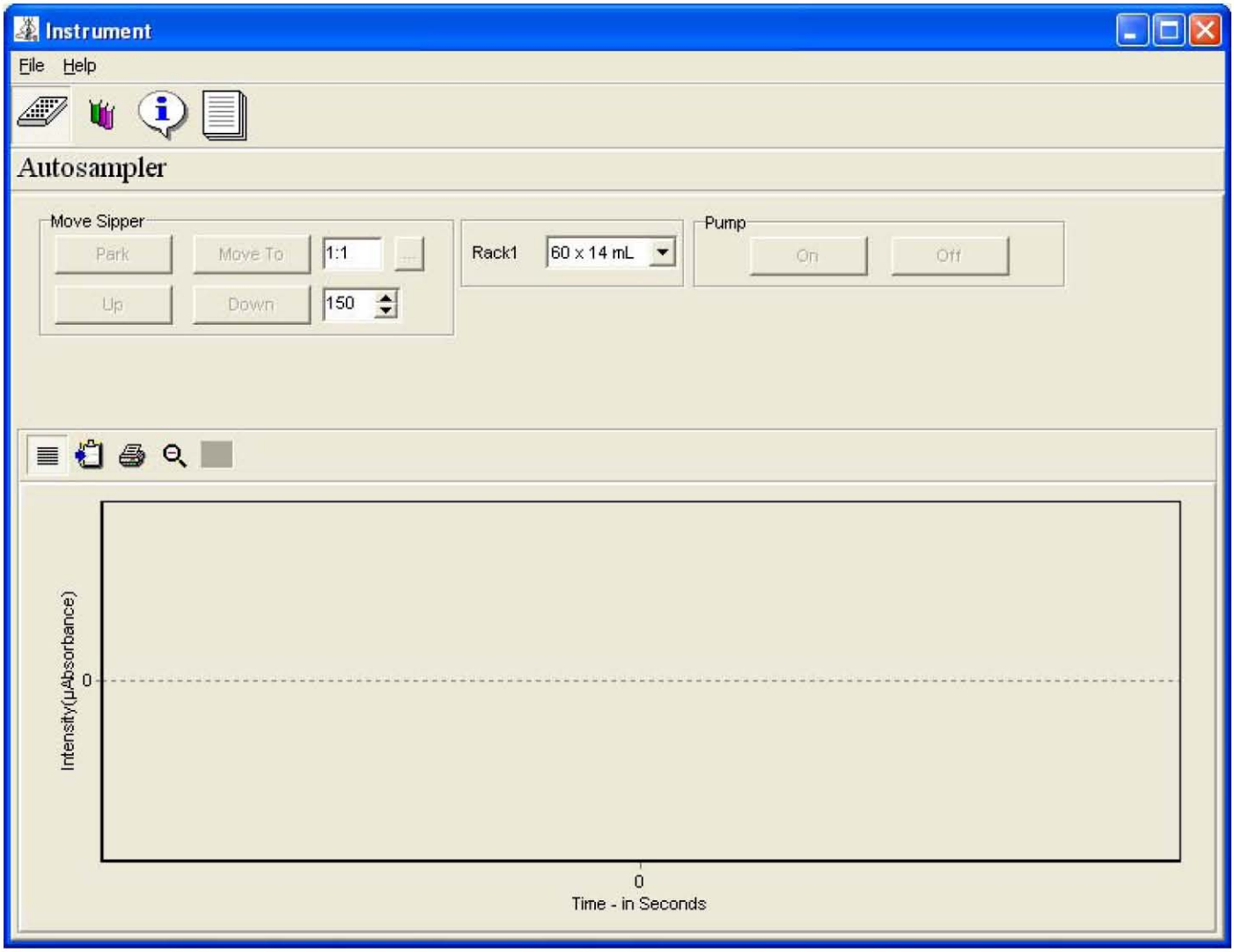

Appendix A – CETAC figure 3

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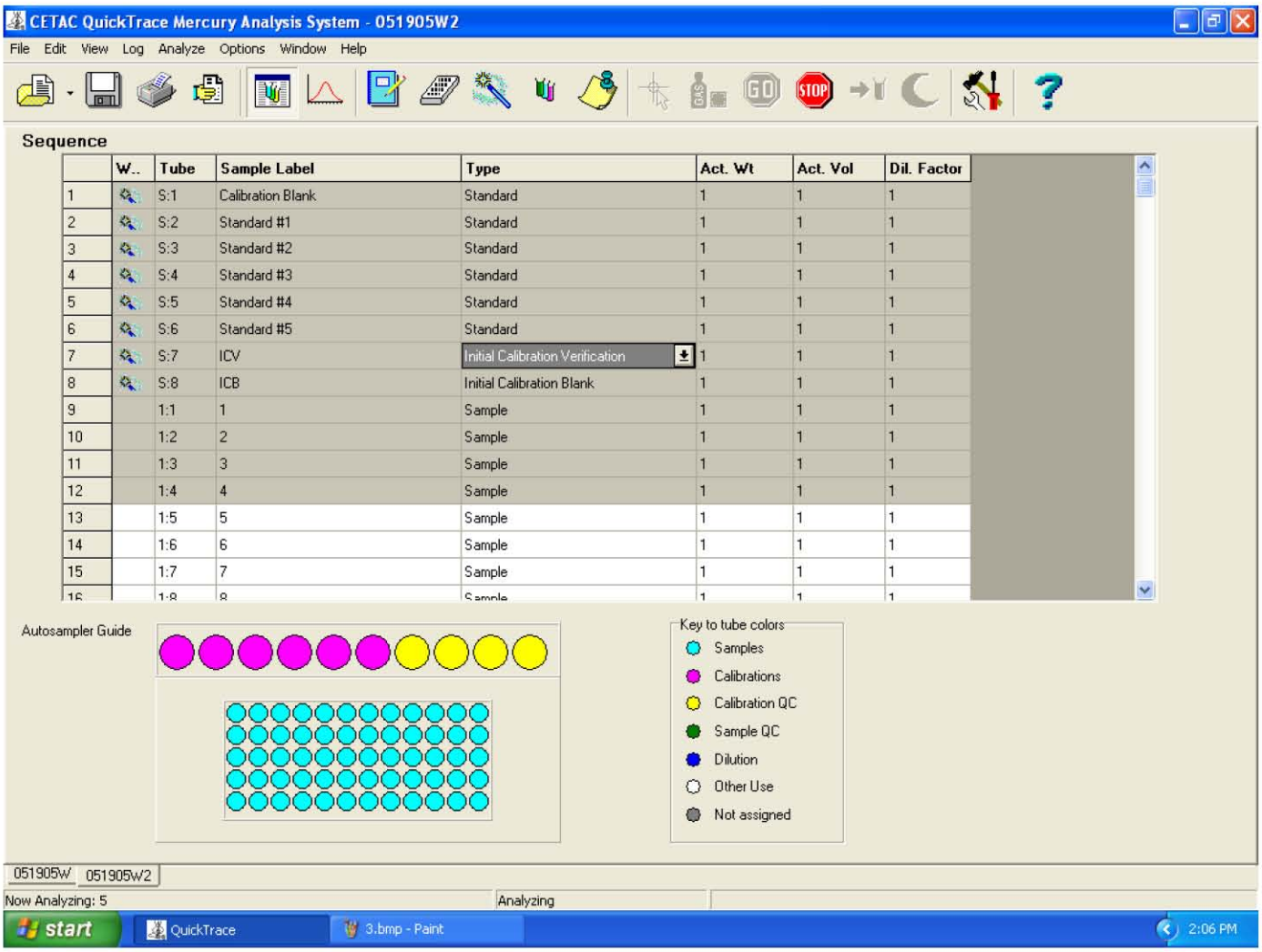

	W..	Tube	Sample Label	Type	Act. Wt	Act. Vol	Dil. Factor
1		S:1	Calibration Blank	Standard	1	1	1
2		S:2	Standard #1	Standard	1	1	1
3		S:3	Standard #2	Standard	1	1	1
4		S:4	Standard #3	Standard	1	1	1
5		S:5	Standard #4	Standard	1	1	1
6		S:6	Standard #5	Standard	1	1	1
7		S:7	ICV	Initial Calibration Verification	1	1	1
8		S:8	ICB	Initial Calibration Blank	1	1	1
9		1:1	1	Sample	1	1	1
10		1:2	2	Sample	1	1	1
11		1:3	3	Sample	1	1	1
12		1:4	4	Sample	1	1	1
13		1:5	5	Sample	1	1	1
14		1:6	6	Sample	1	1	1
15		1:7	7	Sample	1	1	1
16		1:8	8	Sample	1	1	1

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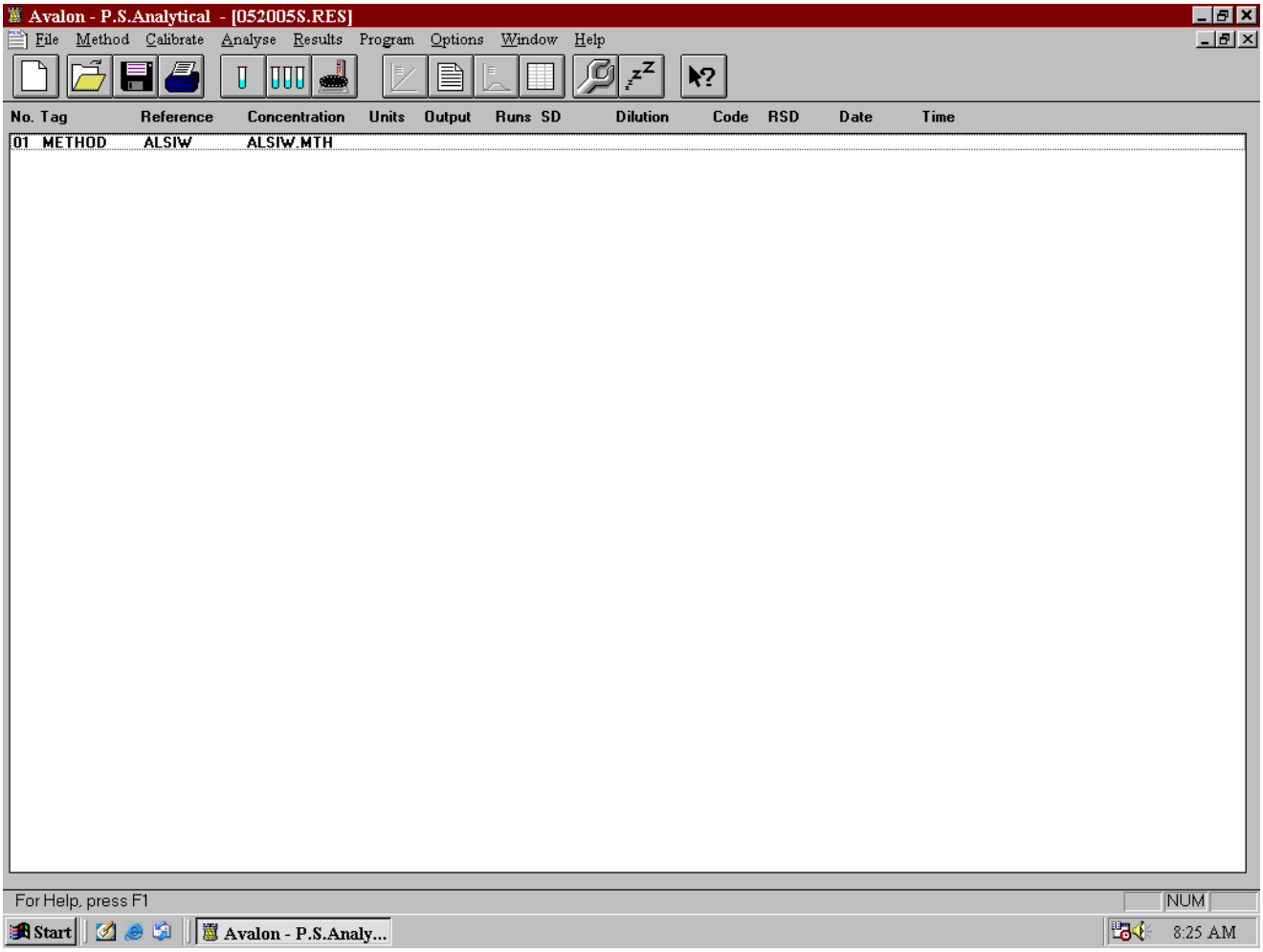
Appendix B – PSA



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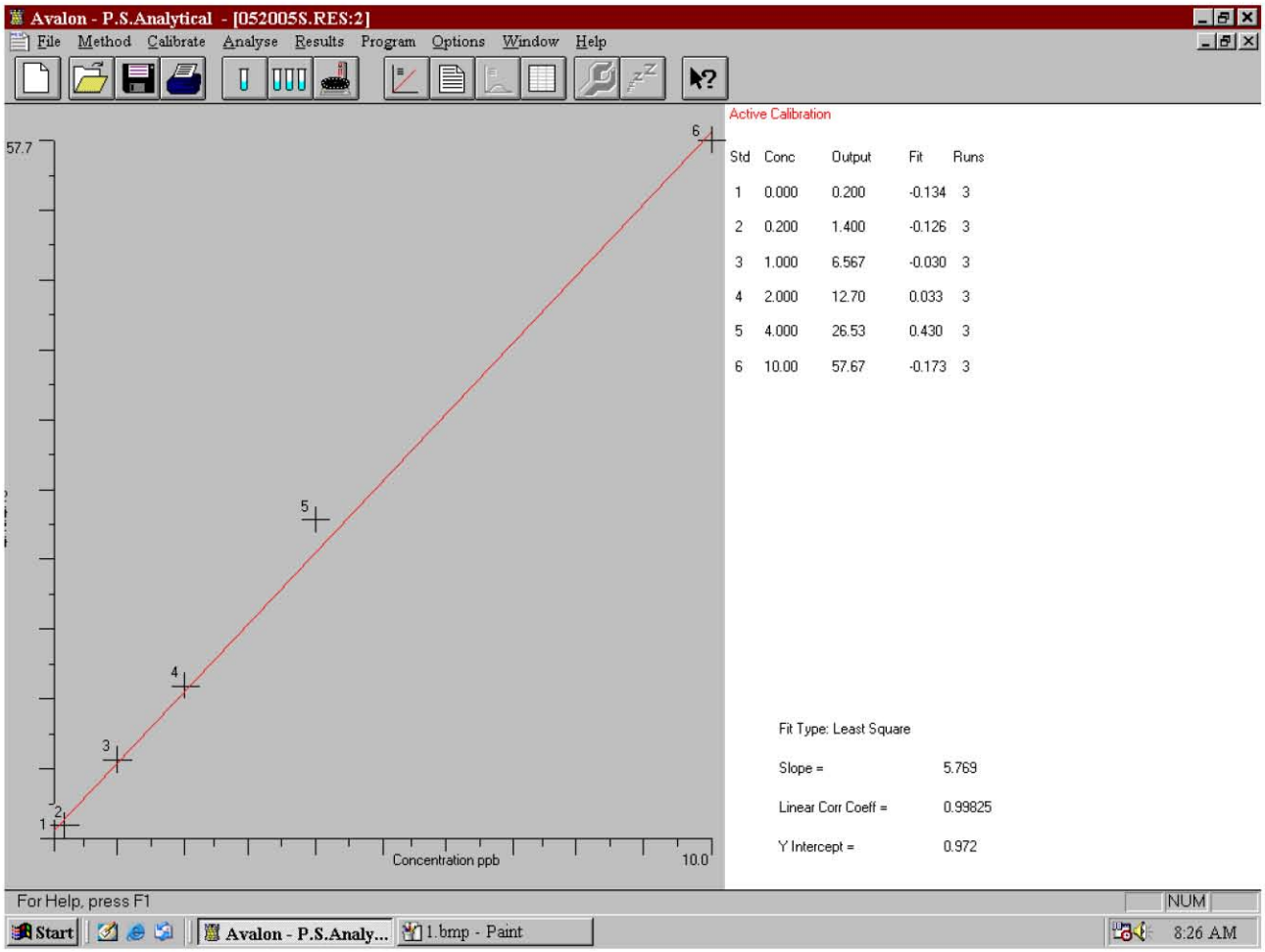
Appendix B – PSA



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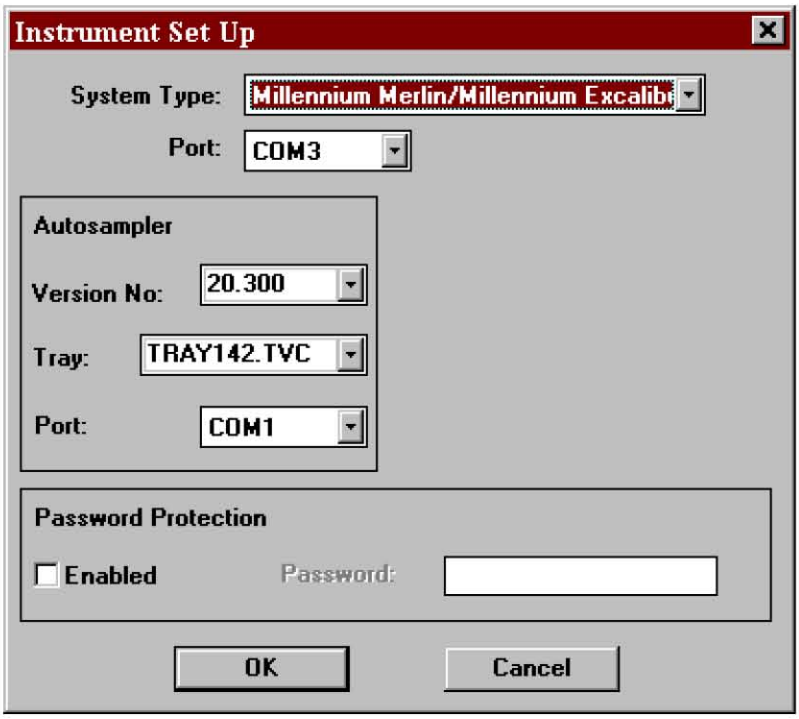

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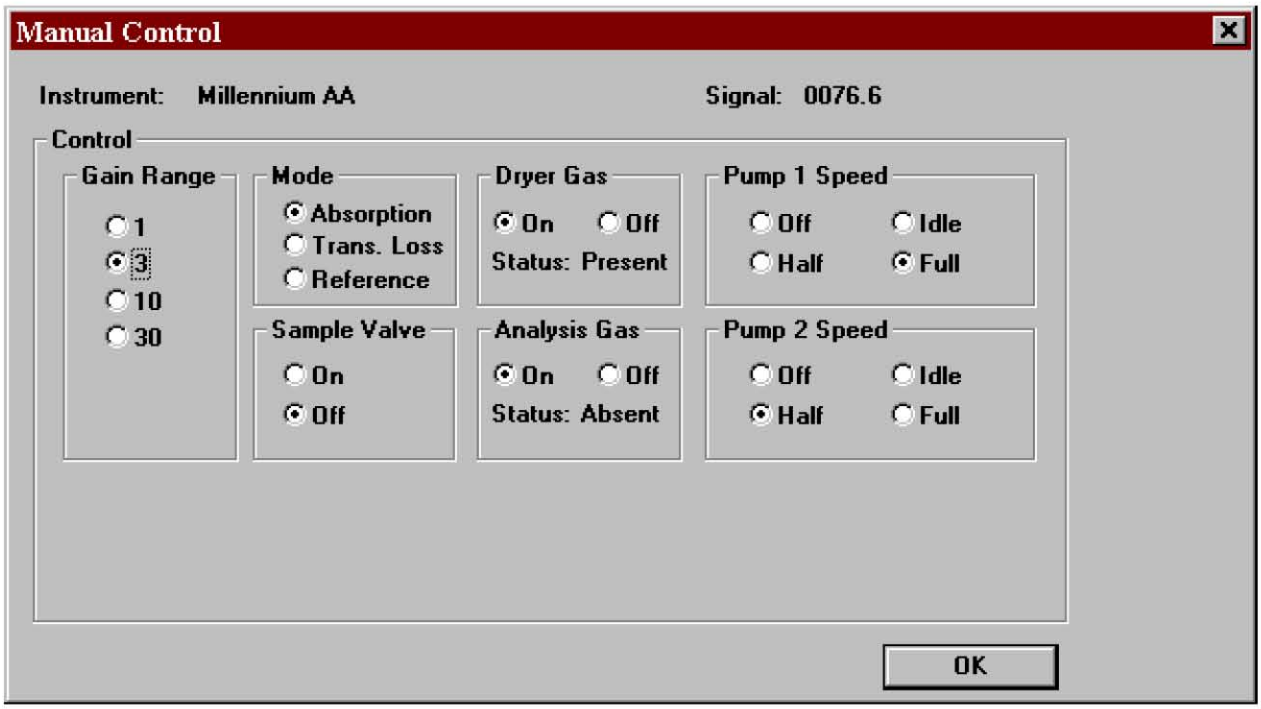
Appendix B – PSA



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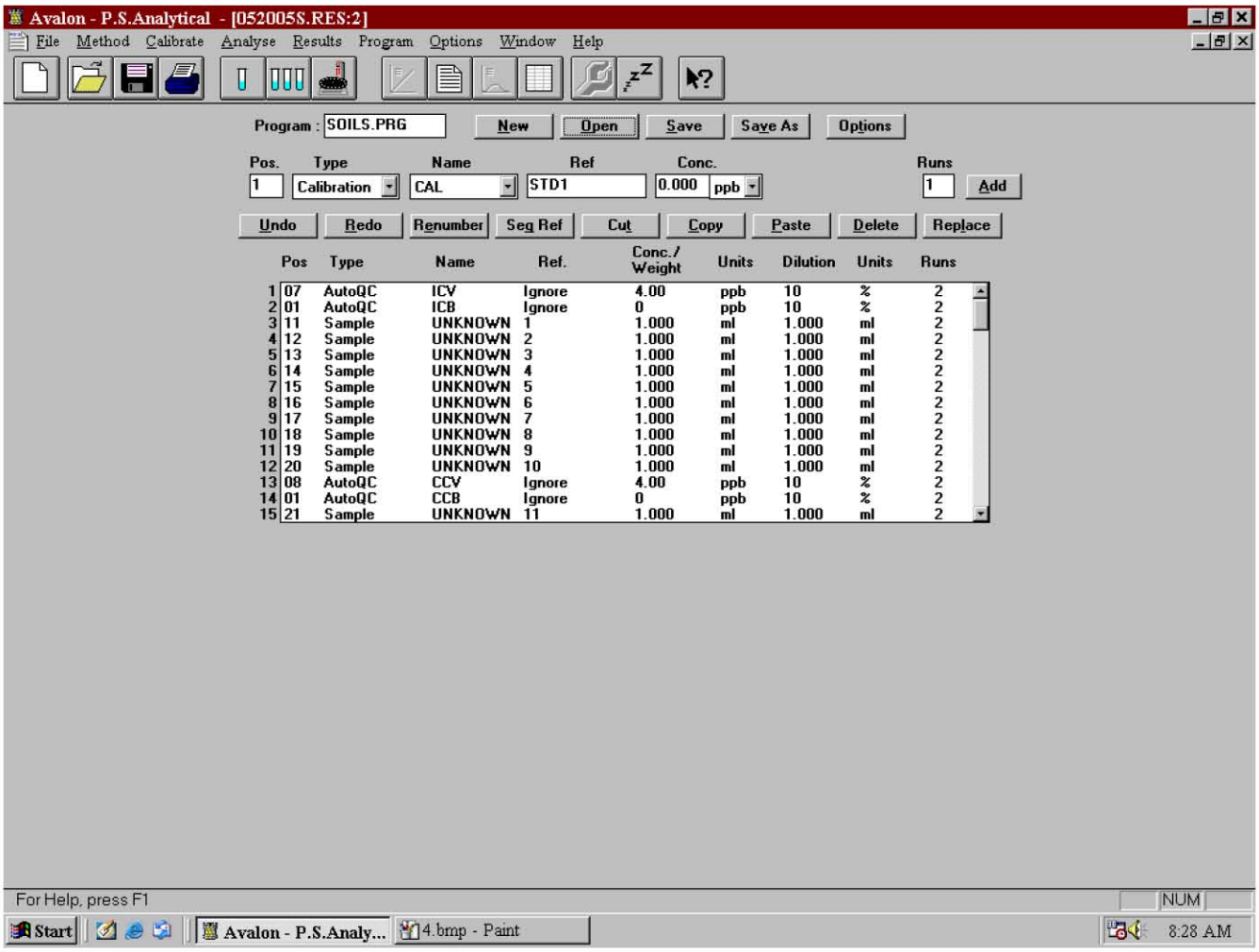
Appendix B – PSA



	Pos	Type	Name	Ref.	Conc./ Weight	Units	Dilution	Units	Runs
1	07	AutoQC	ICV	Ignore	4.00	ppb	10	%	2
2	01	AutoQC	ICB	Ignore	0	ppb	10	%	2
3	11	Sample	UNKNOWN	1	1.000	ml	1.000	ml	2
4	12	Sample	UNKNOWN	2	1.000	ml	1.000	ml	2
5	13	Sample	UNKNOWN	3	1.000	ml	1.000	ml	2
6	14	Sample	UNKNOWN	4	1.000	ml	1.000	ml	2
7	15	Sample	UNKNOWN	5	1.000	ml	1.000	ml	2
8	16	Sample	UNKNOWN	6	1.000	ml	1.000	ml	2
9	17	Sample	UNKNOWN	7	1.000	ml	1.000	ml	2
10	18	Sample	UNKNOWN	8	1.000	ml	1.000	ml	2
11	19	Sample	UNKNOWN	9	1.000	ml	1.000	ml	2
12	20	Sample	UNKNOWN	10	1.000	ml	1.000	ml	2
13	08	AutoQC	CCV	Ignore	4.00	ppb	10	%	2
14	01	AutoQC	CCB	Ignore	0	ppb	10	%	2
15	21	Sample	UNKNOWN	11	1.000	ml	1.000	ml	2

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CETAC HG WORKSHEET

File:_____ SnCl$_2$ solution: _____g SnCl$_2$ in _____of 1.4% H$_2$SO$_4$
Matrix:_____ NH2OH / HCl log#: _____ Pipette ID#_____
Analyst:_____ Post Spike: 50 ul_____ into 10 ml of sample.
Date:_____

Sample	Sample
1	37
2	38
3	39
4	40
5	41
6	42
7	43
8	44
9	45
10	46
11	47
12	48
13	49
14	50
15	51
16	52
17	53
18	54
19	55
20	56
21	57
22	58
23	59
24	60
25	61
26	62
27	63
28	64
29	65
30	66
31	67
32	68
33	69
34	70
35	71
36	72

Appendix C

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Appendix D

PSA HG WORKSHEET

File:_____
Matrix:_____
Analyst:_____
Date:_____

$SnCl_2$ solution: _____g $SnCl_2$ in _____of 1.4% H_2SO_4
NH2OH / HCl log#: _____ Pipette ID#_____
Post Spike: 50 ul_____ into 10 ml of sample.

Sample	Sample
1	37
2	38
3	39
4	40
5	41
6	42
7	43
8	44
9	45
10	46
11	47
12	48
13	49
14	50
15	51
16	52
17	53
18	54
19	55
20	56
21	57
22	58
23	59
24	60
25	61
26	62
27	63
28	64
29	65
30	66
31	67
32	68
33	69
34	70
35	71
36	72

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SOP Change History Sheet

Section No.	Section	Reason for Change
1	Scope and Application	SOP update
8.2	Quality Control	PADEP Audit response
8	Quality Control Requirements	USACE audit response
12	Reporting Results	Updated for new LIMS
5	Apparatus and Materials	A2LA Audit Response SOP update 5/3/05
7	Instrument Calibration	SOP update to calibration levels 5/03/05
10	Procedure	SOP update 5/3/05
	Appendix A	Inserted New Instrument Set-up Records for CETAC 5/19/05
	Appendix B	Inserted New Instrument Set-up Records for PSA 5/19/05
	Appendix C	Insert New Instrument Logbook for CETAC 5/19/05
	Appendix D	Insert New Instrument Logbook for PSA 5/19/05

Revision 23: 03/23/2006

1.2	Scope and Application	DoD audit response, updated methods
1.8	Scope and Application	Added project requirement verbiage
6.3	Reagents	Updated vendor information

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SOP Change History Sheet (continued)

Section No.	Section	Reason for Change
6.6	Reagents	Added decolorizing agent volume as per PADEP audit response
7.3.1	Instrument Calibration	Updated reference method and standards reference
7.6	Instrument Calibration	Added corrective actions for calibration blank concentrations as per PADEP/DoD audit responses
8.2	Quality Control	Added ongoing proficiency verbiage
8.2	Quality Control	Updated table to reflect method addition/revision and concentration revisions as per DoD audit response
8.3-8.5	Quality Control	Major revisions/additions throughout
10.1.7, 10.1.9, 10.2.6	Procedure	Added verbiage about Hydroxylamine addition as per PADEP audit response
10.1.8	Procedure	Added r-value
11.4	Calculations	Added specific calculations as per DoD audit response
12	Reporting Results	Major revisions/additions throughout

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SOP Change History Sheet (continued)

Section No.	Section	Reason for Change
16	Troubleshooting	Added section as per DoD audit response

Revision 13: 10/29/07

Spelling, grammar, and formatting changes may have been made throughout SOP.

1.8	Scope and Application	Update MDL location
4.3	Safety	Update MSDS availability
4.4	Safety	Added reference to CHP and fume hoods
4.5	Safety	Removed section
6	Reagents	Added NOTE
7.2, 7.4.2, 7.6	Instrument Calibration	Added sections
8.3	Quality Control	Added section, update table
10.1.10	Procedure	Remove reporting limits
10.2	Procedure	Major revisions to procedure made throughout section
11.3	Calculations	Removed section
12.3	Reporting Results	Added dilution statement

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SOP Concurrence Form
for the Distribution and Revision of Standard Operating Procedures

I have read, understood, and concurred with the Standard Operating Procedure (SOP) described above and will perform this procedure as it is written in the SOP.

Print Name	Signature	Date

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Document Title: Microwave Assisted Acid Digestion of Sediments, Sludges, Soils, and Oils

Document Control Number: _____

Organization Title: ANALYTICAL LABORATORY SERVICE, INC. (ALSI)

Address: 34 Dogwood Lane
Middletown, PA 17057
Phone: (717) 944-5541

Approved by:

_____ _____
Helen MacMinn, Date
Quality Assurance Manager

_____ _____
Lisa Miller, Date
Metals Supervisor

_____ _____
Jason Knight, Date
Validator

Annual Review:

_____ _____
Reviewed By Date Reviewed

_____ _____
Approved By Date Approved

_____ _____
Reviewed By Date Reviewed

_____ _____
Approved By Date Approved

Annual Review (continued):

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Reviewed By _____ Date Reviewed _____

Approved By _____ Date Approved _____

Reviewed By _____ Date Reviewed _____

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1 Scope and Application

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1.1 This document states the laboratory's policies and procedures established in order to meet requirements of all certifications/accreditations currently held by the laboratory, including the most current NELAC standards.

1.2 This microwave extraction method is designed to mimic extraction using conventional heating with nitric and hydrochloric acid, according to EPA methods 200.2 and 3050. Since these methods are not intended to accomplish total decomposition of the sample, the extracted analyte concentrations may not reflect the total content in the sample. This method is applicable to the microwave-assisted acid extraction/dissolution of sediments, sludges, soils, and oils requiring digestion by Method 3051A of EPA SW846, Revision 1, January 1998.

1.3 Samples prepared by Method 3051A may be analyzed by ICP or ICP/MS for the following metals:

ICP

Aluminum*	Manganese
Antimony*	Molybdenum
Arsenic	Nickel
Barium*	Potassium
Beryllium*	Selenium
Boron	Silver*
Cadmium	Sodium
Calcium	Strontium
Chromium*	Thallium
Cobalt	Tin
Copper	Vanadium*
Iron*	Zinc
Lead	
Magnesium*	

ICP/MS

Aluminum*	Manganese

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Antimony*	Mercury
Barium*	Molybdenum
Beryllium*	Nickel
Boron	Silver*
Cadmium	Strontium
Chromium*	Thallium
Cobalt	Tin
Copper	Titanium
Lead	Vanadium*
Magnesium*	Zinc

* Indicates elements that typically require the addition of HLC to achieve equivalent results with EPA Method 3050.

1.4 For matrices such as certain types of oils, this method may not provide total sample dissolution. For other matrices, such as soils and sediments, it shall be considered as an extraction method. Other elements and matrices may be analyzed by this method if performance is demonstrated for the analytes of interest.

1.5 Individual project requirements may override criteria listed in this SOP.

2 Summary of Method

2.1 A representative sample of up to 0.5 g is extracted in 9.0 mL concentrated nitric acid and 3.0 mL hydrochloric acid for 20 minutes using microwave heating. The sample and acids are places in a fluorocarbon polymer (PFA or TFM) of quartz microwave vessel of vessel liner. The vessel is sealed, weighed, and heated in the microwave unit. After cooling, the vessel contents are weighed, centrifuged, and then diluted to 50 mL in a clean SCP digested vessel.

3 Interferences

3.1 In order to identify problem matrices and method error, blanks, spikes, spike duplicates and check samples are run at regular intervals, as specified in each relevant analytical method.

3.2 Very reactive samples or volatile materials may create high pressures due to the evolution of gaseous digestion products. This may cause venting of the

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vessels with potential loss of sample and/or analytes. The complete decomposition of either carbonates, or carbon based samples, may produce enough pressure to vent the vessel in the sample size is greater than 0.25 g.

3.3 Many types of samples will be dissolved by this method. A few refractory sample matrix compounds, such as quartz, silicates, titanium dioxide, alumina, and other oxides may not be dissolved and in some cases may sequester target analyte elements.

3.4 Samples that are oily or continuously vent in the microwave shall be digested by an alternate hotplate digestion method (see ALSI Prep SOP 09-3050B).

4 Safety

4.1 The toxicity or carcinogenicity of each reagent used in this method has not been precisely defined. Therefore, each chemical shall be treated as a potential health hazard.

4.2 ALSI maintains material safety data sheets (MSDS) on all chemicals used in this procedure. ALSI recommends that all individuals performing this SOP familiarize themselves with the MSDSs associated with the procedure prior to SOP performance. MSDSs are available to all staff and are located in hard copy in the QA reference library and electronically on the ALSI server in the MDSD folder.

4.3 Analysts shall consult the Material Safety Data Sheets (MSDS) for each chemical used in the digestion process.

4.4 Since the chemical make-up of the samples is not known, analysts shall treat the samples with extreme caution. Proper protective equipment must be used including PVC gloves, lab coats, safety glasses and a fume hood.

4.5 Although there are many safety features built into the microwave, technicians must remember that the samples will be acidified to 18% nitric acid and 6% hydrochloric acid, heated to approximately 175°C, and reaching pressures up to 435 psi. All parts of the digestion vessels must be examined to ensure that there are no visible faults that could release the sample during digestion.

4.6 Analysts must be familiar with the proper assembly and use of the vessels and all related safety equipment. Information regarding the safe use of the MSD-

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2100 can be found in the *CEM MARS Operation Manual, REV 2 Feb. 2006,* to be found in the Metals Prep Lab next to the LIMS PC.

5 Apparatus and Materials

5.1 Microwave, CEM Mars 5000.

5.2 Calibrated 50 mL disposable vessels. SCP #010500261, or equivalent.

5.3 Centrifuge, Garver electrofuge, or equivalent.

5.4 Balance capable of weighing 0.01 g, Mettler PM2000, or equivalent.

5.5 Acid Dispensers (Finnpipette), from Thermo capable of dispensing 0.5 mL to 10 mL of acid.

5.6 Thermo Finntip tips, VWR catalog #53515-050 or equivalent.

5.7 PTFE boiling stones from ThermoFisher catalog #09-191-20, or equivalent.

6 Reagents

NOTE: Unless otherwise noted in this section all chemicals are stored at room temperature and labeled with an expiration date of five years from receipt. Manufacturer's labeled expiration dates, when provided, take precedent over all other expiration dates.

6.1 Reagent Water - Reagent water is water in which an interferant is not observed at the analyte of interest. For this purpose, ALSI uses a Filson Water Purification System, which provides analyte-free, >18.0 megohm-cm deionized water on demand. All references to water in the method refer to reagent water unless otherwise specified.

6.2 Concentrated Nitric Acid (HNO_3) - Baker Instra-analyzed Reagent Grade, VWR, catalog #JT9598-34 or equivalent. If the manufacturer does not supply an expiration date, the reagent must be labeled as expiring one year from when opened. The analyst must write this date directly on the outside of the bottle using a permanent marker.

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Note: Acid bottles must be contained inside Teflon carriers at all times. If an expiration date is not supplied by the manufacturer, the expiration will be five years from the date opened. This date shall be marked directly on the acid bottle.

6.3 Ultra Pure Concentrated Nitric Acid (HNO_3) – EM Science, VWR catalog #EM-NX0408-6 or equivalent. If the manufacturer does not supply an expiration date, the reagent must be labeled as expiring one year from when opened. The analyst must write this date directly on the outside of the bottle using a permanent marker.

6.4 Concentrated Hydrochloric Acid (HCl) - Baker Analyzed Reagent Grade, VWR catalog #JT9535-33 or equivalent. If the manufacturer does not supply an expiration date, the reagent must be labeled as expiring one year from when opened. The analyst must write this date directly on the outside of the bottle using a permanent marker.

Note: Acid bottles must be contained inside Teflon carriers at all times. If an expiration date is not supplied by the manufacturer, the expiration will be five years from the date opened. This date shall be marked directly on the acid bottle.

6.5 Ultra Pure Concentrated Hydrochloric Acid (HCl) – EM Science, VWR catalog #EM-HX0608-6, or equivalent. If the manufacturer does not supply an expiration date, the reagent must be labeled as expiring one year from when opened. The analyst must write this date directly on the outside of the bottle using a permanent marker.

6.6 ICP Spiking Standard (A), SCP P/N 901-6A5-800 Stock Solution in 5% HNO_3, purchased from SCP Science or equivalent NIST certified standard. This is a pre-mixed standard of Ag, Cr, Ti, Mn, V, Cd, and Sr at 20 mg/mL, As, Be, and Sb at 40 mg/mL, and Tl at 100 mg/mL in 5% HNO3.

6.7 ICP Sn Spiking Standard (B) solution in 20% HCl. This standard is made up in-house from the single element tin solution. SCP, catalog #140-052-502, or equivalent NIST certified standard. To a 200 mL class A volumetric, add a small portion of reagent water (Section 6.1), 40 mL of concentrated HCl (Section 6.4), and 8.0 mL of single element 1000 ppm Tin solution. This standard is good for three months when stored at room temperature.

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6.8 ICP Spiking Standard (C2), SCP P/N 901-6A5-803 Stock Solution in 5% HNO_3, purchased from SCP Science or equivalent NIST certified standard. This is a pre-mixed standard of Al, B, Ni, Ba, Li, Pb, Se, Co, Mo, Zn, and Cu at 200 mg/mL, Fe at 2000 mg/mL, Na, K, Ca, and Mg at 1000 mg/mL, and Zn at 200 mg/mL in 5% HNO_3.

6.9 ICP Bi Spiking Standard (C1) solution in 5% HNO_3. This standard is made up in-house from the single element bismuth solution. SCP, catalog #140-051-832, or equivalent NIST certified standard. To a 200 mL class A volumetric, add a small portion of reagent water (Section 6.1), 10 of concentrated HCl (Section 6.4), and 40.0 mL of single element 1000 ppm Bismuth solution. This standard is good for three months when stored at room temperature.

6.9.1 ICP Spiking Standard C. This standard is made up in-house from standards Spiking Standard 901-6A5-803 (Section 6.8), and Bi Spiking Standard (Section 6.9). The two standards are mixed at a 1:1 ratio, given an in-house ID#, and documented in the most recent Metals Reagent Logbook. This standard is good for three months when stored at room temperature.

6.10 ICP/MS Spiking Standard A, P/N 4400-130597 in 1% HNO_3, purchased from CPI, or equivalent. This standard contains Al, As, Be, Cd, Co, Cr, Mn, Mo, Ni, Pb, Sb, Se, Tl, V, and Zn at 10 µg/mL.

6.11 ICP/MS Spiking Standard B, P/N 4400-130775 in 1% HNO_3, purchased from CPI, or equivalent. This standard contains Ag, Ba, Mg, Fe, Ca, B, and Sr at 10 µg/mL.

6.12 ICP/MS Spiking Standard C, P/N WW-MSCAL-1 in 5% HNO_3, purchased from Inorganic Ventures, or equivalent NIST certified standard. This standard contains Hg at 5.0 µg/mL.

6.13 Powdered Paint Spiking Material (2582), purchased from the U.S. Dept. of Commerce National Institute of Standards and Technology, or equivalent NIST certified standard. This is a powdered paint standard with a lead concentration of 208.8 mg/kg.

7 Cleaning

7.1 Supplies used in this procedure are washed with soap, rinsed with D.I. water,

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rinsed with a 10% Nitric Acid (HNO_3), and again rinsed with D.I. Water before use. Refer to SOP 19-GLWH.

NOTE: Exact measurements are not necessary to produce the 10% HNO_3 cleaning reagent. Production is approximately 100 mL concentrated HNO_3 into 900 mL of deionized water. Some heat will be generated from the addition of acid to water.

7.2 For determination of trace elements, contamination and loss are of prime consideration. Potential contamination sources include improperly cleaned vessels and general contamination within the laboratory environment from dust, etc. A clean laboratory work area designated for trace element sample handling must be used. Sample containers can introduce positive and negative errors in the determination of trace elements by (1) contributing contaminants through surface adsorption or leaching, (2) depleting element concentrations through adsorption processes. All reusable lab ware shall be sufficiently clean for the task objectives.

7.3 The inner chamber of the microwave unit shall be kept clean at all times. When samples vent, the inside of the unit will accumulation contaminates if not kept properly cleaned. There are no specific cleaning instructions, just use a damp towel to wipe down the inner chamber.

8 Quality Control

8.1 All policies and procedures in the most current revision of the ALSI QA Plan shall be followed when performing this procedure.

8.2 Demonstration of Capability (DOC) – DOCs must be performed by each analyst prior to performing this method and repeated at any time there is a significant change in instrument type. To perform DOCs, four consecutive Laboratory Fortified Blanks (LCSs), with a matrix matching that of the calibration standards, are analyzed. The recoveries obtained must be within 85-115% of the known values for each associated metal, and consecutive reads must have an RSD less than 10%. If the DOCs are outside these acceptance limits, a new set of LCSs must be digested and analyzed. This process is repeated until the DOCs are completed successfully.

8.2.1 Ongoing proficiency must be established annually as specified in the QA Plan, Technical Training.

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8.2.2 The DOC's for the IH NLLAP lead program must be prepped using the Powdered Paint Spiking Material (Section 6.13). The analyte recoveries must be within the method requirements of 80-120% and their relative percent difference must be less than or equal to 10%, 75% of the time. If the DOC recoveries fall outside these method requirements, the analyst must repeat the study until he or she is deemed proficient.

8.3 Method Blank (MB) – A method blank shall be performed at a frequency of one per batch of no more than 20 samples. The method blank shall be carried throughout the entire sample preparation and analytical process. These blanks will be useful in determining if samples are being contaminated during the digestion process. Upon analysis, if the method blank concentration is greater than or equal to the reporting limit, AND is greater than 1/10 the concentration of the samples in the batch, the source of the contamination must be investigated and measures taken to minimize or eliminate the problem. Any samples associated with a blank that failed the above criteria shall be reprocessed in a new prep batch. If no sample volume remains for reprocessing, the results shall be reported with an appropriate qualifying statement.

8.3.1 A method blank for **ICP analysis (6010B)** is prepared as follows: Weigh out 0.5 g of Teflon chips (Section 5.8) into a small weigh boat using the Mettler balance. Insert the Teflon chips into a clean digestion vessel and add, 9.0 mL of conc. HNO_3 (Section 6.2), and 3.0 mL of conc. HCl (Section 6.4). Cap the vessel, and microwave with the rest of the batch. After digestion and cooling, transfer the digestate into a clean SCP vessel (Section 5.2), and bring up to 50 mL using reagent water. Centrifuge the digestate for at least 5 minutes then take it to the Metal Lab for analysis with the rest of the batch.

8.3.2 A method blank for an **ICP/MS analysis (6020)** is prepared as follows: Weigh out 0.5 g of Teflon chips (Section 5.8) into a small weigh boat using the Mettler balance. Insert the Teflon chips into a clean digestion vessel and add, 9.0 mL of Ultra Pure HNO_3 (Section 6.3), and 3.0 mL of Ultra pure HCl (Section 6.5). Cap the vessel, and microwave with the rest of the batch. After digestion and cooling, transfer the digestate into a clean SCP vessel (Section 5.2), and bring up to 50 mL using reagent water. Centrifuge the digestate for at least 5 minutes then take it to the Metal Lab for analysis with the rest of the batch.

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8.3.3 A method blank for **IH LEAD ICP analysis (6010b)** is prepared as follows: Weigh out 0.5 g of Teflon chips (Section 5.8) into a small weigh boat using the Mettler balance. Insert the Teflon chips into a clean digestion vessel and add, 9.0 mL of conc. HNO3 (Section 6.2), and 3.0 mL of conc. HCl (Section 6.4). Cap the vessel, and microwave with the rest of the batch. After digestion and cooling, transfer the digestate into a clean SCP vessel (Section 5.2), and bring up to 50 mL using reagent water. Centrifuge the digestate for at least 5 minutes then take it to the Metal Lab for analysis with the rest of the batch.

NOTE: The method blank concentration must be <1/2 the reporting limit for USACE / DOD samples. If the blank recoveries are outside this acceptance limit, the samples associated with the batch will need to be redigested in a new batch.

NOTE: The Metals analysis lab will notify the PREP department when method blanks fail, and reprocessing is necessary. The samples will show up in the MDIG digestion Queue.

8.4 A Laboratory Fortified Blank / Laboratory Control Sample (LCS) is processed once per batch of no more than 20 samples. The LCS must be subjected to all preparation steps. The resulting percent recovery at the time of analysis must be within 80-120% of the true value. If the recovery falls outside this range, the source of the problem shall be investigated and solved. All associated samples will then be reprocessed in a new prep batch.

NOTE: The Metals analysis lab will notify the PREP department when LCS's fail, and reprocessing is necessary. The samples will show up in the MDIG digestion Queue.

8.4.1 An LCS for **ICP analysis (6010B)** is prepared as follows: Weigh out 0.50 g ± 0.05 g of Teflon chips (Section 5.8) into a small weigh boat using the Mettler balance. Insert the Teflon chips into a clean digestion vessel and add, 9.0 mL of conc. HNO_3 (Section 6.2), and 3.0 mL of conc. HCl (Section 6.4). Add 0.50 mL of ICP Spike (A) (Section 6.6), 0.50 mL of ICP Spike (B) (Section 6.7), and 0.50 mL of ICP Spike (C) (Section 6.9.1). Cap the vessel, and microwave with the rest of the batch. After digestion and cooling, transfer the digestate into a clean SCP vessel (Section 5.2), and bring up to 50 mL using reagent water.

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Centrifuge the digestate for at least 5 minutes then take it to the Metal Lab for analysis with the rest of the batch.

8.4.2 An LCS for an **ICP/MS analysis (6020)** is prepared as follows: Weigh out 0.5 g of Teflon chips (Section 5.8) into a small weigh boat using the Mettler balance. Insert the Teflon chips into a clean digestion vessel and add, 9.0 mL of Ultra Pure HNO_3 (Section 6.3), and 3.0 mL of Ultra pure HCl (Section 6.5). Add 0.50 mL of ICP/MS Spiking Standard A (Section 6.10), 0.50 mL ICP/MS Spiking Standard B (Section 6.11), and 0.10 mL of ICP/MS Spiking Standard C (Section 6.12). Cap the vessel, and microwave with the rest of the batch. After digestion and cooling, transfer the digestate into a clean SCP vessel (Section 5.2), and bring up to 50 mL using reagent water. Centrifuge the digestate for at least 5 minutes then take it to the Metal Lab for analysis with the rest of the batch.

8.4.3 An LCS for **IH LEAD ICP analysis (6010b)** is prepared as follows: Weigh out 0.50 g ± 0.05 g of Teflon chips (Section 5.8) and 0.125 g ± 0.05 g of Powdered Paint Spiking Material (Section 6.13), into a small weigh boat using the Mettler balance. Insert the contents into a clean digestion vessel and add, 9.0 mL of conc. HNO_3 (Section 6.2), and 3.0 mL of conc. HCl (Section 6.4). Cap the vessel, and microwave with the rest of the batch. After digestion and cooling, transfer the digestate into a clean SCP vessel (Section 5.2), and bring up to 50 mL using reagent water. Centrifuge the digestate for at least 5 minutes then take it to the Metal Lab for analysis with the rest of the batch.

NOTE: The Metals analysis lab will notify the PREP department when LCSs fail, and reprocessing is necessary. The samples will show up in the MDIG digestion Queue.

8.5 A Matrix Spike (MS) – A matrix spike is processed at a frequency of 10%, or at least once per batch of no more than 20 samples. The MS must be subjected to all preparation steps.

8.5.1 A Matrix Spike for **ICP analysis (6010B)** is prepared as follows: Weigh out 0.50 g X 0.05 g of the sample that is to be spiked into a small weigh boat using the Mettler balance. Insert the sample into a clean digestion vessel and add, 9.0 mL of conc. HNO_3 (Section 6.2), and 3.0 mL of conc. HCL (Section 6.4). Add 0.50 mL of ICP Spike (A) (section 6.6), 0.50 mL of ICP Spike (B) (Section 6.7), and 0.50 mL

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of ICP Spike (C) (Section 6.9.1). Cap the vessel, and microwave with the rest of the batch. After digestion and cooling, transfer the digestate into a clean SCP vessel (Section 5.2), and bring up to 50 mL using reagent water. Centrifuge the digestate for at least 5 minutes then take it to the Metal Lab for analysis with the rest of the batch.

8.5.2 A Matrix Spike for an **ICP/MS analysis (6020)** is prepared as follows: Weigh out 0.50 g ± 0.05 g of the sample to be spiked into a small weigh boat using the Mettler balance. Insert the sample into a clean digestion vessel and add, 9.0 mL of Ultra Pure HNO_3 (Section 6.3), and 3.0 mL of Ultra pure HCl (Section 6.5). Add 0.50 mL of ICP/MS Spiking Standard A (Section 6.10), 0.50 mL ICP/MS Spiking Standard B (Section 6.11), and 0.10 mL of ICP/MS Spiking Standard C (Section 6.12). Cap the vessel, and microwave with the rest of the batch. After digestion and cooling, transfer the digestate into a clean SCP vessel (Section 5.2), and bring up to 50 mL using reagent water. Centrifuge the digestate for at least 5 minutes then take it to the Metal Lab for analysis with the rest of the batch.

8.5.3 A Matrix Spike for an **IH LEAD ICP analysis (6010b)** is prepared as follows: Weigh out 0.50 g ± 0.05 g of the sample to be spiked and 0.125 g ± 0.05 g of Powdered Paint Spiking Material (Section 6.13), into a small weigh boat using the Mettler balance. Insert the contents into a clean digestion vessel and add, 9.0 mL of conc. HNO_3 (Section 6.2), and 3.0 mL of conc. HCl (Section 6.4). Cap the vessel, and microwave with the rest of the batch. After digestion and cooling, transfer the digestate into a clean SCP vessel (Section 5.2), and bring up to 50 mL using reagent water. Centrifuge the digestate for at least 5 minutes then take it to the Metal Lab for analysis with the rest of the batch.

Note: Some client contracts (ex. DOD) require the preparation of matrix spikes for every new matrix received. The Horizon LIMS will designate that these samples are to be prep spiked. The 1 per 20 batch spiking rule will not always be applicable to these samples. If the LIMS designates a sample MS/MSD, it is <u>not</u> to be disregarded by the analyst.

8.6 A Matrix Spike Duplicate (MSD) - A matrix spike duplicate is processed at a frequency of 10%, or at least once per batch of no more than 20 samples. The MSD is performed on the same sample as the Matrix Spike and prepared in the

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same manner. The MSD must be subjected to all preparation steps. (see Sections 8.4.1 , 8.4.2, and 8.4.3 for spiking instructions.

NOTE: Some client contracts (ex. DOD) require the preparation of matrix spike duplicate for every new matrix received. The Horizon LIMS will designate that these samples are to be prep spiked. The 1 per 20 batch spiking rule will not always be applicable to these samples. If the LIMS designates a sample MS/MSD, it is not to be disregarded by the analyst.

8.6.1 Samples selected for duplicate and matrix spike analysis shall be rotated among clients so that various matrix problems may be noticed and/or addressed. Poor performance may indicate a problem with a sample composition and shall be reported to the client.

8.7 Duplicate (DUP) – Sample duplicates are performed only upon client request. A sample duplicate is simply digesting the same sample in two separate individually labeled vessels. The relative percent difference (RPD) is then calculated between the two digestates.

8.8 Method Detection Limits – Method Detection Limit study must be performed according to SOP 99-MDL or the reference methods, whichever is more frequent. MDLs are prepared using the Reporting Limit Standard, which is made up by the Metals Analyst. For digestion, weight out 0.50 g ± 0.05 g of RPL standard into 8 separate digestion vessels. Add, 9.0 mL of conc. HNO_3 (Section 6.2), and 3.0 mL of conc. HCl (Section 6.4). Cap the vessel, and microwave with the rest of the batch. After digestion and cooling, transfer the digestate into a clean SCP vessel (Section 5.2), and bring up to 50 mL using reagent water. Take it to the Metal Lab for analysis with the rest of the batch.

8.8.1 A method Blank and LCS must be prepared along with the MDLs. These digestates are then analyzed by ICP in order to determine the method detection limits. The MDL process must be repeated until results yield valid limits. The metals lab will inform you if the MDLs need to be reprocessed.

8.8.2 MDLs for the IH LEAD Analysis are prepared using the powered paint certified reference material (Section 6.13). For digestion, weight out 0.06 g of powdered paint standard into 8 separate porcelain crucibles. These are prepared along with a method blank and LCS. These digestates are then analyzed by ICP in order to determine the method

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detection limits. The MDL process must be repeated until results yield valid limits. The metals lab will inform you if the MDLs need to be reprocessed.

8.9 The expiration date of all standards and reagents shall be labeled on their respective containers. If an expiration date is not supplied by the manufacturer, the default expiration date shall be one year from the date opened.

8.10 All mechanical pipettes used in this digestion process must calibrated annually to verify the entire range of use. Select four to five settings throughout the pipette range, and perform a full calibration at each setting. This calibration data must be recorded in the metals autopipette calibration logbook. (See ALSI SOP 09-AP for calibration procedure.)

8.10.1 A single setting pipette calibration is also required on a weekly basis to verify dispensing volumes. Select a mid-range volume to perform this calibration, and be sure to document the procedure in the metals autopipette logbook. (See ALSI SOP 09-AP for calibration procedure.)

8.10.2 The ALSI Lab I.D. number of all mechanical pipettes used in this digestion process must be documented in the EXCEL digestion logbook. (Appendix A)

8.11 The Mettler balance used to weigh the digestion vessels must be calibrated each day. Prior to use, the analyst must verify that daily calibration has been recorded in the appropriate Balance Calibration Logbook. The procedure for calibrating the balance can be found in ALSI SOP 09-PM2000.

8.12 All QC spiking solutions used in this method must be stored in area separate from samples and sample digestates. If the spiking solutions are going to be kept in the same room as samples, then a separate drawer or enclosed cabinet must be designated for their storage.

8.13 Contamination Control – Laboratory dust wipe sampling by analyst shall be completed at least quarterly to determine surface contamination levels of lead in the associated areas. Sample preparation is not to proceed until surface contamination is less than the specified maximum allowable concentration of $40 \mu g/ft^2$.

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Quality Control Requirements

(Specific Project Requirements may override these requirements)

Parameter	Concentration	Frequency	Corrective Action
Method Blank (MB)	--	One per batch of 20 samples or less.	Dependent upon analysis results. Samples in the batch must be < the reporting limit or ≥ 10X the method blank. For batches involving samples from USACE / DOD the method blank recovery must be <1/2 the reporting limit. If not, the samples associated with the blank must be redigested.
Laboratory Fortified Blank (LCS)	See Section 8.4	One per 20 samples or at least once per 8-hour shift.	Dependent upon analysis results. If LCS recoveries remain outside acceptable limits of 80-120% after reanalysis, the samples associated with it must be redigested and reanalyzed.
* Matrix Spike (MS)	See Sections 8.5	One per batch of no more than 20 samples.	The matrix spike recovery must be within 75-125% of the expected value. If the spike fails, a post digestion spike is performed at the time of analysis, and a comment is added to the client's lab report. The metals analyst will add these comments when the sample results are entered.
*Duplicate (DUP) or Matrix Spike Duplicate (MSD)	For MSD see Sections 8.6 & 8.7	One MSD per batch of no more than 20 samples. Sample duplicates are performed only when requested by the client.	The Relative Percent Difference (RPD) between the Spike and Spike duplicate must be within 20%. If the RPD is above 20%, a comment must be added to the report.

9 Sample Collection, Preservation and Handling

9.1 Both plastic and glass containers are suitable.

9.2 Samples used for this digestion are not preserved and are stored in one of the walk-in coolers.

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9.3 The holding time for samples associated with this method is six-months for the sampling date.

9.4 Samples and sample digestates must be stored at room temperature separately from prep spiking solutions.

10 Procedure

10.1 Any apparatus coming into contact with the samples or QC must be cleaned following the guidelines established in Section 7.0.

10.2 ALSI holds a service contract with CEM Corporation for our MARS XPRESS microwave. As per that agreement, a service technician performs routine maintenance and calibrates the unit twice a year. A certificate of calibration is provided and stored in the metals prep area. It is the responsibility of the lab tech to check these certificate records, and make sure the microwave calibration is performed once every six months. If the calibration is older than six months, the lab tech shall schedule a field service visit immediately. If needed, digestions may continue until the field service rep. has a chance to service the unit.

10.3 The Mars Xpress is capable of digesting up to 24 digestates at one time. This enables the lab tech to digest up to 20 samples and all required batch QC. The microwave carrousel has 40 available positions in two separate rings. The outer ring has 24 available slots, and the inner ring has 16. The inner ring is **NOT** to be used for this digestion method.

10.4 The microwave carrousel itself contains Kevlar liners for each available digestion slot. This Kevlar liner serves as a shield in case a digestion vessel ruptures. The vessels themselves have been designed with the pressure release system, so rupturing should be rare, but it is possible.

10.5 After scheduling the samples for digestion, set up a carrousel with the appropriate number of digestion vessels. Using the Mettler balance, weigh out no more than 0.50 g of well-mixed sample into a small weigh boat. At this time the Method Blank (Section 8.3), Laboratory Control Sample (Section 8.4), Matrix Spike (Section 8.5), and Matrix Spike Duplicate (Section 8.6) shall also be weighed out. These sample weights need to be recorded in the 3051A Digestion Log.

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NOTE: For samples that appear to have a large metal content, the lab tech shall use less sample for the digestion. A 0.25 g portion or less is recommended.

CAUTION: The lab tech shall be aware of the potential for a vigorous reaction with samples containing volatile or easily oxidized organic species when reagents are added. When digesting a matrix of this type, initially use no more than 0.10 g of sample. If a vigorous reaction occurs upon the addition of reagents, allow the sample to predigest in the uncapped digestion vessel until the reaction ceases.

10.6 When the samples have been weighed out and the weights recorded, carefully transfer the samples into the microwave digestion vessels. If any of the sample is lost during transfer to the vessel, reweigh the sample out.

10.7 Add 9.0 mL of conc. HNO_3 (Sections 6.2 and 6.3), and 3.0 mL of conc. HCl (Sections 6.4 and 6.5) to each vessel. Some samples, especially sludges and oils will stick to the inner walls of the vessel. While adding the reagents, wash down the inner walls of the vessel so as to get the entire sample down into the acid. If the reagents do not adequately wash the sample down, gently tap the vessel on the counter.

10.8 The LCS, MS, and MSD shall be spiked at this time. See Sections 8.4, 8.5, and 8.6 for instructions.

10.9 Insert a Teflon pressure release cork in to each vessel, and hand tighten down the vessel cap.

10.10 Using the Mettler balance, weigh each individual vessel to the nearest 100th of a gram. Record these weights in the 3051A Digestion Log.

10.11 After weighing the vessels place them back into the carrousel. Open the microwave and place the carrousel so that the base fits into the peg in the bottom of the microwave. Close the door.

10.12 From the CEM Main Menu, select LOAD METHOD. Then select USER DIRECTORY. Scroll down to Either EPA 3051_8 ALSI, EPA 3051_16 ALSI, or EPA 3051_24 ALSI. The 8, 16, or 24 correspond to a maximum number of samples that can be digested. In order to reach the desired 175ºC, the microwave uses different Wattages for each method. Be sure to choose the

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appropriate method for the number of samples you're digesting.

10.13 After selecting the method, the display screen returns to the MAIN MENU. The method currently selected appears at the bottom of the screen. If the method is correct, hit the green start button.

10.14 The microwave will go through an initialization step, and then digest the samples for 20 minutes. The microwave will ramp wattage so as to heat the samples to 175ºC in the first ten minutes, and ten hold at this temperature for the second ten minutes.

NOTE: The microwave unit uses an average when calculating the temperature for the display screen. For this reason, the lab tech can expect to see a large variation in the digestion temperatures. The temperature displayed on the screen may not be the actual temperature of the samples. If the unit's temperature calibration is up to date, this temperature display can be ignored.

10.15 Following the 20-minute digestion, the microwave unit will automatically go through a COOL DOWN phase. The tech is advised not to remove the carousel until the unit has cooled for at least ten minutes.

10.16 When the vessels are cooled, weigh them on the Mettler balance to the nearest 100th gram. If the difference in weights from the initial weight of vessel to the final weight of vessel is greater than 5.00 g, the sample must be discarded and redigested. This indicates a loss of sample through the pressure release system. Either less sample needs to be used for next digestion, or digestion method itself needs to be switched over to 3050B (hotplate). Be sure to document the final vessels weights in the 3051A Digestion Log.

10.17 All samples that lost less than 5.00 grams can be slowly opened and bottled for analysis. Open the vessels in the hood. Depending on the content, some samples release large amounts of gas when vented. Once the top of the vessel has been removed, the Teflon pressure release cork can also be removed. Be sure to rinse this cork with reagent water so as to recover as much digestate as possible.

10.18 Pour the digestate into a labeled 50 mL SCP vessel. Thoroughly rinse down the inner walls of the digestion vessel with reagent water, and add it to the SCP vessel as well.

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10.19 Bring the SCP vessels up to the 50 mL mark with reagent water and cap them.

10.20 Centrifuge all digestates for at least 5 minutes.

10.21 Take the labeled digestates to the Metals Lab for analysis.

11 Calculations

11.1 Not applicable to this method.

12 Reporting Results

12.1 Verify that all required information has been entered into the digestion logbook.

12.2 Open the production Horizon LIMS, and go to "batch posting" under the Operations TAB. Enter the Horizon Batch Number (HBN), which corresponds to MDIG digestion batch. When the batch opens, the samples will already have default initial volumes of 0.50 grams final digestate volumes of 50 mL. These volumes will need to be adjusted to match the initial sample weights and final prep volumes in the 3051A Digestion Log.

12.3 Once the sample prep factors have been updated, the analyst initials and final prep date and time need to be entered in their appropriate fields.

12.4 Double check that all information entered in steps 12.1 through 12.3 is correct, have information reviewed by second analyst, and hit the save TAB in the upper left corner of the Horizon page. Once the batch is saved, the prep factors are applied to the samples, and the META analysis code becomes available for the Metals Dept.

13 Waste Disposal

13.1 Refer to ALSI SOP 19-Waste Disposal.

14 Pollution Prevention

14.1 Pollution prevention encompasses any technique that reduces or eliminates the quantity or toxicity of waste at the point of generation. Numerous opportunities for pollution prevention exist in laboratory

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operations. Management shall consider pollution prevention a high priority. Extended storage of unused chemicals increases the risk of accidents. The laboratory shall consider smaller quantity purchases which will result in fewer unused chemicals being stored and reduce the potential for exposure by employees. ALSI tracks chemicals when received by recording their receipt in a traceable logbook. Each chemical is then labeled according to required procedures and stored in assigned locations for proper laboratory use.

15 Definitions

15.1 Refer to ALSI QA Plan under Laboratory Quality Control Checks for general definitions.

16 Troubleshooting

16.1 Refer to maintenance logs and instrument manual, including CEM MARS XPRESS manual, for guidance in troubleshooting specific problems related to the apparatus used in this method.

Appendix A

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INORGANIC MICROWAVE SAMPLE PREPARATION

EPA Method: 3051A
ALSI SOP: 09-3051A
Microwave ID Number: CEM MARS XPRESS

Date of last Microwave Calibration: _____

Type of Prep Batch:
I - 6010B Batch #_____
M - 6020 Batch #_____
L - IH LEAD Batch #_____

	Date	Time	Tech
Start			
Finish			

Position #	Sample #	Initial Weight Of Vessel (g)	Final Weight Of Vessel (g)	Difference in Vessel Weight (g)	Spike Amount (µl of each)	Spike Lot #	Initial Sample Amount	Final Volume (50 ml)	Batch Type	Pipette ID #	QC Type
1				0.00							
2				0.00							
3				0.00							
4				0.00							
5				0.00							
6				0.00							
7				0.00							
8				0.00							
9				0.00							
10				0.00							
11				0.00							
12				0.00							
13				0.00							
14				0.00							
15				0.00							
16				0.00							
17				0.00							
18				0.00							
19				0.00							
20				0.00							
21				0.00							
22				0.00							
23				0.00							
24				0.00							
25											
26											

Comments:
1.) Concentrated HNO3 Lot #:
4.) Reagent:Conc. HCl
5.) Teflon Boiling Stones: BATCH# 3626-6I069 CHEMWARE ITEM # 0919120

Reviewed/Approved By:
Date Reviewed:

Revision: 05/07

3051A LOGBOOK TEMPLATE.xls

SOP Change History Sheet

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Section No.	**Section**	**Reason for Change**
Revision 0: 06/01/2007		New Procedure

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SOP Concurrence Form
for the Distribution and Revision of Standard Operating Procedures

I have read, understood, and concurred with the Standard Operating Procedure (SOP) described above and will perform this procedure as it is written in the SOP.

Print Name	Signature	Date

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UNCONTROLLED DOCUMENT

Document Title: Volatile Organic Compounds by Gas Chromatography/Mass Spectrometry (GC/MS): Capillary Column Technique

Document Control Number: _____

Organization Title: ANALYTICAL LABORATORY SERVICE, INC. (ALSI)
Address: 34 Dogwood Lane
Middletown, PA 17057

Phone: (717) 944-5541

Approved by:

_____ _____
Helen MacMinn, Date
Quality Assurance Manager

_____ _____
Christopher Kahler, Date
GC/MS Supervisor

_____ _____
Erin Ripka, Date
Validator

Annual Review:

_____ _____
Reviewed By Date Reviewed

_____ _____
Approved By Date Approved

_____ _____
Reviewed By Date Reviewed

_____ _____
Approved By Date Approved

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Annual Review (continued):

Reviewed By	Date Reviewed
Approved By	Date Approved

Reviewed By	Date Reviewed
Approved By	Date Approved

Reviewed By	Date Reviewed
Approved By	Date Approved

Reviewed By	Date Reviewed
Approved By	Date Approved

Reviewed By	Date Reviewed
Approved By	Date Approved

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TABLE OF CONTENTS

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1 Scope and Application

1.1 This standard operating procedure is adapted from "Test Methods for Evaluating Solid Waste Physical/Chemical Methods" (SW-846), Method 8260B, Revision 2, December 1996, Method 5035A, Revision 1, July 2002, and Method 5030C, Revision 3, December 2003. The method detection limits (MDLs) can be found in the most current GC/MS method detection limit book. The detection limits for a specific sample may differ from those listed due to the nature of interferences in a particular sample matrix.

1.2 Method 8260B is used to determine volatile organic compounds in a variety of solid waste matrices. This method is applicable to nearly all types of samples, regardless of water content, including ground water, aqueous sludges, caustic liquors, acid liquors, waste solvents, oily wastes, mousses, tars, fibrous wastes, polymeric emulsions, filter cakes, spent carbons, spent catalysts, soils and sediments. The following compounds can be determined by this method:

		Appropriate Technique
Analyte	CAS No.[b]	Purge-and-Trap
Acetone	67-64-1	pp
Acetonitrile	75-05-8	pp
Acrolein (Propenal)	107-02-8	pp
Acrylonitrile	107-13-1	pp
Allyl alcohol	107-18-6	ht
Allyl chloride	107-05-1	a
Benzene	71-43-2	a
Benzyl chloride	100-44-7	a
Bromacetone	598-31-2	pp
Bromochloromethane	74-97-5	a
Bromodichloromethane	75-27-4	a
4-Bromofluoraobenzene	460-00-4	a
Bromoform	75-25-2	a
Bromomethane	74-83-9	a
n-Butanol	71-36-3	ht
2-Butanone (MEK)	78-93-3	pp
Carbon disulfide	75-15-0	pp
Carbon tetrachloride	56-23-5	a
Chloral hydrate	302-17-0	pp
Chlorobenzene	108-90-7	a
Chlorobenzene	126-99-8	a
Chlorodibromomethane	124-48-1	a
Chloroethane	75-00-3	a
2-Chloroethanol	107-07-3	pp
bis-(2-Chloroethyl) sulfide	505-60-2	pp
2-Chloroethyl vinyl ether	110-75-8	a
Chloroform	67-66-3	a
Chloromethane	74-87-3	a
Chloroprene	126-99-8	a
3-Chloropropene	107-05-1	a
3-Chloropropionitrile	542-76-7	I
1,2-Dibromo-3-chloropropane	96-12-8	pp
1,2-Dibromoethane	106-93-4	a
Dibromomethane	74-95-3	a
1,2-Dichlorobenzene	95-50-1	a
1,3-Dichlorobenzene	541-73-1	a
1,4-Dichlorobenzene	106-46-7	a
cis-1,4-Dichloro-2-butene	1476-11-5	a
trans-1,4-Dichloro-2-butene	110-57-6	pp
Dichlorodifluoromethane	75-71-8	a
1,1-Dichloroethane	75-34-3	a
1,2-Dichloroethane	107-06-2	a

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1,1-Dichloroethene	75-35-4	a
trans-1,2-Dichloroethene	156-60-5	a
1,2-Dichloropropane	78-87-5	a
1,3-Dichloro-2-propanol	96-23-1	pp
cis-1,3-Dichloropropene	10061-01-5	a
trans-1,3-Dichloropropene	10061-02-6	a
1,2,3,4-Diepoxybutane	1464-53-5	a
Diethyl ether	60-29-7	a
1,4-Difluorobenzene	540-36-3	a
1,4-Dioxane	123-91-1	pp
Epichlorohydrin	106-89-8	i
Ethanol	64-17-5	i
Ethyl acetate	141-78-6	i
Ethylbenzene	100-41-4	a
Ethylene oxide	75-21-8	pp
Ethyl methacrylate	97-63-2	a
Hexachlorobutadiene	87-68-3	a
Hexachloroethane	67-72-1	i
2-Hexanone	591-78-6	pp
2-Hydroxypropionitrile	78-97-7	i
Iodomethane	74-88-4	a
Isobutyl alcohol	78-83-1	pp
Isopropylbenzene	98-82-8	a
Malononitrile	109-77-3	pp
Methacrylonitrile	126-98-7	pp
Methylene chloride (DCM)	75-09-2	a
Methyl methacrylate	80-62-6	a
4-Methyl-2-pentanone (MIBK)	108-10-1	pp
Naphthalene	91-20-3	a
Nitrobenzene	98-95-3	a
2-Nitropropane	79-46-9	a
Pentachloroethane	76-01-7	i
2-Picoline	109-06-8	pp
Propargyl alcohol	107-19-7	pp
β-Propiolactone	57-57-8	pp
Propionitrile (ethyl cyanide)	107-12-0	ht
Propylamine	107-10-8	a
Pyridine	110-96-1	i
Styrene	100-42-5	a
1,1,1,2-Tetrachlorethane	630-20-6	a
1,1,2,2-Tetrachlorethane	79-34-5	a
Tetrachloroethene	127-18-4	a
Toluene	108-88-3	a
1,2,4-Trichlorobenzene	120-82-1	a
1,1,1-Trichloroethane	71-55-6	a
1,1,2-Trichloroethane	79-00-5	a
Trichloroethene	79-01-6	a
Trichlorofluoromethane	75-69-4	a
1,2,3-Trichloropropane	96-18-4	a
Vinyl acetate	108-05-4	a
Vinyl chloride	75-01-4	a
o-Xylene	95-47-6	a
m-Xylene	108-38-3	a
p-Xylene	106-42-3	a

a	Adequate response by this technique.
b	Chemical Abstract Services Registry Number.
ht	Method analyte only when purged at 80°C.
i	Inappropriate technique for this analyte.
pc	Poor chromatographic behavior
pp	Poor purging efficiency resulting in high EQLs.

NOTE: For the preparation of soils and solids, see the 19-5035 SOP.

1.3 Method 8260B can be used to quantitate most volatile organic compounds that have boiling points below 200°C and that are insoluble or slightly soluble in water. Volatile water-soluble compounds can be included in this analytical technique. However, for the more soluble compounds, quantitation limits are approximately ten times higher because of poor purging efficiency. Such compounds include low-molecular-weight halogenated hydrocarbons, aromatics, ketones, nitriles, acetates, acrylates, ethers and sulfides. The following analytes are also amenable to analysis by Method 8260B:

Bromobenzene	1-Chlorohexane
n-Butylbenzene	2-Chlorotoluene
sec-Butylbenzene	4-Chlorotoluene
tert-Butylbenzene	Crotonaldehyde
Chloroacetonitrile	Dibromofluoromethane

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1-Chlorobutane	cis-1,2-Dichloroethene
1,3-Dichloropropane	Methyl-t-butyl ether
2,2-Dichloropropane	Pentafluorobenzene
1,1-Dichloropropene	n-Propylbenzene
Fluorobenzene	1,2,3-Trichlorobenzene
p-Isopropyltoluene	1,2,4-Trimethylbenzene
Methyl acrylate	1,3,5-Trimethylbenzene

1.4 The estimated quantitation limit (EQL) of Method 8260B for an individual compound is somewhat instrument dependent. Using standard quadruple instrumentation, limits shall be approximately 5 μg/kg (wet weight) for soil/sediment samples, 0.5 mg/kg (wet weight) for wastes, and 5 μg/L for ground water. EQLs will be proportionately higher for sample extracts and samples that require dilution or reduced sample size to avoid saturation of the detector.

1.5 Method 8260B is based upon a purge-and-trap, gas chromatographic/mass spectrometric (GC/MS) procedure. This method is restricted to use by, or under the supervision of, analysts experienced in the use of purge-and-trap systems and gas chromatograph/mass spectrometers, and skilled in the interpretation of mass spectra and their use as a quantitative tool.

1.6 An additional method for sample introduction is direct injection. This technique has been tested (by agencies other than ALSI) for the analysis of waste oil diluted with hexadecane 1:1 (vol/vol) and may have application for the analysis of some alcohols and aldehydes in aqueous samples. ALSI does not use the direct injection technique and the technique will not be covered by this standard operating procedure.

1.7 This standard operating procedure also describes the preparation of water-miscible liquids, non-water-miscible liquids, solids, wastes and soils/sediments for analysis by the purge-and-trap procedure.

1.8 This document states the laboratory's policies and procedures established in order to meet requirements of all certifications/accreditations currently held by the laboratory, including the most current NELAC standards.

1.9 The Method Detection Limits (MDLs) are on the ALSI network and maintained and updated by the QA Department. The detection limits for a specific sample may differ from those listed due to the nature of interferences in a particular sample matrix.

1.10 Individual project requirements may override criteria listed in this SOP.

2 Summary of Method

2.1 An inert gas is bubbled through a 5-mL water sample contained in a purging chamber at ambient temperature. The purgeables are efficiently transferred from the aqueous phase to the vapor phase. The vapor is swept through a sorbent trap where the purgeables are trapped. After purging is completed, the trap is heated and back-flushed with helium to desorb the purgeables onto a gas chromatographic column. The

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gas chromatograph is temperature programmed to separate the purgeables, which are then detected with a mass spectrometer.

3 Interferences

3.1 Impurities in the purge gas, organic compounds outgassing from the plumbing ahead of the trap and solvent vapors in the laboratory, account for the majority of contamination problems. The analytical system must be demonstrated to be free from contamination under the conditions of the analysis by running laboratory reagent blanks as described in Section 8.4. The use of non-Teflon plastic tubing, non-Teflon thread sealants, or flow controllers with rubber components in the purge and trap system shall be avoided.

3.2 Samples may be contaminated by diffusion of volatile organics (particularly fluorocarbons and methylene chloride) through the septum seal into the sample during shipment and storage. A field reagent blank prepared from organic-free reagent water and carried through the sampling and handling protocol can serve as a check on contamination.

3.3 Contamination by carry-over can occur whenever a low level sample is analyzed immediately after a high level sample. To reduce carry-over, the purging device and sample syringe must be rinsed with reagent water between sample analyses. Whenever an unusually concentrated sample is encountered, one or more cleaning blanks shall be analyzed to check for cross contamination. For samples containing large amounts of water-soluble materials, suspended solids, high boiling compounds or high purgeable levels, it may be necessary to wash the purging device with a soap solution, rinse with organic-free reagent water, and then dry in an oven at 105°C. The trap and other parts of the system are also subject to contamination; therefore, frequent baking and purging of the entire system may be needed. In extreme situations, the whole purge and trap device may require dismantling and cleaning.

3.4 Special precautions must be taken to analyze for methylene chloride. The analytical and sample storage area shall be isolated from all atmospheric sources of methylene chloride. Otherwise random background levels will result. Laboratory clothing worn by analysts shall be clean since exposure to methylene chloride fumes during extraction procedures can contribute to sample contamination.

4 Safety

4.1 The toxicity or carcinogenicity of each reagent in this method has not been precisely defined; however, each chemical compound shall be treated as a potential health hazard. From this viewpoint, exposure to these chemicals must be reduced to the lowest possible level by whatever means available.

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4.2 Analysts shall consult the material safety data sheets (MSDS) for each chemical used in the analysis. ALSI maintains MSDSs on all chemicals used in this procedure. ALSI recommends that all individuals performing this SOP familiarize themselves with the MSDSs associated this method prior to SOP performance. MSDSs are available to all staff and are located in hard copy in the QA office and electronically on the ALSI server in the MSDS folder.

4.3 The following parameters covered by this method have been tentatively classified as known or suspected, human or mammalian carcinogens: benzene, carbon tetrachloride, chloroform, 1,4-dichlorobenzene and vinyl chloride. Primary standards of these toxic compounds shall be prepared in a hood.

4.4 Since the chemical makeup of the samples is not known, analysts shall treat the samples with extreme caution. Precautionary steps would include using chemical resistant gloves, wearing a fully-buttoned lab coat, and safety glasses.

5 Apparatus and Materials

5.1 Purge-and-trap device (Example system provided below)

5.1.1 Purge and Trap concentrator: Tekmar 3000, Model #14-30000-000, Serial #93133003, or equivalent.

5.1.2 Autosampler: Archon-EST, Model #D4-505220-16, Serial #12543, or equivalent.

5.1.3 Trap: VocarbJ 3000, Purge Trap K, purchased from Supelco, catalog #2-4920, or equivalent, or equivalent.

5.2 Gas chromatography/mass spectrometer/data system. (Example system provided below.)

5.2.1 Gas chromatograph: Hewlett Packard 5890 Series II, Serial # 3336A50415, or equivalent.

5.2.2 Gas chromatographic column: 75 m x 0.53 mm ID megabore capillary column coated with DB624 (J & W Scientific), 3 µm film thickness, or equivalent.

5.2.3 Mass spectrometer: Hewlett Packard 5970 Series Mass Selective Detector, Model #5970B, Serial #3004A12574, or equivalent.

5.2.4 Electron Multiplier: K and M Model #7596M, purchased from CPI, part

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#4200-01, or equivalent.

5.2.5 GC/MS Interface

5.2.5.1 Jet separator if necessary: purchased from SIS, part #13505, or equivalent.

5.2.5.2 Transfer line: 0.53 ID fused silica guard column, phenyl methyl deactivated, purchased from Restek, catalog #0045, or equivalent. Not needed with split injector and EPC (electronic pressure control).

Note: Currently, none of the GCMS instruments have need of a jet separator but may require one in the future.

5.2.6 GC Inlet: O-I Low-Dead-Volume Injector Port kit, O-I-Analytical, Part #176926, or equivalent.

5.2.7 Data System

5.2.7.1 Hewlett Packard MS DOS Chemstation, used for instrument tuning and data collection.

5.2.7.2 Hewlett Packard 4920 ChemServer with Envision and Target 4.13 software.

5.2.8 See the instrument maintenance logbooks, located in the data review area of the GC/MS laboratory, for serial number and all pertinent information relating to all other GC/MS instruments used for the analysis of 8260B volatile samples.

5.3 Microsyringes: Hamilton gastight, various volumes between 10 µL and 100 µL: VWR #60376-220,230,241,252,263,274, or equivalent.

5.4 Syringe valve: two-way, with Luer ends.

5.5 Syringes: 5 mL, Hamilton Gastight: VWR # 60376-321, or equivalent.

5.6 Balance – ACCULAB VI-200; 200 gm capacity; 0.01 gm resolution or equivalent.

5.7 Micro Reaction Vessels: 1.0 mL, Supelco #3-3293 or equivalent.

5.8 Mininert Valves: 15 mm, Supelco #614160 or equivalent.

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5.9 Vials: 40 mL I-CHEM: VWR # IRS136-0040, or equivalent.

5.10 Vials: 20 mL I-CHEM: VWR # IRS126-0020, or equivalent.

5.11 Teflon faced liners: VWR # 66001-236, or equivalent.

5.12 Disposable pipettes: Pasteur, VWR 5 ¾" # 14672-200, or equivalent.

5.13 Volumetric flasks: Class A, various volumes, with ground-glass stoppers.

5.14 Spatula: stainless steel VWR # 57952-107, or equivalent.

6 Reagents

NOTE: Unless otherwise noted in this section all chemicals are stored at room temperature and labeled with an expiration date of five years from receipt. Manufacturer's labeled expiration dates, when less than five years, take precedent over all other expiration dates.

6.1 Reagent grade inorganic chemicals shall be used in all tests. Unless otherwise indicated, it is intended that all inorganic reagents shall conform to the specifications of The Committee on Analytical Reagents of the American Chemical Society, where such specifications are available. Other grades may be used, provided it is first ascertained that the reagent is of sufficiently high purity to permit its use without lessening the accuracy of the determination.

6.2 Reagent water: Reagent water is water in which an interference is not observed at the analyte of interest. For this purpose, tap water is used. De-ionized water shall not be used for this method as it has been shown to contain interferences due to cartridge bleed. NOTE: Once resolved, DI water may be used.

6.3 Compressed Helium gas: ultrahigh purity grade.

6.4 Methanol: EM Science Purge & Trap grade, # MX0482-6 or equivalent.

6.5 Primary Stock Solutions: Primary stock solutions may be prepared from pure standard materials or purchased as certified solutions. Standards for all 8260B compounds are purchased as certified solutions. These certified solutions are stored in flame-sealed ampoules in the small freezer marked "Volatile Standards" located in the GCMS volatile area of the laboratory at -10°C to -20°C. Each certified solution has an expiration date and needs to be properly discarded if that date is exceeded. For all secondary working solutions, vials are labeled with the name of the standard, the date prepared, the expiration date, the preparer's initials and the reference to the volume and page number in the GCMS VOC Standards Logbook. All standard preparations

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must be documented in the GCMS VOC Standards Logbook. Storage location is the volatile standards freezer.

6.5.1 If the primary stock solutions are to be prepared from pure standard materials, follow the instructions in Section 5.7 of Method 8260B.

6.5.2 As an alternative to Section 5.7 of Method 8260B, the following procedure may be used to prepare standards from pure standard materials that are a liquid at room temperature.

6.5.2.1 Determine the desired concentration, **C**, in µg/mL of the stock solution.

6.5.2.2 Determine the desired volume, **V**, in mL of the stock solution.

6.5.2.3 Lookup the density, **D**, of the liquid analyte.

6.5.2.4 Find the purity, **P**, in percent of the chemical. If it is 96% or greater, assume the purity is 100%.

6.5.2.5 Determine the volume, **VA**, in µL of chemical necessary to prepare the standard using the following equation.

$$\mathbf{VA} = (\mathbf{C}*\mathbf{V})/(10*\mathbf{P}*\mathbf{D})$$

6.5.2.6 Partially fill a **V** mL volumetric flask with purge and trap methanol.

6.5.2.7 Add **VA** µL of the chemical. Note more than one chemical may be added to a solution using this procedure.

6.5.2.8 Dilute to volume and invert three times to mix.

6.6 Tuning Solution: The tuning solution is prepared containing 50 µg/mL of 4-Bromofluorobenzene in P+T (purge and trap) Methanol.

6.6.1 Place about 48 mL of P+T methanol in a 50-mL Class A volumetric flask.

6.6.2 Add 1.25 mL of Restek's 2000 µg/mL 4-Bromofluorobenzene mix, Cat. #30026, to the methanol, dilute mixture to volume, and invert 3 times to mix.

6.6.3 Note: Preparations of varied amounts are acceptable for this standard as long as the ratio of BFB to methanol is 1:40 (50 µg/mL).

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6.6.4 This solution has a six-month expiration date from the time prepared and is stored in the volatile standards freezer.

6.7 Internal Standard (IS) solution: The internal standard solution is prepared containing 150 µg/mL of the 8260A internal standards. This standard is abbreviated as 826IS. Note, since the auto sampler adds the spiking solution, the sample loop must be calibrated according to manufacturer's instructions and the IS solution may need to be prepared at a slightly different concentration to spike the standards at 30 ppb. Record the preparation of the alternate solution in the standard logbook with the identification of the system it will be used with.

6.7.1 The IS solution contains the following compounds at 150 µg/mL: chlorobenzene-d5, fluorobenzene, and 1,4-dichlorobenzene-d4.

6.7.2 IS solution preparation. (Note: The ratio of standard to methanol will remain the same if different volumes are prepared.)

6.7.2.1 Place about 23 mL of P+T methanol in a 25-mL Class A volumetric flask.

6.7.2.2 Add 1.5 mL of Restek's 2500 µg/mL 8260A Internal Standard Mix, cat. #30241, dilute mixture to volume, and invert 3 times to mix.

6.7.2.3 This solution has a six-month expiration from the date prepared and is stored in the volatile standards freezer.

6.8 8260 Surrogate Solution. The 8260 surrogate solution is prepared containing 150 µg/mL of the 8260A surrogate compounds. This solution is used to prepare samples. This standard is abbreviated as **826SS**. Note: since the auto sampler adds the spiking solution, the sample loop must be calibrated according to manufacturer's instructions and the SS solution may need to be prepared at a slightly different concentration to spike the standards at 30 ppb. Record the preparation of the alternate solution in the standard logbook with the identification of the system it will be used with.

6.8.1 The 8260 surrogate solution contains the following compounds at 150 µg/mL: 4-bromofluorobenzene, 1,2-dichloroethane-d4, dibromofluoromethane, and toluene-d8.

6.8.2 8260 surrogate solution preparation. Note: Any volume can be prepared as long as the ratio of surrogate mix to methanol is 1:50.

6.8.3 Place about 48 mL of P+T methanol in a 50-mL Class A volumetric flask.

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6.8.4 Add 1.0 mL of Restek's 2500 µg/mL 8260A Surrogate Standard Mix, cat. #30240, dilute mixture to volume, and invert 3 times to mix.

6.8.5 This solution has a six-month expiration date from the time prepared and is stored in the volatile standards freezer.

6.9 High 8260 Surrogate Solution. The 8260 surrogate solution is prepared containing 250 µg/mL of the 8260A surrogate compounds. This solution is used to prepare initial calibrations. This standard is abbreviated as **H826SS**.

6.9.1 The H8260 surrogate solution contains the following compounds at 250 µg/mL: 4-bromofluorobenzene, 1,2-dichloroethane-d4, dibromofluoromethane, and toluene-d8.

6.9.2 H8260 surrogate solution preparation. Note: Any volume can be prepared as long as the ratio of surrogate mix to methanol is 1:10.

6.9.2.1 Place slightly less than 9 mL of P+T methanol in a 10 mL volumetric flask.

6.9.2.2 Add 1.0 mL of Restek's 2500 µg/mL 8260A surrogates mix, Cat. #30240, to the methanol.

6.9.2.3 Dilute mixture to volume.

6.9.2.4 Invert the flask 3 times to mix and place the solution into labeled sub-vials.

6.9.2.5 This solution has a six-month expiration date from the time prepared and is stored in the volatile standards freezer.

6.10 Calibration Solutions.

6.10.1 The following stock solutions are purchased to prepare the calibration and calibration check standards:

Name	***Catalog #***	***Abbreviation***
502.2 CAL2000 MEGA MIX	30431	VCSMEGA
Custom V standard Acrolein	54588	VCS Acrolein
8260B Acetates Mix	30489	VCS Acetates
Custom Ketones Mix (10,000 µg/mL)	559848	VCS Ketones
2-Chloroethylvinylether Standard	30265	VCS 2 CEVE
502.2 Calibration mix 1A	30439	V Gas

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Custom VOA Additions Mix (2000-50,000 µg/mL) 559847 VCS Additions

6.10.2 The concentrations of the stock solutions and their concentration in the calibration solutions are recorded in Appendix A.

6.10.3 Preparation of VOA NEW, a secondary stock standard.

6.10.3.1 Add approximately 3.0 mL (but no more than 4.0 mL) of P+T methanol to a 10-mL volumetric flask.

6.10.3.2 Add 1.0 mL of the following stock standards: VCSMEGA, VCS Acetates, VCS Ketones, VCS Additions, VCS Acrolein, and VCS 2 CEVE.

6.10.3.3 Dilute mixture to volume.

6.10.3.4 Invert the flask 3 times to mix and place the solution into labeled sub vials.

6.10.3.5 This solution has a two-month expiration date from the time prepared and is stored in the volatile standards freezer.

6.11 Quality control sample solutions.

6.11.1 The following stock solutions are purchased to prepare the matrix spikes and blank spikes:

Name	***Catalog #***	***Abbreviation***
502.2 CAL200 MEGA Mix	30432	QCS MEGA
Custom Acetates Mix	560215	QCS Acetates
Custom Q Acrolein	54589	QCS Acrolein
Custom 2-Chloroethylvinylether Std	560216	QCS2CEVE
Custom Q Gases	52911	QGAS
Custom Ketones Mix (1000µg/mL)	560214	QCS Ketones
Custom VOA Additions Mix (200-5000 µg/mL)	560213	QCS Additions

6.11.2 The concentrations of the stock solutions and their concentration in the calibration verification solution are recorded in Appendix B.

6.11.3 Preparation of QVOALCS, a secondary stock standard.

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6.11.3.1 Add approximately 6.0 mL (but no more than 7.0 mL) of P+T methanol to a 10-mL volumetric flask.

6.11.3.2 Add 0.5 mL of the following stock standards: QCSMEGA, QCS Acetates, QCS Ketones, QCS Additions, QCS Acrolein, and QCS2CEVE.

6.11.3.3 Dilute mixture to volume.

6.11.3.4 Invert flask 3 times and place into labeled sub-vials.

6.11.3.5 This solution has a two-month expiration from the date prepared and is stored in the volatile standards freezer.

6.12 Antifoam Agent (Sigma – SE-15, product #A8582 or equivalent).

6.12.1 10 µL of antifoam is added to 5 mL of sample. An antifoam blank shall precede any samples run with antifoam to prove that there are no target analytes present in the antifoam solution. If using an Archon sampler, add 100 µL to the 40-mL vial.

6.13 DPD Free Chlorine Reagent, HACH # 21055-60, or equivalent.

7 Instrument Calibration

7.1 The specific configuration of each volatile instrument (ms01, ms03, ms05, and ms07) is recorded in the instrument's maintenance logbook.

7.2 The purge and trap program of each volatiles instrument is recorded in the instrument maintenance logbook.

7.3 The GC/MS methods are printed out with each analytical batch. This includes the tune reports and the methods. NOTE: If no changes have been made to the methods, photocopies of the latest updated method can be produced from the originals. These copies are archived with the associated raw data.

7.4 Tuning Requirements. Before the beginning of the analysis of samples, blanks, MS/MSDs, duplicates, or standards; the instrument must be hardware tuned to meet the requirements stated below.

7.4.1 Inject or purge 1.0 µL (50 ng of BFB) of the tuning solution into the instrument.

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7.4.2 When the run is complete, process the data on the Target system using the BFB method.

7.4.3 BFB performance may be evaluated using the following scans: apex, left of the apex, right of the apex, average of the apex (left, apex, and right), average of the entire BFB peak, or any of the preceding with background subtraction. Note: if background subtraction is performed, the background scan must elute within 10 scans before BFB begins to elute.

NOTE: **The current software criteria set up in our BFB method uses the average of three scans: the apex, scan left of the apex, and scan right of the apex. These criteria satisfy DoD specifications.**

7.4.4 Compare the performance of BFB to the following table:

Mass (m/z)	Abundance Criteria
50	15 to 40% of mass 95
75	30-60% of mass 95
95	Base peak, 100% Relative abundance
96	5-9% of m/z 95
173	<2% of mass 174
174	>50% of mass 95
175	5 to 9% of mass 174
176	>95% but <101% of mass 174
177	5 to 9% of mass 176

7.4.5 When the instrument meets the above requirements analysis may begin and continue for 12 hours from the injection of the tuning solution. For example, if the tuning solution is injected at 0100 on 12/1/98, the last sample may inject at 1300 on12/1/98.

7.5 Initial calibration.

7.5.1 Each instrument in the laboratory could have a specific initial calibration curve analyzed on it but mainly use the following concentrations.

7.5.1.1 The following calibration standards are analyzed for the initial calibration, VSTD001, VSTD005, VSTD020, VSTD050, VSTD100, and VSTD200.

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7.5.2 Prepare calibration solutions following the table in appendix A. For the Archon auto sampler, simply place these solutions in a 40-mL VOC vials, the auto sampler will add the IS solution automatically.

NOTE: Appendix A allows for surrogate standards to be elevated along with the same concentration of each individual calibration standard resulting in a multi-point calibration.

7.5.3 Calibration Criteria.

7.5.3.1 The average fit must have a %RSD of less than 15% over at least five calibration points (Six points are normally analyzed). It is acceptable to drop calibration points from either end of the calibration. Note: if the high calibration standard is dropped for a compound, the limit of quantitation must be lowered to the next calibration concentration for that compound.

7.5.3.2 The calibration curves are generated with the Target software. A primary or secondary curve fit may also be used for any compound with a %RSD greater than 15%, but shall be less than 50%. (**DoD requires less than %30**)

7.5.3.2.1 Power and quadratic fits require 6 points. The R value must be 0.99 or greater. **(DoD requires $\geq$ 0.995)**Our Target software uses R^2 so it must be $\geq$ 0.98 and 0.99 for DoD.

7.5.3.2.2 The linear primary fit requires at least 5 points. The R value must be 0.99 or greater. **(DoD requires $\geq$. 995)** Our Target software uses R^2 so it must be $\geq$ 0.98 and 0.99 for DoD.

7.5.3.2.3 A %RSD of <30% must be achieved for the Calibration Check Compounds (CCCs) before the curve passes. If it is between 15% and 30% RSD, a primary or secondary curve fit must be used. The CCCs are as follows:

1,1-Dichloroethane
Chloroform
1,2-Dichloropropane
Toluene
Ethylbenzene
Vinyl Chloride

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7.5.4 Structural isomers that have very similar mass spectra and less than 30 seconds difference in retention time can be explicitly identified only if the resolution between isomers in a standard is acceptable. Acceptable resolution is achieved if the baseline to valley height between isomers is less than 25 % of the sum of the two peak heights. Otherwise, structural isomers are identified as isomeric pairs. In other words, sum the isomers and report any results as total of the isomer X and Y. Isomers of this type need to be calibrated as a sum also.

7.5.4.1 After an initial calibration, a blank spike (LCS) must be analyzed before the analysis of samples can begin. The recoveries of the LCS must fall within laboratory acceptable limits for each compound of interest. If these recovery limits are met, samples may be run under the initial calibration to finish the 12-hour tune. **DoD requires** the second source verification meet 25% recovery of expected value.

7.6 GC/MS calibration verification

7.6.1 Prior to the analysis of samples, inject the BFB standard. The resultant mass spectra for the BFB must meet all of the criteria as stated in the standard operating procedure for tuning the GC/MS system. These criteria must be demonstrated each twelve hours of operation.

7.6.1.1 When the analysis of **DoD samples** is to take place, BFB must meet criteria by the average of three (3) scans. The scans include the apex, the scan left of the apex, and the scan right of the apex.

7.6.2 The initial calibration curve for each compound of interest must be checked and verified once every twelve hours during analysis with the introduction technique used for samples. Analyzing a 50 ppb calibration standard and checking the SPCCs and CCCs accomplish this.

Note: When DoD samples are to be analyzed for 15 or less analytes, all of the target analytes shall meet the same criteria as the CCCs.

7.6.2.1 When the analysis of **DoD samples** is to take place, a continuing calibration standard may need to be analyzed following the samples in a 12-hour period.

7.6.3 System Performance Check Compounds (SPCCs) - Once the continuing calibration check standard is analyzed (Section 7.6.2), the SPCCs are checked. If the SPCC criteria are met, a comparison of relative response factors is made for all compounds. This is the same check applied during the initial calibration. If the minimum relative response factors are not met, the system must be

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evaluated and corrective action must be taken 4 before sample analysis begins. Some possible problems are standard mixture degradation, injection port inlet contamination, contamination at the front end of the analytical column, and active sites in the column or chromatographic system.

7.6.3.1 The minimum relative response factor for volatile SPCCs are as follows:

Chloromethane	0.10
1,1-Dichloroethane	0.10
Bromoform	0.10
Chlorobenzene	0.30
1,1,2,2-Tetrachloroethane	0.30

7.6.4 Calibration Check Compounds (CCCs) - After the system performance check is met, CCCs listed below are used to check the validity of the initial calibration. If the %RSD for each CCC is less than or equal to 20%, the initial calibration is assumed valid. If the criterion is not met (> 20% RSD), for any one CCC, corrective action must be taken. Problems similar to those listed under SPCCs could affect this criterion. If no source of the problem can be determined after corrective action has been taken, a new six-point calibration MUST be generated. This criterion MUST be met before quantitative sample analysis begins.

1,1-Dichloroethane
Chloroform
1,2-Dichloropropane
Toluene
Ethylbenzene
Vinyl Chloride

7.6.5 The internal standard responses and retention times in the check calibration standard must be evaluated immediately after or during data acquisition. If the retention time for any internal standard changes by more than 30 seconds from the midpoint (50) standard of the last initial calibration check (12 hours), the chromatographic system must be inspected for malfunctions and corrections must be made, as required. If the EICP area for any of the internal standards changes by a factor of two (-50% to +100%) from the midpoint (50) standard of the last initial calibration, the mass spectrometer must be inspected for malfunctions and corrections made. When corrections are made, reanalysis of samples analyzed while the system was malfunctioning is necessary. NOTE: During the course of a 12-hour tune period, all samples and blanks must also follow these criteria when referenced against the continuing calibration standard run in that tune period.

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8 Quality Control

8.1 All policies and procedures in the most current revision of the ALSI QA Plan shall be followed when performing this procedure.

8.2 ALSI operates a formal quality control program. The minimum requirements of this program consist of an initial demonstration of laboratory capability and an ongoing analysis of spiked samples to evaluate and document data quality. The laboratory shall maintain records to document the quality of the data generated. Ongoing quality checks are compared to established performance criteria to determine if the results of analyses meet the performance characteristics of the method. When results of sample spikes indicate atypical method performance, a quality control check standard shall be analyzed to confirm that the measurements were performed in an in-control mode of operation. (i.e.: If the MS/MSD fails, an LCS shall be analyzed.) It is the practice of the GC/MS department to analyze a laboratory control sample in every 12-hour tune period.

8.3 The analyst must make an initial, one-time, demonstration of the ability to generate acceptable accuracy and precision with this method. This ability is established as described in Section 8.9. If the analyst meets the acceptance criteria, they are now capable of running actual samples. Ongoing proficiency must be established annually as specified in the QA plan, Technical Training.

8.4 Each day, a reagent water blank must be analyzed to demonstrate that interferences from the analytical system are under control.

8.5 The method blank shall be performed at a frequency of one per 12-hour tune period per matrix type or preparation method. The results of this analysis shall be one of the QC measures to be used to assess tune period acceptance. The source of method blank contamination shall be investigated, and measures taken to correct, minimize, or eliminate the problem if the concentration exceeds one-half the reporting limit. If one-half the reporting limit (RL) is exceeded, the laboratory shall evaluate whether reanalysis of the samples are necessary, based on the following criteria:

8.5.1 The blank contamination exceeds a concentration greater than 1/10 of the measured concentration of any sample in the associated preparatory batch, or

8.5.2 The blank contamination is greater than 1/10 of the project specified limit.

8.5.3 Any samples associated with a blank that fail these criteria shall be reanalyzed, except when the sample analysis resulted in a non-detect. If no sample volume remains for reanalysis, the results shall be reported with appropriate data qualifying codes.

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8.5.4 The current laboratory practice is to comment on a sample associated with a method blank in which one or more analytes were detected at or above the reporting limit in the blank and also in the sample. (i.e. If j-values are detected, no comment is necessary)

8.5.5 **DoD:** If the method blank concentration is greater than or equal to ½ the reporting limit AND is greater than $^{1}/_{10}$ the sample concentration, the source of the contamination must be investigated and measures take to minimize or eliminate the problem and affected samples reanalyzed. If reanalysis is not possible, data shall be reported with a qualifying statement.

8.6 The laboratory must, on an ongoing basis, analyze a spike and spike duplicate on a minimum of 5 % of all samples to monitor and evaluate laboratory data quality. It is the policy of the GC/MS department to spike one sample per every 20 samples. Samples selected for duplicate and matrix spike analysis shall be rotated among client samples so that various matrix problems may be noted and/or addressed. Poor performance in a duplicate or spike may indicate a problem with the sample composition and shall be reported to the client whose sample produced the poor recovery.

8.6.1 Analyze one 5-mL sample aliquot to determine the background concentration (B) of each parameter.

8.6.2 Spike a second 40-mL sample vial with 84 µL and 42 µL of the QVOALCS/QGAS(see Section 6.11 and Appendix B) using an 100-µL gastight syringe and analyze it twice, and determine the concentration after spiking (A) of each parameter. Calculate each percent recovery (P) as:

$$P = \frac{\text{Spiked sample conc. - unspiked sample conc.}}{T} \times 100\%$$

where T = the known true value of the spike

8.6.3 Compare the percent recovery (P) for each parameter with the corresponding QC acceptance criteria found in the most current listing of QC recovery limits.

8.6.4 If any individual P falls outside the designated range for recovery, that parameter has failed the acceptance criteria. However, since some failures may occur due to sample matrix interferences, if the LCS (Section 8.7) passes the set criteria for those failing compounds, the system performance is acceptable. In this case, a comment needs to go on the background sample stating that one or more compounds failed in the MS/MSD associated but passed in the associated LCS. If the LCS is acceptable and the specific matrix interference

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is identified, report with a qualifying statement. If the specific matrix interference is unknown, reanalyze the sample and matrix spike to determine matrix effect or analytical error.

8.7 If any parameter fails the acceptance criteria for recovery in Section 8.6, a Laboratory Control Sample (LCS) containing each parameter that failed must be prepared and analyzed. Note: The current practice is to run an LCS at the same frequency as the method blank, which is one per 12-hour tune period. This is more than the method requires but allows for QC to be more closely associated with each sample in that 12-hour tune period.

8.7.1 Prepare a Laboratory Control Sample (LCS) by using a 100 or 250 µL gastight syringe and adding 50 µL of QGAS and 100 µL of QVOALCS listed in Section 6.11 to 50 mL of reagent water and analyze.

8.7.2 Analyze the Laboratory Control Sample (LCS) to determine the concentration measured (A) of each failed parameter. Calculate each percent recovery (P_s).

8.7.3 Compare the percent recovery (P_s) for each failed parameter with the corresponding LCS acceptance criteria found in the latest control charts generated for the Method 8260 LCS. **DoD requires** specific acceptance criteria found in the DoD Quality Systems Manual. If the recovery of any such parameter, which failed in the MS/MSD, falls outside the designated range, the laboratory performance for that parameter is judged to be out of control, and the problem must be immediately identified and corrected. The analytical result for that parameter, if detected in any samples associated with that LCS, is suspect and shall not be reported for regulatory compliance purposes. If any results are reported, a comment must accompany that result stating the failure and the possibility of a low or high bias to the data. If the LCS fails for one or more compounds that met criteria in the associated MS/MSD, the MS/MSD can prove that the instrument performance is valid as long as the acceptance criteria are as stringent as the criteria for the LCS.

8.7.4 It will be the judgment of the analyst and/or supervisor to approve the data acquired using the initial calibration. If evaluation of the system in addition to the failed QCs indicates a lack of integrity of the data, it will be reanalyzed.

8.8 As a quality control check, the laboratory must spike all samples with the surrogate standard spiking solution and calculate the percent recovery of each surrogate compound. Recoveries must fall within the calculated limits. See Section 8.13 for the development of surrogate control limits. If the surrogate recoveries do not fall within the calculated limits, the sample shall be re-analyzed and the system shall be evaluated for malfunctions. If the surrogate recovery is acceptable in the re-analysis, report the

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data from the re-analysis. If data must be reported in which a surrogate(s) is out, report with a comment.

8.8.1 HORIZON LIMS standard verbiage comment V8L - One or more 8260 surrogates were recovered outside of the recovery limits. Then it lists the current limits.

8.8.2 HORIZON LIMS standard verbiage comment VSM - One or more volatile surrogate(s) was recovered outside of the recovery limits. Its recovery was confirmed by re-analysis indicating a significant matrix effect.

NOTE: A sample with a surrogate out will normally be re-analyzed followed by reporting with a comment VSM. However, if holding time is expired, comment V8L will be used, and the sample will not be re-analyzed.

8.9 To establish the ability to generate accuracy and precision, the analyst must perform the following operation as an initial demonstration of capability.

8.9.1 A quality control (QC) check sample concentrate is prepared containing each parameter of interest. The concentrate must be from an external source, different from the source used for the calibration standards.

8.9.2 Using a 100 or 250 µL gastight syringe, inject 50 µL and 100 µL of the QGAS/QVOALCS solutions into a 50 mL volumetric flask containing reagent water. This is done four (4) times. See Appendix B.

8.9.3 Calculate the average recovery ($\overline{X}$) in µg/L, and the standard deviation of the recovery (s) in µg/L, for each parameter of interest using the four results.

8.9.4 For each parameter, compare s and X with the DOC forms of the corresponding acceptance criteria in the latest control charts generated for 8260B MS/MSDs, respectively. If s and X for all parameters of interest meet the acceptance criteria, the system performance is acceptable and analysis of samples can begin. If any individual s exceeds the precision limit or any individual X falls outside the range for accuracy, the system performance is unacceptable for that parameter.

8.10 If one or more of the parameters tested fail at least one of the acceptance criteria from Section 8.9, the analyst must proceed according to Section 8.10.1 or 8.10.2.

8.10.1 Locate and correct the source of the problem and repeat the test for all parameters of interest beginning with Section 8.9.2.

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8.10.2 Beginning with Section 8.9.2, repeat the test only for those parameters that failed. Repeated failure will confirm a general problem with the measurement system. If this occurs, locate and correct the problem and repeat the test for all compounds of interest beginning with Section 8.9.2.

8.11 The laboratory must, on an ongoing basis, demonstrate through the analysis of Laboratory Control Samples (LCSs) that the operation of the measurement system is in control. The procedure is described in Section 8.7. The frequency of the check standard analysis is equivalent to 5 % of all samples analyzed. This 5% is equivalent to 1 in 20 samples, which is what the GCMS department defines as a batch. This may be reduced if spike recoveries from samples (see Section 8.6) meet all specific control criteria. It is the practice of the GCMS department to analyze a LCS every 12-hour tune period even though the method does not require it. A batch will typically consist of two or more 12-hour tune periods until 20 samples have been analyzed including all QC.

8.12 The laboratory must maintain performance records to document the quality of data generated.

8.13 As part of the QC program, control limits for samples must be assessed and records must be maintained. After the analysis of at least 20 spiked samples as in Section 8.6, calculate the average percent recovery (P) and the standard deviation of the percent recovery (s_p). Express the accuracy assessment as a percent recovery interval from P - $3s_p$ to P + $3s_p$ (i.e., If P = 100% and s_p = 10%, the accuracy interval is expressed as 70 - 130%). Update the accuracy assessment for each parameter at least annually.

8.14 MDL Studies. Method detection limit studies are performed annually to statistically determine the concentration levels an analytical system is capable of determining. MDL studies must be performed according to SOP 99-MDL or the reference method, whichever is more frequent. Reporting limits are set approximately 3-5 times the method detection limit, but not lower than the lowest initial calibration standard. (For DoD reporting purposes, reporting limits are set at least 3 times the MDL, and not more than 10 times the MDL.)

8.14.1 The group leader will determine at what level (concentration) the MDL study will be performed. At least seven replicates are to be analyzed. All replicates analyzed must be included in the MDL study. Note: The current concentration used for MDL studies is 0.8 µg/L.

8.14.2 The QLCS and the QGAS standards can be used to prepare the MDL studies, but using the initial calibration standards, VOANEW and VGAS, is a more commonly used method.

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8.14.3 Use the Target software to generate an MDL study report.

9 Sample Collection, Preservation and Handling

9.1 Sample Collection

9.1.1 Standard 40-mL glass screw-cap VOA vials with Teflon-lined silicone septa may be used for liquid samples.

9.1.2 When collecting the samples, liquids shall be introduced into the vials gently to reduce agitation, which might drive off volatile compounds. In general, liquid samples shall be poured into the vial without introducing any air bubbles within the vial as it is being filled. Shall bubbling occur as a result of violent pouring, the sample must be poured out and the vial refilled. The vials shall be completely filled at the time of sampling, so that when the septum cap is fitted and sealed, and the vial inverted, no headspace is visible. The sample shall be hermetically sealed in the vial at the time of sampling, and must not be opened prior to analysis to preserve their integrity.

9.1.2.1 Due to differing solubility and diffusion properties of gases on liquid matrices at different temperatures, it is possible for the sample to generate some headspace during storage. This headspace will appear in the form of micro bubbles, and shall not invalidate a sample for volatile analysis.

9.1.2.2 The presence of a macro bubble in a sample vial generally indicates either improper sampling technique or a source of gas evolution within the sample. The latter case is usually accompanied by a buildup of pressure within the vial (e.g., carbonate-containing samples preserved with acid). Studies conducted by the USEPA (EMSL-Ci, unpublished data) indicate the Pea-sized bubbles (i.e., bubbles not exceeding 1/4 inch or 6 mm in diameter) did not adversely affect volatiles data. These bubbles were generally encountered in wastewater samples, which are more susceptible to variations in gas solubility than are groundwater samples. NOTE: **For DoD samples**, any size air bubble will be commented on the lab report. See Section 9.3.2.

9.1.3 If the aromatic compounds benzene, toluene, and ethyl benzene are to be determined; a second separate sample shall be collected as follows because refrigeration alone may not preserve these compounds for more than seven days. Collect about 500 mL of sample in a clean container. Adjust the pH to about 2 while stirring vigorously by adding 1:1 HCl. Check the pH with

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narrow range (1.4 to 2.8) pH paper. Fill the sample vial as described in Section 9.1.2.

9.2 Sample Preservation

9.2.1 Preserve aqueous samples using HCl to a pH <2. Sample preservation shall be performed immediately upon sample collection. The sample shall then be iced above the freezing point of water up to 6°C in transport.

9.2.2 Ascorbic acid preservative is added to the vial prior to shipping to the sample site if the sample contains residual chlorine. Immediately following collection of the sample, shake the vial vigorously for one minute. Maintain the hermetic seal until the time of sample analysis.

9.2.3 Once samples are received, they must be refrigerated above the freezing point of water up to 6°C until analysis.

9.3 Sample Handling

9.3.1 All samples must be analyzed within 14 days of collection. All samples not analyzed within this time frame must be discarded and re-sampled for analysis, unless permission is given by the client to run the sample past its hold time. If this occurs, it must be clearly noted on the laboratory report.

9.3.1.1 If a dilution of the sample was analyzed after the hold time due to compounds exceeding the calibration range in the initial (and reportable) analysis, the standard verbiage comment VDL in the HORIZON LIMS may be used.

9.3.2 Check the run logbook to see if there was headspace in the sample. Add a comment to the report if it was present. The standard verbiage code for this in the HORIZON LIMS is HSP.

9.3.3 Check the run logbook to see if the pH of the sample was greater than 2. Add comment to the report if it exceeded 2. The standard verbiage code for this in the HORIZON LIMS is PH>.

9.3.4 Chlorine: Check the run logbook to see if there was free chlorine in the sample. Add a comment to the report if it was present.

10 Procedure

10.1 Daily tuning criteria and GC/MS calibration verification criteria must be met before

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analyzing samples.

10.2 All samples must be allowed to warm to ambient temperature before analysis.

10.3 Sample preparation and analysis.

10.3.1 Blanks must be free from target analytes above the established reporting limits.

10.3.1.1 Using the Archon autosampler, fill a 40-mL VOC vial with reagent water and cap, load on the autosampler and run. The Archon will add the IS/SS automatically.

10.3.2 Laboratory Control Samples (LCSs).

10.3.2.1 Using the Archon autosampler, place slightly less than 50 mL of reagent water in a 50-mL volumetric flask. Add 100 µL of QVOA LCS and add 50 µL of QGAS. Dilute to volume, invert 3 times, and place in a 40-mL VOC vial. The Archon will add the IS/SS automatically.

10.3.3 Samples:

10.3.3.1 Note in the run logbook whether or not the sample has headspace. Mark a Y in the HSP column if there is an air bubble bigger than a large pea (one quarter inch in diameter). Otherwise, mark an N in this column.

10.3.3.2 In order to prevent system overload it is a good practice to check each sample's history in the LIMS before analyzing the sample. If the sample has no history, then immediately before loading the instrument, open the vial, lift to within approximately 2-3 inches of the nose, wave a hand across the top of the sample towards the nose. Run the sample at a dilution if it has a polluted or organic chemical odor.

10.3.3.3 To composite samples, gently pour the sample containers into a clean appropriately sized beaker. Swirl the beaker gently to mix, and pour contents back into the sample vials. Mark the sample vials with a "C" to denote that they were composited. NOTE: Only at a client's request are 8260 samples ever composited.

10.3.3.4 Prepare sample dilutions according to the following table (Note: This table may not be inclusive of every dilution that will need to be performed. It may be necessary to perform intermediate dilutions or to

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use a larger volumetric flask to perform the larger dilutions): Note: **For DoD samples;** dilutions shall be limited to steps that are less than 100-fold.

Dilution factor	*Water volume (mL)*	*Sample added*	*Final Volume (mL)*
2	2.5	2.5 mL	5.0
2	25	25 mL	50
4	3.75	1.25 mL	5.0
4	37.5	12.5 mL	50
5	4.0	1.0 mL	5.0
5	40	10 mL	50
10	4.5	500 µL	5.0
10	45	5.0 mL	50
20	4.75	250 µL	5.0
20	47.5	2.5 mL	50
50	4.9	100 µL	5.0
50	49	1000 µL	50
100	4.95	50 µL	5.0
100	49.5	500 µL	50
200	4.97	25 µL	5.0
200	49.7	250 µL	50
500	4.99	10 µL	5.0
500	49.9	100 µL	50
1000	5.0	5.0 µL	5.0
1000	50	50 µL	50
2000	5.0	2.5 µL	5.0
2000	50	25 µL	50
5000	5.0	1.0 µL	5.0
5000	50	10 µL	50
10000	50	5.0 µL	50
20000	50	2.5 µL	50
50000	50	1.0 µL	50

10.3.3.5 Dilutions with a 5.0 mL final volume are prepared in the following manner.

10.3.3.5.1 Rinse a 5.0-mL syringe several times with reagent water.

10.3.3.5.2 Fill the syringe with reagent water and adjust the water volume to the appropriate mark.

10.3.3.5.3 Move the plunger back to 5 mL.

10.3.3.5.4 Quickly add the volume of sample, then prepare for the appropriate autosampler.

10.3.3.6 Prepare dilutions in Class A volumetric flasks in the following manner.

10.3.3.6.1 Partially fill a clean volumetric with reagent water.

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10.3.3.6.2 Quickly add the appropriate volume of sample.

10.3.3.6.3 Quickly dilute to volume. Invert 3 times to mix. Prepare for the appropriate autosampler.

10.3.3.7 Using the Archon autosampler, place the sample vial (it may be necessary to remove the label) or a capped 40-mL VOC vial filled with diluted sample on the autosampler, and run. The Archon will add the IS/SS automatically.

10.3.3.8 Antifoam may be added to prevent foaming. It is added 100 µL at a time to a 40-mL vial or 50-mL flask, or 10-µL to a 5-mL syringe.

10.3.3.9 Check the pH of the unused sample (this includes sample spikes if they were taken from a different vial) with pH paper. Record in column of the run logbook either the pH or whether or not the pH was less than or equal to 2 denoted "<2", if greater than 2 it is denoted ">2".

10.3.3.10 Check for the presence of free chlorine with an aliquot of DPD free chlorine reagent added to 10 mL of sample. It will turn pink if chlorine is present. In the Cl column of the run logbook, record a "Y" if free chlorine was detected, record an "N" if it was not. Note: We use a dispenser purchased from HACH to determine the aliquot size.

10.3.3.11 If running low or med level soils by 8260B, see the SOP for the 5035 Method (02-5035).

10.3.4 Sample spikes (MS/MSD).

10.3.4.1 Using the Archon auto sampler, inject 84 µL of QVOALCS and 42 µL of QGAS through the vial's septum. Shake or roll the vial to mix contents. Place the sample vial (it may be necessary to remove the label) or a capped 40-mL VOC vial filled with diluted sample on the auto sampler and run. The Archon will add the IS/SS automatically.

10.3.5 Duplicates.

10.3.5.1 Prepare duplicates the same way as normal samples. Duplicates shall only be prepared on samples that have historically had target hits. Otherwise, matrix spike duplicates shall be analyzed. The RPD

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acceptable limit is <40 %. **DoD requires** the RPD acceptable limit is <30%.

10.4 Data analysis.

10.4.1 Tune time. All analyses must have an injection time within 12 hours of the injected 50 ng BFB tuning solution, which met method criteria. The only exception to this is ending calibration checks that are requested by some clients. They shall run within 24 hours of the BFB (immediately after the last sample in the sequence).

10.4.2 Internal standard areas and retention times.

10.4.2.1 The internal standard areas in each analysis shall be within a factor of two of their abundance in the calibration verification standard. Note, this is not only a method requirement, but also a good laboratory practice as it helps to ensure that the instrument system is functioning normally.

10.4.2.2 The retention times of internal standards in each analysis shall be within 0.5 minutes of their retention times in the calibration verification standard. Note, this is not only a method requirement, but also a good laboratory practice as it helps to ensure that the instrument system is functioning normally.

10.4.2.3 The internal standard areas may vary due to the following reasons: instrument malfunction, wrong amount of IS/SS mix added, partially open sample valve, sample overload (i.e., shall have been run very diluted), etc.

10.4.2.3.1 ALSI LIMS standard verbiage comment VIS – One or more volatile internal(s) was recovered outside of the recovery limits. Its recovery was confirmed by re-analysis indicating a significant matrix effect.

10.4.2.4 The retention times may vary due to the following reasons: sample overload, sample foaming, plug or obstruction in the instrument, instrument malfunction, unstable room temperature, etc.

10.4.3 Surrogates.

10.4.3.1 The surrogates shall be recovered within the recovery limits. If they are not the sample shall be re-analyzed and the system shall be evaluated for malfunctions. If the surrogate recovery is acceptable in

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the re-analysis, report the data from the re-analysis. If data must be reported in which a surrogate(s) is out, report with a comment.

10.4.3.1.1 HORIZON LIMS standard verbiage comment V8 - One or more 8260 surrogates recovered outside of the recovery limits. Then it lists the current limits.

10.4.3.1.2 HORIZON LIMS standard verbiage comment VSM - One or more volatile surrogate(s) was recovered outside of the recovery limits. Its recovery was confirmed by re-analysis indicating a significant matrix effect.

NOTE: A sample with a surrogate out will normally be re-analyzed followed by reporting with a comment VSM. However, if holding time is expired, comment V8 will be used, and the sample will not be re-analyzed.

10.4.4 Target hits.

10.4.4.1 Positive hits. Identified by comparing the mass spectrum of the compound with a reference mass spectrum of the compound from a standard, which was analyzed on the same instrument. Obtain EICPs (the overlays on the right of the Target review window) for the primary (quantitating) mass and at least two secondary masses for each parameter of interest. The following criteria must be met to make a qualitative identification.

10.4.4.1.1 The characteristic masses of each parameter of interest must maximize in the same scan or within one scan of each other. Beware of co eluting interferences.

10.4.4.1.2 The retention time must fall within ± 30 seconds of the retention time of the compound in the daily QC calibration verification check.

10.4.4.1.3 The relative peak heights of the characteristic masses in the EICPs must fall within ± 20 % of the relative intensities of the masses in a reference mass spectrum.

10.4.4.2 Negative hits. Hits which do not meet the requirements for a positive hit are marked as unknown on Target.

10.4.4.3 Over-range hits. If a requested target analyte is a positive hit (be aware that if an analyte is present at a high enough concentration, its

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mass spectrum may be distorted) and exceeds the instrument's initial calibration range, the sample shall be rerun at a dilution until the analyte is within the instrument's calibration range (preferably in the upper half of the calibration range). If internal and surrogate recoveries are acceptable in the original analysis, all compounds except those that exceeded the calibration range will be reported from this run. Those that did exceed the calibration range will be reported from the dilution analysis (DL).

10.4.4.4 If manual integrations are required, the procedure in SOP 99-Integration is followed.

10.4.5 Blanks: Blanks shall have no target hits present at the reporting limit. A blank's surrogates shall be within the surrogate recovery limits. If a requested analyte is present above the reporting limit in the blank and it is present above the reporting limit in a sample(s), the sample shall be rerun. If that is not possible fill out a corrective action form explaining the situation and report the data with a comment similar to the following: "This sample had a hit of 8 µg/L of TCE which was present in the associated method blank at 1 µg/L." **NOTE**: **For DoD samples,** blanks shall have no target hits present above 2 times the calculated MDL. Blanks must not exceed one-half the reporting limit. See Section 8.5 under quality control for additional information.

10.4.6 QC samples (MS/MSD, blank spikes, duplicates).

10.4.6.1 Generate a MS/MSD report (form 3) using Quickforms in the Target software.

10.4.6.2 Compare the percent recovery, P, of each parameter with the corresponding QC acceptance criteria. If the spike sub-list MS/MSD.spk is used, these shall be the limits present on MS/MSD report generated with Quickforms.

10.4.6.3 If any individual P falls outside the designated range for recovery in either the MS or MSD, that parameter has failed the acceptance criteria. A blank spike containing each parameter that failed shall have been analyzed.

10.4.6.3.1 Analyze the blank spike to determine the concentration measured (A) of each failed parameter. Compounds which did not fail in the MS/MSD are not considered. The target software will calculate the percent recoveries of the blank spike. Use the spike sub-list WATERQC. The equation to

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calculate percent recovery (P) in a blank spike follows. T is the known true value of the spike.

$$P = A * 100\% / T$$

10.4.6.3.2 Compare the percent recovery, P, of each parameter with the corresponding QC acceptance criteria found in Appendix C. If the spike sub-list WATERQC is used, these shall be the limits present on blank spike report generated with Quickforms.

10.4.6.3.3 If the recovery of any such parameter, P, falls outside the designated range, the laboratory performance for that parameter is judged to be out of control, and the problem must be immediately identified and corrected. The analytical result for that parameter in the unspiked sample is suspect and may not be reported for regulatory compliance purposes. If the data must be reported due to either the samples hold time or a lack of sufficient sample for re-analysis, fill out a corrective action form explaining the problem, and comment on the sample report.

10.4.6.3.4 It will be the judgment of the analyst and/or supervisor to approve the data acquired using this initial calibration. If evaluation of the system in addition to the failed QCs indicates a lack of integrity of the data, the samples will be reanalyzed.

10.4.6.4 Duplicates (including MSD) shall have a % Repeatability of 40 % or less. NOTE: **For DoD samples**, control limits calculated by using LCS data will be used to determine acceptable Relative Percent Difference.

10.4.7 Library searches.

10.4.7.1 The selection and quantitation of non-target peaks is performed automatically by the Target software. Note: The sample shall be processed for client specific compounds only. Otherwise, the Target software will not pick any other target compounds as library peaks. If a sub-list containing client specific analytes is not used, the analyst must add, to the library search form, any compounds that were detected in the analysis that the client does not want reported. Also, if any changes have been made to the sample such as deleting or integrating peaks, the

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library search must be redone by selecting "process unknowns" in Target.

10.4.7.2 If the software selects any internal standard, surrogate, or target compounds, delete them in Target. The air peak (the first large peak on the chromatogram usually, its primary m/e will be 44) shall be deleted also. Also, early eluters with mass 40 can be deleted.

10.4.7.3 The Target software will perform a library search on and estimate the concentration of the 20 largest non-target peaks.

10.4.7.4 Only after visual comparison of sample spectra with the nearest library searches shall a tentative identification be assigned to the peak. The analyst will need to search each non-target peak on the Target system to view the library searches. Consider the following sets of guidelines before making a tentative identification.

10.4.7.5 Guidelines for making tentative identification of non-target compounds. In other words, making a specific identification of non-target compounds, i.e., limonene, hexamethylbenzene. These guidelines are from a contract laboratory program statement of work.

10.4.7.5.1 Major ions (ions greater than 10% of the most abundant ion) in the reference spectrum shall be present in the sample spectrum.

10.4.7.5.2 The relative intensities of the major ions shall agree within plus or minus 20%. Example: For an ion with an abundance of 50% in the reference spectrum, the corresponding sample ion abundance must be between 30 and 70%.

10.4.7.5.3 Molecular ions present in the reference spectrum shall be present in the sample spectrum.

10.4.7.5.4 Ions present in the reference spectrum but not in the sample spectrum shall be reviewed for possible subtraction from the sample spectrum because of background contamination or co eluting peaks. Data system library reduction programs can sometimes create these discrepancies.

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10.4.7.5.5 If in the analyst's technical judgment, no valid identification is possible, the compound shall be reported as unknown. If possible give an additional classification to the compound (i.e., unknown phthalate, unknown hydrocarbon, unknown acid type, unknown chlorinated compound, etc.). If the probable molecular weights can be determined, include them.

10.4.7.6 Guidelines for making tentative ID based on match quality.

10.4.7.6.1 If a non-target compound is present in the calibration mixes it can be identified as that compound no matter how good or bad the match quality is as long as the criteria for identifying the spectra of target compounds are met for those compounds, i.e., hexane, benzyl chloride, 1,2,4-trimethylbenzene, etc.

10.4.7.6.2 If a tentatively identified compound has a match of greater than 90% and the next closest match is greater than 30 % less, tentatively identify the peak as that compound.

10.4.7.6.3 If the match quality of 2 or more isomers are very close together and greater than 70% with no other unrelated compounds within 10 %, identify that peak as _____ isomer. Be as specific as possible.

10.4.7.6.4 Identify classes of compounds if all the compounds above 50 % match belong to the same class, or if the 2 or 3 closest matches belong to one chemical class and the next matches have significantly different match quality.

10.4.7.6.5 Use the analyst's experience when possible. Also, be consistent throughout a group of samples, referring back to retention times as a guide.

11 Calculations

11.1 All calculations are performed by the Target software.

12 Reporting Results

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12.1 Horizon LIMS results are reported to three significant figures but limited to the number of decimal places in the reporting limit for the individual compound or analyte.

12.2 When entering data into the Horizon LIMS do not round off results: Horizon will automatically round off to 3 significant figures after all internal calculations are completed.

12.3 Report the actual result, even if it is less than the reporting limit. Any sample with a result less than the reporting limit is reported as ND (non-detectable); LIMS will automatically report the appropriate detection limit. The client may request that "J values" be reported. J values are hits between the reporting limit and the method detection limit. They are reported with a "J" flag.

12.4 If the primary analysis of a sample was diluted, the reporting limits must be raised proportionate to the dilution factor. The following standard verbiage comments in the LIMS may be added to explain to the client why the reporting limits are elevated.

12.4.1 VLE - Sample was run at a dilution due to late eluting non-target compounds.

12.4.2 VNT - Sample was run at a dilution due to the level of non-target compounds.

12.4.3 VTC - Sample was run at a dilution due to the level of target compounds.

12.5 Any errors must be marked through with a single line with the analyst's initial, the date, and the correction.

12.6 All raw data used for reporting results must be dated and initialed by the qualified laboratory personnel performing first and second review.

13 Waste Disposal

13.1 Refer to ALSI SOP 19-Waste Disposal.

14 Pollution Prevention

14.1 Pollution prevention encompasses any technique that reduces or eliminates the quantity or toxicity of waste at the point of generation. Numerous opportunities for pollution prevention exist in laboratory operations. Management shall consider pollution prevention a high priority. Extended storage of unused chemicals increases the risk of accidents. The laboratory shall consider smaller quantity purchases which will result in fewer unused chemicals being stored and reduce the potential for exposure by employees. ALSI tracks chemicals when received by recording their

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receipt in a traceable logbook. Each chemical is then labeled according to required procedures and stored in assigned locations for proper laboratory use.

15 Definitions

15.1 Refer to ALSI QA Plan under Laboratory Quality Control Checks for general definitions.

16 Troubleshooting

16.1 Refer to maintenance logs and instrument manuals for guidance in troubleshooting specific problems related to the instrumentation used in this method.

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UNCONTROLLED DOCUMENT

TABLE 1
BFB KEY M/Z ABUNDANCE CRITERIA

MASS	M/Z ABUNDANCE CRITERIA
50	15 TO 40% OF MASS 95
75	30 TO 60% OF MASS 95
95	BASE PEAK, 100% RELATIVE ABUNDANCE
96	5 TO 9% OF MASS 95
173	<2% OF MASS 174
174	>50% OF MASS 95
175	5 TO 9% OF MASS 174
176	>95% BUT <101% OF MASS 174
177	5 TO 9% OF MASS 176

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APPENDIX A

Theoretical Standard Concentrations

Initial Calibration
SW846 Method 8260B

VOANEW = 1.0 mL of VCSMEGA, VCS Acetates, VCS Ketones, VCS Additions, VCS Acrolein, and VCS2CEVE to a final volume of 10 mL in P & T methanol.

Prepare the 6 initial calibration standards from the following table:

Standard ID	Volume Added			Flask Volume (mL)
	VOANEW	VGas	H826SS	
VSTD200	50 µL	50 µL	40 µL	50
VSTD100	25 µL	25 µL	20 µL	50
VSTD050	25 µL	25 µL	20 µL	100
VSTD020	20 µL	20 µL	16 µL	200
VSTD005	12.5 µL	12.5 µL	10 µL	500
VSTD001	2.5 µL	2.5 µL	2 µL	500

Compound Name	Standard Mix	Stock (ppm)	VSTD200	VSTD100	VSTD050	VSTD020	VSTD005	VSTD001
Benzene	VCSMEGA	2000	200 ppb	100 ppb	50 ppb	20 ppb	5 ppb	1 ppb
Bromobenzene	VCSMEGA	2000	200 ppb	100 ppb	50 ppb	20 ppb	5 ppb	1 ppb
Bromochloromethane	VCSMEGA	2000	200 ppb	100 ppb	50 ppb	20 ppb	5 ppb	1 ppb
Bromodichloromethane	VCSMEGA	2000	200 ppb	100 ppb	50 ppb	20 ppb	5 ppb	1 ppb
Bromoform	VCSMEGA	2000	200 ppb	100 ppb	50 ppb	20 ppb	5 ppb	1 ppb
n-Butylbenzene	VCSMEGA	2000	200 ppb	100 ppb	50 ppb	20 ppb	5 ppb	1 ppb
Sec-Butylbenzene	VCSMEGA	2000	200 ppb	100 ppb	50 ppb	20 ppb	5 ppb	1 ppb
Tert-Butylbenzene	VCSMEGA	2000	200 ppb	100 ppb	50 ppb	20 ppb	5 ppb	1 ppb
Carbon tetrachloride	VCSMEGA	2000	200 ppb	100 ppb	50 ppb	20 ppb	5 ppb	1 ppb
Chlorobenzene	VCSMEGA	2000	200 ppb	100 ppb	50 ppb	20 ppb	5 ppb	1 ppb
Chloroform	VCSMEGA	2000	200 ppb	100 ppb	50 ppb	20 ppb	5 ppb	1 ppb
2-Chlorotoluene (o)	VCSMEGA	2000	200 ppb	100 ppb	50 ppb	20 ppb	5 ppb	1 ppb
40Chlorotoluene (p)	VCSMEGA	2000	200 ppb	100 ppb	50 ppb	20 ppb	5 ppb	1 ppb
Dibromochloromethane	VCSMEGA	2000	200 ppb	100 ppb	50 ppb	20 ppb	5 ppb	1 ppb
1,2-Dibromo-3-chloropropane	VCSMEGA	2000	200 ppb	100 ppb	50 ppb	20 ppb	5 ppb	1 ppb
1,2-Dibromoethane (EDB)	VCSMEGA	2000	200 ppb	100 ppb	50 ppb	20 ppb	5 ppb	1 ppb
Dibromomethane	VCSMEGA	2000	200 ppb	100 ppb	50 ppb	20 ppb	5 ppb	1 ppb
1,2-Dichlorobenzene	VCSMEGA	2000	200 ppb	100 ppb	50 ppb	20 ppb	5 ppb	1 ppb
1,3-Dichlorobenzene	VCSMEGA	2000	200 ppb	100 ppb	50 ppb	20 ppb	5 ppb	1 ppb
1,4-Dichlorobenzene	VCSMEGA	2000	200 ppb	100 ppb	50 ppb	20 ppb	5 ppb	1 ppb
1,1-Dichloroethene	VCSMEGA	2000	200 ppb	100 ppb	50 ppb	20 ppb	5 ppb	1 ppb
Cis-1,2-Dichloroethene	VCSMEGA	2000	200 ppb	100 ppb	50 ppb	20 ppb	5 ppb	1 ppb
Trans-1,2-Dichloroethene	VCSMEGA	2000	200 ppb	100 ppb	50 ppb	20 ppb	5 ppb	1 ppb

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Compound Name	Standard Mix	Stock (ppm)	VSTD200	VSTD100	VSTD050	VSTD020	VSTD005	VSTD001
1,2-Dichloropropane	VCSMEGA	2000	200 ppb	100 ppb	50 ppb	20 ppb	5 ppb	1 ppb
1,3-Dichloropropane	VCSMEGA	2000	200 ppb	100 ppb	50 ppb	20 ppb	5 ppb	1 ppb
2,2-Dichloropropane	VCSMEGA	2000	200 ppb	100 ppb	50 ppb	20 ppb	5 ppb	1 ppb
1,1-Dichloropropene	VCSMEGA	2000	200 ppb	100 ppb	50 ppb	20 ppb	5 ppb	1 ppb
Cis-1,3-Dichloropropene	VCSMEGA	2000	200 ppb	100 ppb	50 ppb	20 ppb	5 ppb	1 ppb
Trans-1,3-Dichloropropene	VCSMEGA	2000	200 ppb	100 ppb	50 ppb	20 ppb	5 ppb	1 ppb
Ethylbenzene	VCSMEGA	2000	200 ppb	100 ppb	50 ppb	20 ppb	5 ppb	1 ppb
Hexachlorobutadiene	VCSMEGA	2000	200 ppb	100 ppb	50 ppb	20 ppb	5 ppb	1 ppb
Isopropylbenzene (Cumene)	VCSMEGA	2000	200 ppb	100 ppb	50 ppb	20 ppb	5 ppb	1 ppb
p-Isopropyltoluene	VCSMEGA	2000	200 ppb	100 ppb	50 ppb	20 ppb	5 ppb	1 ppb
Methylene Chloride	VCSMEGA	2000	200 ppb	100 ppb	50 ppb	20 ppb	5 ppb	1 ppb
Naphthalene	VCSMEGA	2000	200 ppb	100 ppb	50 ppb	20 ppb	5 ppb	1 ppb
n-Propylbenzene	VCSMEGA	2000	200 ppb	100 ppb	50 ppb	20 ppb	5 ppb	1 ppb
Styrene	VCSMEGA	2000	200 ppb	100 ppb	50 ppb	20 ppb	5 ppb	1 ppb
1,1,1,2-Tetrachloroethane	VCSMEGA	2000	200 ppb	100 ppb	50 ppb	20 ppb	5 ppb	1 ppb
1,1,2,2-Tetrachloroethane	VCSMEGA	2000	200 ppb	100 ppb	50 ppb	20 ppb	5 ppb	1 ppb
Tetrachloroethene	VCSMEGA	2000	200 ppb	100 ppb	50 ppb	20 ppb	5 ppb	1 ppb
Toluene	VCSMEGA	2000	200 ppb	100 ppb	50 ppb	20 ppb	5 ppb	1 ppb
1,2,3-Trichlorobenzene	VCSMEGA	2000	200 ppb	100 ppb	50 ppb	20 ppb	5 ppb	1 ppb
1,2,4-Trimethylbenzene	VCSMEGA	2000	200 ppb	100 ppb	50 ppb	20 ppb	5 ppb	1 ppb
1,3,5-Trimethylbenzene	VCSMEGA	2000	200 ppb	100 ppb	50 ppb	20 ppb	5 ppb	1 ppb
m-xylene	VCSMEGA	2000	200 ppb	100 ppb	50 ppb	20 ppb	5 ppb	1 ppb
p-xylene	VCSMEGA	2000	200 ppb	100 ppb	50 ppb	20 ppb	5 ppb	1 ppb
o-xylene	VCSMEGA	2000	200 ppb	100 ppb	50 ppb	20 ppb	5 ppb	1 ppb
1,1-Dichloroethane	VCSMEGA	2000	200 ppb	100 ppb	50 ppb	20 ppb	5 ppb	1 ppb
1,1,1-Trichloroethane	VCSMEGA	2000	200 ppb	100 ppb	50 ppb	20 ppb	5 ppb	1 ppb
1,2-Dichloroethane	VCSMEGA	2000	200 ppb	100 ppb	50 ppb	20 ppb	5 ppb	1 ppb
1,2,3-Trichloropropane	VCSMEGA	2000	200 ppb	100 ppb	50 ppb	20 ppb	5 ppb	1 ppb
1,2,4-Trichlorobenzene	VCSMEGA	2000	200 ppb	100 ppb	50 ppb	20 ppb	5 ppb	1 ppb
1,1,2-Trichloroethane	VCSMEGA	2000	200 ppb	100 ppb	50 ppb	20 ppb	5 ppb	1 ppb
Trichloroethene	VCSMEGA	2000	200 ppb	100 ppb	50 ppb	20 ppb	5 ppb	1 ppb

Vinyl Acetate	VCS Acetates	2000	200 ppb	100 ppb	50 ppb	20 ppb	5 ppb	1 ppb
Methyl acetate	VCS Acetates	2000	200 ppb	100 ppb	50 ppb	20 ppb	5 ppb	1 ppb
Ethyl acetate	VCS Acetates	2000	200 ppb	100 ppb	50 ppb	20 ppb	5 ppb	1 ppb

Acetone	VCS Ketones	10000	1000 ppb	500 ppb	250 ppb	100 ppb	25 ppb	5 ppb
2-Butanone	VCS Ketones	10000	1000 ppb	500 ppb	250 ppb	100 ppb	25 ppb	5 ppb
4-Methyl-2-pentanone	VCS Ketones	10000	1000 ppb	500 ppb	250 ppb	100 ppb	25 ppb	5 ppb
2-Hexanone	VCS Ketones	10000	1000 ppb	500 ppb	250 ppb	100 ppb	25 ppb	5 ppb
1,1-Dichloro-2-propanone	VCS Ketones	10000	1000 ppb	500 ppb	250 ppb	100 ppb	25 ppb	5 ppb

Pentane	VCS Additions	2000	200 ppb	100 ppb	50 ppb	20 ppb	5 ppb	1 ppb
3-Chloroprene (allyl chloride)	VCS Additions	2000	200 ppb	100 ppb	50 ppb	20 ppb	5 ppb	1 ppb
Di-isobutylene	VCS Additions	2000	200 ppb	100 ppb	50 ppb	20 ppb	5 ppb	1 ppb
1-Chlorohexane	VCS Additions	2000	200 ppb	100 ppb	50 ppb	20 ppb	5 ppb	1 ppb
Methyl-tert-butyl ether	VCS Additions	2000	200 ppb	100 ppb	50 ppb	20 ppb	5 ppb	1 ppb

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Compound Name	Standard Mix	Stock (ppm)	VSTD200	VSTD100	VSTD050	VSTD020	VSTD005	VSTD001
Ethyl ether	VCS Additions	2000	200 ppb	100 ppb	50 ppb	20 ppb	5 ppb	1 ppb
Freon 113 (1,1,2-TCTFE)	VCS Additions	2000	200 ppb	100 ppb	50 ppb	20 ppb	5 ppb	1 ppb
Hexane	VCS Additions	2000	200 ppb	100 ppb	50 ppb	20 ppb	5 ppb	1 ppb
Heptane	VCS Additions	2000	200 ppb	100 ppb	50 ppb	20 ppb	5 ppb	1 ppb
Cyclohexane	VCS Additions	2000	200 ppb	100 ppb	50 ppb	20 ppb	5 ppb	1 ppb
Benzyl chloride	VCS Additions	2000	200 ppb	100 ppb	50 ppb	20 ppb	5 ppb	1 ppb
Iodomethane	VCS Additions	2000	200 ppb	100 ppb	50 ppb	20 ppb	5 ppb	1 ppb
Carbon Disulfide	VCS Additions	2000	200 ppb	100 ppb	50 ppb	20 ppb	5 ppb	1 ppb
Chloroprene	VCS Additions	2000	200 ppb	100 ppb	50 ppb	20 ppb	5 ppb	1 ppb
Octane	VCS Additions	2000	200 ppb	100 ppb	50 ppb	20 ppb	5 ppb	1 ppb
Acrylonitrile	VCS Additions	10000	1000 ppb	500 ppb	250 ppb	100 ppb	25 ppb	5 ppb
2-Nitropropane	VCS Additions	10000	1000 ppb	500 ppb	250 ppb	100 ppb	25 ppb	5 ppb
Tetrahydrofuran	VCS Additions	10000	1000 ppb	500 ppb	250 ppb	100 ppb	25 ppb	5 ppb
Tert-Butyl alcohol	VCS Additions	10000	1000 ppb	500 ppb	250 ppb	100 ppb	25 ppb	5 ppb
Trans-1,4-Dichloro-2-butene	VCS Additions	2000	200 ppb	100 ppb	50 ppb	20 ppb	5 ppb	1 ppb
Methyl methacrylate	VCS Additions	2000	200 ppb	100 ppb	50 ppb	20 ppb	5 ppb	1 ppb
Isobutyl alcohol	VCS Additions	20000	2000 ppb	1000 ppb	500 ppb	200 ppb	50 ppb	10 ppb
Hexachloroethane	VCS Additions	2000	200 ppb	100 ppb	50 ppb	20 ppb	5 ppb	1 ppb
Ethyl methacrylate	VCS Additions	2000	200 ppb	100 ppb	50 ppb	20 ppb	5 ppb	1 ppb
2-Propanol	VCS Additions	10000	1000 ppb	500 ppb	250 ppb	100 ppb	25 ppb	5 ppb
1-Propanol	VCS Additions	20000	2000 ppb	1000 ppb	500 ppb	200 ppb	50 ppb	10 ppb
Propionitrile	VCS Additions	10000	1000 ppb	500 ppb	250 ppb	100 ppb	25 ppb	5 ppb
Methacrylonitrile	VCS Additions	2000	200 ppb	100 ppb	50 ppb	20 ppb	5 ppb	1 ppb
1,4-Dioxane	VCS Additions	50000	5000 ppb	2500 ppb	1250 ppb	500 ppb	125 ppb	25 ppb
Pentachloroethane	VCS Additions	2000	200 ppb	100 ppb	50 ppb	20 ppb	5 ppb	1 ppb
Nitrobenzene	VCS Additions	20000	2000 ppb	1000 ppb	500 ppb	200 ppb	50 ppb	10 ppb
Methyl acrylate	VCS Additions	2000	200 ppb	100 ppb	50 ppb	20 ppb	5 ppb	1 ppb
Chloroacetonitrile	VCS Additions	10000	1000 ppb	500 ppb	250 ppb	100 ppb	25 ppb	5 ppb
1-Chlorobutane	VCS Additions	2000	200 ppb	100 ppb	50 ppb	20 ppb	5 ppb	1 ppb
Dichlorofluoromethane	VCS Additions	2000	200 ppb	100 ppb	50 ppb	20 ppb	5 ppb	1 ppb
tert-amyl methyl ether	VCS Additions	2000	200 ppb	100 ppb	50 ppb	20 ppb	5 ppb	1 ppb
Ethyl tert-butyl ether	VCS Additions	2000	200 ppb	100 ppb	50 ppb	20 ppb	5 ppb	1 ppb
Di-isopropyl ether	VCS Additions	2000	200 ppb	100 ppb	50 ppb	20 ppb	5 ppb	1 ppb
Methyl cyclohexane	VCS Additions	2000	200 ppb	100 ppb	50 ppb	20 ppb	5 ppb	1 ppb
Acetonitrile	VCS Additions	10000	1000 ppb	500 ppb	250 ppb	100 ppb	25 ppb	5 ppb
1,2,3-Trimethylbenzene	VCS Additions	2000	200 ppb	100 ppb	50 ppb	20 ppb	5 ppb	1 ppb
Acrolein	V Acrolein	50000	5000 ppb	2500 ppb	1250 ppb	500 ppb	125 ppb	25 ppb
2-Chloroethyl vinyl ether	VCS2CEVE	2000	200 ppb	100 ppb	50 ppb	20 ppb	5 ppb	1 ppb
Bromomethane	V Gases	200	200 ppb	100 ppb	50 ppb	20 ppb	5 ppb	1 ppb
Chloroethane	V Gases	200	200 ppb	100 ppb	50 ppb	20 ppb	5 ppb	1 ppb
Chloromethane	V Gases	200	200 ppb	100 ppb	50 ppb	20 ppb	5 ppb	1 ppb
Dichlorodifluoromethane	V Gases	200	200 ppb	100 ppb	50 ppb	20 ppb	5 ppb	1 ppb
Trichlorofluoromethane	V Gases	200	200 ppb	100 ppb	50 ppb	20 ppb	5 ppb	1 ppb
Vinyl Chloride	V Gases	200	200 ppb	100 ppb	50 ppb	20 ppb	5 ppb	1 ppb

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APPENDIX B

Theoretical Standard Concentrations
Quality Control Standard / Spike
EPA Method 524.2

QVOALCS = 0.5 mL of QCS MEGA, QCS Acetates, QCS Ketones, QCS Additions, QCS Acrolein, and QCS 2CEVE to a final volume of 10.0 mL in P & T methanol.

Stock mix ID	Volume Added		
	5 mL Final Volume	**50 mL Final Volume**	**100 mL Final Volume**
QVOALCS	10 µL	100 µL	200 µL
QGASES	5 µL	50 µL	100 µL

Compound Name	Standard Mix	Stock (ppm)	Working Conc.
Benzene	QCSMEGA	200	20 ppb
Bromobenzene	QCSMEGA	200	20 ppb
Bromodichloromethane	QCSMEGA	200	20 ppb
Bromoform	QCSMEGA	200	20 ppb
n-Butylbenzene	QCSMEGA	200	20 ppb
Sec-Butylbenzene	QCSMEGA	200	20 ppb
Tert-Butylbenzene	QCSMEGA	200	20 ppb
Carbon tetrachloride	QCSMEGA	200	20 ppb
Chlorobenzene	QCSMEGA	200	20 ppb
Chloroform	QCSMEGA	200	20 ppb
2-Chlorotoluene (o)	QCSMEGA	200	20 ppb
40Chlorotoluene (p)	QCSMEGA	200	20 ppb
Dibromochloromethane	QCSMEGA	200	20 ppb
1,2-Dibromo-3-chloropropane	QCSMEGA	200	20 ppb
1,2-Dibromoethane (EDB)	QCSMEGA	200	20 ppb
Dibromomethane	QCSMEGA	200	20 ppb
1,2-Dichlorobenzene	QCSMEGA	200	20 ppb
1,3-Dichlorobenzene	QCSMEGA	200	20 ppb
1,4-Dichlorobenzene	QCSMEGA	200	20 ppb
1,1-Dichloroethene	QCSMEGA	200	20 ppb
Cis-1,2-Dichloroethene	QCSMEGA	200	20 ppb
Trans-1,2-Dichloroethene	QCSMEGA	200	20 ppb
1,2-Dichloropropane	QCSMEGA	200	20 ppb
1,3-Dichloropropane	QCSMEGA	200	20 ppb
2,2-Dichloropropane	QCSMEGA	200	20 ppb
1,1-Dichloropropene	QCSMEGA	200	20 ppb
Cis-1,3-Dichloropropene	QCSMEGA	200	20 ppb
Trans-1,3-Dichloropropene	QCSMEGA	200	20 ppb
Ethylbenzene	QCSMEGA	200	20 ppb
Hexachlorobutadiene	QCSMEGA	200	20 ppb
Isopropylbenzene (Cumene)	QCSMEGA	200	20 ppb

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Compound Name	Standard Mix	Stock (ppm)	Working Conc.
p-Isopropyltoluene	QCSMEGA	200	20 ppb
Methylene Chloride	QCSMEGA	200	20 ppb
Bromochloromethane	QCSMEGA	200	20 ppb
1,1-Dichloroethane	QCSMEGA	200	20 ppb
1,1,1-Trichloroethane	QCSMEGA	200	20 ppb
1,2-Dichloroethane	QCSMEGA	200	20 ppb
1,2,3-Trichloropropane	QCSMEGA	200	20 ppb
1,2,4-Trichlorobenzene	QCSMEGA	200	20 ppb
1,1,2-Trichloroethane	QCSMEGA	200	20 ppb
Trichloroethene	QCSMEGA	200	20 ppb
Naphthalene	QCSMEGA	200	20 ppb
n-Propylbenzene	QCSMEGA	200	20 ppb
Styrene	QCSMEGA	200	20 ppb
1,1,1,2-Tetrachloroethane	QCSMEGA	200	20 ppb
1,1,2,2-Tetrachloroethane	QCSMEGA	200	20 ppb
Tetrachloroethene	QCSMEGA	200	20 ppb
Toluene	QCSMEGA	200	20 ppb
1,2,3-Trichlorobenzene	QCSMEGA	200	20 ppb
1,2,4-Trimethylbenzene	QCSMEGA	200	20 ppb
1,3,5-Trimethylbenzene	QCSMEGA	200	20 ppb
m-xylene	QCSMEGA	200	20 ppb
p-xylene	QCSMEGA	200	20 ppb
o-xylene	QCSMEGA	200	20 ppb
Methyl acetate	QCS Acetates	200	20 ppb
Ethyl acetate	QCS Acetates	200	20 ppb
Vinyl Acetate	QCS Acetates	200	20 ppb
Acetone	QCS Ketones	1000	100 ppb
2-Butanone	QCS Ketones	1000	100 ppb
4-Methyl-2-pentanone	QCS Ketones	1000	100 ppb
2-Hexanone	QCS Ketones	1000	100 ppb
1,1-Dichloro-2-propanone	QCS Ketones	1000	100 ppb
Pentane	QCS Additions	200	20 ppb
3-Chloroprene (allyl chloride)	QCS Additions	200	20 ppb
Di-isobutylene	QCS Additions	200	20 ppb
1-Chlorohexane	QCS Additions	200	20 ppb
Methyl-tert-butyl ether	QCS Additions	200	20 ppb
Ethyl ether	QCS Additions	200	20 ppb
Freon 113 (1,1,2-TCTFE)	QCS Additions	200	20 ppb
Hexane	QCS Additions	200	20 ppb
Heptane	QCS Additions	200	20 ppb
Cyclohexane	QCS Additions	200	20 ppb
Benzyl chloride	QCS Additions	200	20 ppb
Iodomethane	QCS Additions	200	20 ppb
Carbon Disulfide	QCS Additions	200	20 ppb
Chloroprene	QCS Additions	200	20 ppb

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Compound Name	Standard Mix	Stock (ppm)	Working Conc.
Octane	QCS Additions	200	20 ppb
Acrylonitrile	QCS Additions	1000	100 ppb
2-Nitropropane	QCS Additions	1000	100 ppb
Tetrahydrofuran	QCS Additions	1000	100 ppb
Tert-Butyl alcohol	QCS Additions	1000	100 ppb
Trans-1,4-Dichloro-2-butene	QCS Additions	200	20 ppb
Methyl methacrylate	QCS Additions	200	20 ppb
Isobutyl alcohol	QCS Additions	2000	200 ppb
Hexachloroethane	QCS Additions	200	20 ppb
Ethyl methacrylate	QCS Additions	200	20 ppb
2-Propanol	QCS Additions	1000	100 ppb
1-Propanol	QCS Additions	2000	200 ppb
Propionitrile	QCS Additions	1000	100 ppb
Methacrylonitrile	QCS Additions	200	20 ppb
1,4-Dioxane	QCS Additions	5000	500 ppb
Pentachloroethane	QCS Additions	200	20 ppb
Nitrobenzene	QCS Additions	2000	200 ppb
Methyl acrylate	QCS Additions	200	20 ppb
Chloroacetonitrile	QCS Additions	1000	100 ppb
1-Chlorobutane	QCS Additions	200	20 ppb
Dichlorofluoromethane	QCS Additions	200	20 ppb
tert-amyl methyl ether	QCS Additions	200	20 ppb
Ethyl tert-butyl ether	QCS Additions	200	20 ppb
Di-isopropyl ether	QCS Additions	200	20 ppb
Methyl cyclohexane	QCS Additions	200	20 ppb
Acetonitrile	QCS Additions	1000	100 ppb
Acrolein	Q Acrolein	1500	150 ppb
2-Chloroethyl vinyl ether	QCS2CEVE	200	20 ppb
Bromomethane	Qgas mix	20	20 ppb
Chloroethane	Qgas mix	20	20 ppb
Chloromethane	Qgas mix	20	20 ppb
Dichlorodifluoromethane	Qgas mix	20	20 ppb
Trichlorofluoromethane	Qgas mix	20	20 ppb
Vinyl Chloride	Qgas mix	20	20 ppb

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APPENDIX C

TABLE 2

CALIBRATION AND QC ACCEPTANCE CRITERIA

PARAMETER	RANGE FOR Q (ug/L)	LIMIT FOR s (ug/L)	RANGE FOR X (ug/L)	RANGE FOR P, P, (%)
Benzene	12.8-27.2	6.9	15.2-26.0	37-151
Bromodichloromethane	13.1-26.9	6.4	10.1-28.0	35-155
Bromoform	14.2-25.8	5.4	11.4-31.1	45-169
Bromomethane	2.8-37.2	17.9	D-41.2	D-242
Carbon Tetrachloride	14.6-25.4	5.2	17.2-23.5	70-140
Chlorobenzene	13.2-26.8	6.3	16.4-27.4	37-160
Chloroethane	7.6-32.4	11.4	8.4-40.4	14-230
2-Chloroethylvinyl ether	D-44.8	25.9	D-50.4	D-305
Chloroform	13.5-26.5	6.1	13.7-24.2	51-138
Chloromethane	D-40.8	19.8	D-45.9	D-273
Dibromochloromethane	13.5-26.5	6.1	13.8-26.6	53-149
1,2-Dichlorobenzene	12.6-27.4	7.1	11.8-34.7	18-190
1,3-Dichlorobenzene	14.6-25.4	5.5	17.0-28.8	59-156
1,4-Dichlorobenzene	12.6-27.4	7.1	11.8-34.7	18-190
1,1-Dichloroethane	14.5-25.5	5.1	14.2-28.5	59-155
1,2-Dichloroethane	13.6-26.4	6.0	14.3-27.4	49-155
1,1-Dichloroethene	10.1-29.9	9.1	3.7-42.3	D-234
trans-1,2-Dichloroethene	13.9-26.1	5.7	13.6-28.5	54-156
1,2-Dichloropropane	6.8-33.2	13.8	3.8-36.2	D-210
cis-1,3-Dichloropropene	4.8-35.2	15.8	1.0-39.0	D-227
trans-1,3-Dichloropropene	10.0-30.0	10.4	7.6-32.4	17-183
Ethylbenzene	11.8-28.2	7.5	17.4-26.7	47-150
Methylene chloride	12.1-27.9	7.4	D-41.0	D-221
1,1,2,2-Tetrachloroethane	12.1-27.9	7.4	13.5-27.2	46-157
Tetrachloroethene	14.7-25.3	5.0	17.0-26.6	64-148
Toluene	14.9-25.1	4.8	16.6-26.7	47-150
1,1,1-Trichloroethane	15.0-25.0	4.6	13.7-30.1	52-162
1,1,2-Trichloroethane	14.2-25.8	5.5	14.3-27.1	52-150
Trichloroethene	13.3-26.7	6.6	18.6-27.6	71-157
Trichlorofluoromethane	9.6-30.4	10.0	8.9-31.5	17-181
Vinyl chloride	0.8-39.2	20.0	D-43.5	D-251

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UNCONTROLLED DOCUMENT

Appendix D

GC/MS VOLATILE SAMPLE INFORMATION

Instrument MS03

DATE(S):	CALIBRATION VERIFIED BY:	BATCH CONTINUED FROM PAGE:
DATA FILE NAME:	BFB INJECTED: ICAL DATE:	BATCH CONTINUED TO PAGE:
BATCH NAME:	12-HOUR ENDING:	METHOD:

METH #	POS. #	RUN #	SAMPLE	CLIENT	SAMPLE INFORMATION	DIL.	ANALYST	TEST	pH / %M	HDSP / Wt.	Cl-	First Review	COMMENT	SDG

IS: _____ SS: _____ VGas _____ Qgas _____ Page: _____

Prev. _____ Current _____ Total _____

Batch: _____ Prev.: _____ Current: _____ Total: _____

Rev. 7/05

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Appendix E

Batch Review Checklist

TARGET BATCH: **HORIZON BATCH:**

INSTRUMENT: **METHOD:** **ICAL DATE(S):**

Reviewer 1	Reviewer 2	
		BFB Reviewed
		Calibration/Continuing Calibration reviewed
		Continuing Calibration passes +/- ISTD area - CCAL is zeroed
		Correct ICAL referenced (Y__/N__) (correct start/end times/dates (Y__/N__)
		Any raised reporting limits due to ICAL (Y__/N__) - See attached spreadsheet
		Blank reviewed - Any detections (Y__/N__) If yes, what_____
		LCS/second source reviewed - List failures in comment section
		MS/MSD reviewed - List failures on unspiked sample
		All samples within 12/24-hour tune period (Y__/N__)
		Compound retention times reviewed
		ISTDs for each sample reviewed
		Surrogates for each sample reviewed
		Soil weights/volumes correct
		Samples checked for over-range detections and put back in for reanalysis
		Spectra and Ions have been reviewed for each analyte detected
		Library search has been performed for clients requesting it
		Container IDs in LIMS batch (Y__/N__) - If no, which samples

REPORTS:

	Photocopy of runlog
	Batch summary printed
	ICAL Summary printed
	BFB Reports
	Calibration/CCAL reports
	Reports printed for all samples (include library search if necessary)
	Logbook complete - All standard information included
	Tests scheduled in LIMS
	Data review signed
	Data reported signed
	Data approved signed

COMMENTS:

_____

_____

_____

_____

_____

_____

_____

Rev. 8/06

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SOP Change History Sheet

Section No.	Section	Reason for Change
5.2.5	Apparatus and Materials	Correction to current SOP
6.10 – 6.11	Reagents	Correction to current SOP
7.5.1	Instrument Calibration	Correction to current SOP
7.5.3.2	Instrument Calibration	DoD audit response
7.6.2	Instrument Calibrations	Correction to current SOP
8.6.4	Quality Control	Correction to current SOP
8.7.3	Quality Control	Correction to current SOP
8.5.4	Quality Control	Correction to current SOP
8.11	Quality Control	Correction to current SOP
10.3.1	Procedure	Correction to current SOP
10.3.2	Procedure	Correction to current SOP
10.3.3.4	Procedure	DoD audit response
10.3.7.7 & 9	Procedure	Correction to current SOP
10.3.7.9	Procedure	Correction to current SOP
10.3.3.12	Procedure	Correction to current SOP
10.3.4.1 & 3	Procedure	Correction to current SOP
A & B	Appendix	Correction to current SOP

Revision 8:03/06/2006 **(**Revisions made throughout to update Section references)

1.1	Scope and Application	Updated method revision
1.10	Scope and Application	Added project criteria requirements verbiage

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SOP Change History Sheet (continued)

Section No.	Section	Reason for Change
4.2	Safety	Added MSDS availability
5.3, 5.5, 5.12	Apparatus and Materials	Added vendor information
5.9-5.11	Apparatus and Materials	Revised vendor information
5.14	Apparatus and Materials	Removed pipette reference
6.4	Reagents	Added vendor information
6.5	Reagents	Revised temperature range
6.6.2, 6.7.2.2, 6.8.4, 6.9.2.3, 6.10.3.3, 6.11.3.1, 6.11.3.3	Reagents	Added word “mixture”
6.7, 6.9	Reagents	Added abbreviation verbiage
6.8	Reagents	Added abbreviation verbiage and note
6.10.1	Reagents	Added calibration check standard verbiage, revised catalog #’s
6.10.3.1	Reagents	Revised preparation volumes
6.10.3.2, 6.11.3.2	Reagents	Revised preparation volumes, added standards
6.10.4.2	Reagents	Added volume amount of Acrolein
6.11.1	Reagents	Removed calibration check standard verbiage, revised catalog #’s
6.13	Reagents	Added DPD Free Chlorine to list
7.1	Instrument Calibration	Added instrument and recording location

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SOP Change History Sheet (continued)

Section No.	Section	Reason for Change
7.4.2, 10.4.4.2, 10.4.7.2, 10.4.7.4, 11.1	Instrument Calibration Procedure Calculations	Updated reference from "Chemserver" to read "Target"
7.4.3, 7.6.1.1, 7.6.2.1, 8.14	Instrument Calibration Quality Control	Revised "USACE" to read "DoD"
7.5.4.2, 7.5.5.1, 8.7.3, 10.3.5.1, 10.4.5	Instrument Calibration Quality Control Procedure	Added DoD requirements
7.6.1	Instrument Calibration	Revised wording from "purge" to "inject"
7.6.1.1	Instrument Calibration	Added verbiage concerning scanning
8.3	Quality Control	Added verbiage about ongoing proficiency
8.6.2	Quality Control	Removed reference to third aliquot, added/revised volumes
8.7.1, 8.9.2	Quality Control	Added LCS and QC check sample preparation details
8.14	Quality Control	Added reference to SOP 99-MDL/reference method
9.3, 10.4.3	Sample Collection… Procedure	Replaced "AMS" with "Horizon", revised comment
10.3.3.5	Procedure	Removed references for performing dilutions in 50mL flasks
10.3.3.6	Procedure	Added reference to Class A flasks
10.3.3.10	Procedure	Removed reference to vendor
10.3.4	Procedure	Added mixing directions

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SOP Change History Sheet (continued)

Section No.	Section	Reason for Change
10.4.4.3	Procedure	Added sample reruns to be rerun "at a dilution"
10.4.4.4	Procedure	Added reference to SOP 99-Integration
10.4.6.3.1, 10.4.6.3.2	Procedure	Revised spike sublist reference
10.4.7.5	Procedure	Added verbiage to include "guidelines"
12.3	Reporting Results	Added verbiage for reporting limits and J-values
12.6	Reporting Results	Added instructions to date and initial 1st and 2nd reviews
16	Troubleshooting	Added Section
A, B	Appendix	Substantial revisions throughout both tables

Revision 9: 08/17/2006

6.10-6.11	Reagents	Made current with lab practice as per internal audit findings
A, B, E	Appendix	Made current with lab practice as per internal audit findings

Revision 10: 11/12/07

Spelling, grammar, and formatting changes may have been made throughout SOP.

8.6.2	Reagents	Update spike amounts
10.3.4.1	Procedure	Update spike amounts

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SOP Concurrence Form
for the Distribution and Revision of Standard Operating Procedures

I have read, understood, and concurred with the Standard Operating Procedure (SOP) described above and will perform this procedure as it is written in the SOP.

Print Name	Signature	Date

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Document Title: Sample Preparation for the Determination of Mercury in Drinking Water Samples

Document Control Number: _____

Organization Title: ANALYTICAL LABORATORY SERVICE, INC. (ALSI)

Address: 34 Dogwood Lane
Middletown, PA 17057

Phone: (717) 944-5541

Approved by:

_____ _____
Helen MacMinn, Date
Quality Assurance Manager

_____ _____
Lisa Hampe-Miller, Date
Metals Department Supervisor

_____ _____
Claudia Dennis, Date
Validator

Annual Review:

_____ _____
Reviewed By Date Reviewed

_____ _____
Approved By Date Approved

_____ _____
Reviewed By Date Reviewed

_____ _____
Approved By Date Approved

Annual Review (continued):

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Reviewed By _____ Date Reviewed _____

Approved By _____ Date Approved _____

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1 Scope and Application

1.1 This method is adapted from EPA Methods 245.1, Revision 3.0, 1994.

1.2 This method is used to digest drinking water samples in preparation for mercury analysis.

1.3 This document states the laboratory's policies and procedures established in order to meet requirements of all certifications/accreditations currently held by the laboratory, including the most current NELAC standards.

1.4 In addition to inorganic forms of mercury, organic mercurials may also be present. These organo-mercury compounds will not respond to the cold vapor atomic absorption technique unless they are first broken down and converted to mercuric ions. Potassium permanganate oxidizes many of these compounds, but recent studies have shown that a number of organic mercurials including phenyl mercuric acetate and methyl mercuric chloride are only partially oxidized by this reagent. Potassium persulfate has been found to give approximately 100% recovery when used as the oxidant with these compounds. Therefore, a persulfate oxidation step following the addition of the permanganate has been included to ensure that organo-mercury compounds, if present, will be oxidized to the mercuric ion before measurement. A heat step is required for methyl mercuric chloride when present in or spiked into a natural system.

1.5 Method Detection Limits (MDLs) are available on the ALSI network and are maintained and updated by the QA Department. The Detection Limits for a specific sample may differ from those listed due to the nature of interferences in a particular sample matrix.

1.6 Individual project requirements may override criteria listed in this SOP.

2 Summary of Method

2.1 Samples analyzed for mercury must be digested to ensure mercury is in the elemental state for analysis. A known portion of each water sample is transferred to a teflon/silicone septum 40-mL VOA glass vial and are digested in potassium permanganate-potassium persulfate solution and oxidized for 2 hours at 95°C.

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3 Interferences

3.1 Interferences have been reported for waters containing sulfide, chloride, copper and tellurium. Organic compounds which have broadband UV absorbance (around 253.7 nm) are confirmed interferences. The concentration levels for interferants are difficult to define. This suggests that quality control procedures must be strictly followed.

3.2 Volatile materials (e.g. chlorine) which absorb at 253.7 nm will cause a positive interference. Positive samples shall be reanalyzed without the addition of stannous chloride to rule out this interference.

3.3 Low level mercury sample preparation, digestion, and analysis may be subject to environmental contamination if performed in areas with high ambient backgrounds where mercury was previously employed as an analytical reagent in analyses such as total Kjeldahl nitrogen (TKN) or chemical oxygen demand (COD).

4 Safety

4.1 This procedure requires the use of many reagents including acids and oxidizers. The toxicity or carcinogenicity of each reagent used in this method has not been precisely defined; however, each chemical compound shall be treated as a potential health hazard. From this viewpoint, exposure to these chemicals must be reduced to the lowest possible level by whatever means available.

4.2 ALSI maintains Material Safety Data Sheets (MSDSs) on all chemicals used in this procedure. ALSI recommends that all individuals performing this SOP familiarize themselves with the MSDSs' associated with the procedure prior to SOP performance. MSDSs are available to all staff and are located in hard copy in the QA reference library and electronically on the ALSI server in the MSDS folder.

4.3 Lab personal shall adhere to the rules listed in SOP 99-H&S, 90-Chemical Hygiene Plan and Laboratory Safety Pocket Handbook. The minimum PPE requirement for this method is safety glasses, a fully buttoned lab coat and chemical resistant gloves. The acidification of samples containing reactive materials may result in release of toxic gases, such as cyanides or sulfides. A fume hood shall be used during the acidification of samples. This PPE should reduce the possibility of contact to a safe level, but the analyst should not limit himself to these PPE minimums.

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4.4 Mercury compounds are highly toxic if swallowed, inhaled or absorbed through the skin. Analyses should be conducted in a laboratory exhaust hood. The analyst should use chemical resistant gloves when handling concentrated mercury standards.

4.5 All personnel handling environmental samples known to contain or to have been in contact with human waste should be immunized against known disease causative agents.

5 Apparatus and Materials

5.1 40-mL VOA vials with Teflon/Silicone Septum, Precleaned Protocol B Industrial Glassware #2795FL-PC or equivalent.

5.2 Assorted Class A variable volume dispensing pipettes, calibrated according to ALSI SOP 19-AP.

5.2.1 (20-200 µL volume) Finnpipette Digital Pipettors, Thermo Labsystems, VWR catalog #53515-020 or equivalent

5.2.2 (200-1000 µL volume) Finnpipette Digital Pipettors, Thermo Labsystems, VWR catalog #53515-044 or equivalent

5.2.3 (2-10 mL volume) Finnpipette Digital Pipettors, Thermo Labsystems, VWR catalog #53515-050 or equivalent

5.3 Disposable pipette tips for Finnpipette Digital Pipettors-

5.3.1 (Unifit Tips, 1-200 µL) VWR catalog #53503-094 or equivalent

5.3.2 (Finntip 1000, 100-1000 µL) VWR catalog #53515-876 or equivalent

5.3.3 (Finntip 10mL, 2-10 mL) VWR catalog #53516-178 or equivalent

5.4 Disposable Transfer Pipettes- VWR catalog #14670-103 or equivalent

5.5 Class A volumetric flasks-

5.5.1 (25 mL) VWR catalog #29620-109 or equivalent

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5.5.2 (100 mL) VWR catalog #29620-142 or equivalent

5.5.3 (200 mL) VWR catalog #29620-164 or equivalent

5.5.4 (500 mL) VWR catalog #29620-200 or equivalent

5.5.5 (1000 mL) VWR catalog #29620-222 or equivalent

.

5.6 Amber glass jar- (1 L) VWR catalog #IR141-0950 or equivalent

5.7 Dispensers for acids, calibrated according to ALSI SOP 19-AP.

5.7.1 (1-5 mL) Brinkmann Instruments Bottletop Dispenser, VWR catalog #17553-524, or equivalent

5.7.2 (0.1-2.5 mL) Brinkmann Instruments Bottletop Dispenser, VWR catalog #7553-522, or equivalent

5.8 Water Bath, Precision model 186, capable of maintaining water depth of 2-3 inches and a temperature of 94-96°C for 2 hours.

5.9 Balance capable of weighing to nearest 0.1 g. (Mettler PM 4800 or equivalent). Note: The analytical balance must be calibrated each day. Prior to use the analyst must verify a record of calibration in the Balance Calibration Logbook. The procedure for balance calibration may be found in ALSI SOP 09-PM2000.

5.10 Certified thermometer for water bath, calibrated annually against a NIST thermometer per ALSI SOP 09-TCAL. Reference ALSI SOP 99-Temp for further information.

6 Reagents

NOTE: Unless otherwise noted in this section all chemicals are stored at room temperature and labeled with an expiration date of five years from receipt. Manufacturer's labeled expiration dates take precedent over all other expiration dates. All reagents and standard solutions in this section must be labeled and logged into appropriate laboratory logbooks. In addition, the logbook numbers must be labeled on the reagent or standard solution and on all appropriate preparation worksheets. Reagent bottles must also include the analyst's initials, preparation date, and expiration date.

6.1 Reagent water - A Filson Water Purification System is used which provides

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analyte-free, >16.0 megohm-cm deionized water on demand. This water is used for preparation of all reagents, calibration standards, and as dilution water.

6.2 Concentrated Sulfuric Acid (H_2SO_4) - J.T.Baker ACS Reagent Trace Metal Grade with mercury content < 1 µg/L, VWR catalog # JT9673-33 or equivalent. Label as expiring one year from date opened and record on the bottle.

6.3 Concentrated Nitric Acid (HNO_3) - J.T. Baker ACS Reagent Trace Metal Grade with low mercury content < 1 µg/L, VWR catalog # JT9598-34 or equivalent. Label as expiring one year from date opened and record on the bottle. Note: If a high reagent blank is obtained, the acid must be checked for mercury impurities.

6.4 Potassium permanganate ($KMnO_4$) - J.T. Baker ACS Reagent, VWR catalog # JT3227-5 or equivalent.

6.4.1 Potassium permanganate solution (5% $KMnO_4$) - dissolve 50 g of potassium permanganate ($KMnO_4$) in 1000 mL reagent water. Store for up to 3 months in a properly labeled 1-L amber glass bottle.

6.5 Potassium persulfate ($K_2S_2O_8$) - J.T. Baker ACS Reagent, VWR catalog # JT3239-05 or equivalent.

6.5.2 Potassium persulfate solution (5% $K_2S_2O_8$) - dissolve 50 grams of potassium persulfate ($K_2S_2O_8$) in 1000 mL of reagent water. Store for up to 3 months in a properly labeled 1-L amber glass bottle.

6.6 Mercury Calibration Standard (25 ppb).

6.6.1 Mercury Stock Standard (1000 ppm) - QCD Analysts, catalog # SKU980W12, or equivalent. This standard must be discarded according to the manufacturer's label.

6.6.2 Intermediate Mercury Standard (1 ppm) - Place 0.100 mL of (1000 ppm) Mercury Stock Standard (Section 6.6.1) and 0.300 mL of concentrated HNO_3 into a 100-mL Class A volumetric flask half full with reagent water. Dilute to volume and mix well. Store at room temperature for 14 days.

6.6.3 Working Mercury Standard (25 ppb) - Place 2.5 mL of (1 ppm) Intermediate Mercury Standard (Section 6.6.2) and 0.300 mL of concentrated HNO_3 in a 100-mL Class A volumetric flask. Dilute to

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volume and mix well. Prepare fresh daily.

6.7 Mercury QC or Second Source (25 ppb).

6.7.1 Mercury QC Stock Standard (1000 ppm) - High Purity Standards, catalog # 100033-1, or equivalent. The Mercury QC or Second Source Standard must be prepared from a stock solution obtained from a supplier which is different than the supplier used for the stock solution in 6.6.1, above. This standard must be discarded according to the manufacturer's label.

6.7.2 Intermediate QC Mercury Standard (1 ppm) - Place 0.100 mL of (1000 ppm) Mercury QC Stock Standard (Section 6.7.1) and 0.300 mL of concentrated HNO_3 into a 100-mL Class A volumetric flask. Dilute to volume and mix well. Record the preparation of this standard in the Inorganic Prep Logbook. Store at room temperature for 14 days.

6.7.3 Working QC Mercury Standard (25 ppb) - Place 2.5 mL of (1 ppm) Intermediate QC Mercury Standard (Section 6.7.2) and 0.300 mL of concentrated HNO_3 in a 100-mL Class A volumetric flask. Dilute to volume and mix well. Prepare fresh daily.

6.8 Mercury Matrix Spike Solution is obtained from the 1 ppm Intermediate Mercury Standard (6.6.2). See Section 10.5 for instructions on spike preparation.

7 Glassware Cleaning

7.1 Glassware washing procedures can be found in ALSI SOP 19-GLWH.

8 Quality Control

8.1 All policies and procedures in the most current revision of the ALSI QA Plan shall be followed when performing this procedure.

8.2 Blanks, Standards, ICV, CCV, and LCS solutions and MS and MSD samples are digested with every batch of samples, up to 20 samples per batch.

Quality Control Requirements

Specific project requirements may override the following:

Parameter	Concentration	Frequency	Control Limits	Corrective Action

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Method Blank	-	1 per batch of 20 samples or less.	Refer to SOP 03-Hg.	Refer to SOP 03-Hg.
ICV Second Source	4 µg/L	1 per analytical run.	Refer to SOP 03-Hg.	Refer to SOP 03-Hg.
LCS Solution (Lab Fortified Blank)	2 µg/L	1 per batch of 20 samples or less.	Refer to SOP 03-Hg.	Refer to SOP 03-Hg.
Matrix Spike**	Waters – 5 µg/L	1 per 10 samples with at least 1 per batch.	Refer to SOP 03-Hg.	Refer to SOP 03-Hg.
Matrix Spike Duplicate or sample duplicate**	--	1 per 10 samples with at least 1 per batch.	Refer to SOP 03-Hg.	Refer to SOP 03-Hg.
CCV (Same Source)	4.0 µg/L	A sufficient volume of CCV sample must be digested to allow for the analysis of a CCV every 10 samples during the analytical run. A minimum of 2 aliquots is recommended.	Refer to SOP 03-Hg.	Refer to SOP 03-Hg.
ICB/CCB	--	A sufficient volume of ICB/CCB must be digested to allow for the analysis of an ICB/CCB every 10 samples during the analytical run. A minimum of 3 aliquots is recommended.	Refer to SOP 03-Hg.	Refer to SOP 03-Hg.

** Samples selected for matrix spike and matrix spike duplicate analysis shall be rotated among client samples so that various matrix problems may be noted and/or addressed. Poor performance in a duplicate or spike may indicate a problem with the sample composition and shall be reported to the client whose sample produced the poor recovery.

8.3 A demonstration of capability (DOC) shall be performed by each analyst performing this procedure before any client samples are analyzed.

8.3.1 The DOC is determined by the analysis of four different Laboratory Control Samples (LCS's).

8.3.2 The percent recovery of the four LCS's must be within ±15% of the true value, and the percent RPD must be $\leq$ 10%. If demonstration of capability fails, reanalyze.

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8.3.3 The analyst must repeat this step (8.3) until precision and accuracy criteria are met.

8.4 Ongoing proficiency must be established annually as specified in the QA Plan, Technical Training.

8.5 MDL studies must be performed according to SOP 99-MDL or the reference methods, whichever is more frequent.

9 Sample Collection, Preservation, and Storage

9.1 Because of the extreme sensitivity of the analytical procedure and the presence of mercury in the laboratory environment, care must be taken to avoid extraneous contamination. Sampling devices, sample containers and plastic items should be determined to be free of mercury; the sample should not be exposed to any condition in the laboratory that may result in contamination from airborne mercury vapor.

9.2 Preserve aqueous samples using HNO_3 to a pH <2. Sample preservation shall be performed immediately upon sample collection. If this is not possible, then samples shall be preserved as soon as possible when received at the laboratory. If samples are preserved in the laboratory, hold for 24 hours then check the pH. If pH is >2, sample must be re-acidified and the pH must be checked after 24 hours.

9.3 Samples requiring dissolved mercury shall be filtered through a 0.45 µm filter BEFORE the preservation acid is added. Minimum required is 75 mL.

9.4 Samples and sample digestates are stored at room temperature, and are digested and analyzed within 28 days of the sampling date.

9.5 Samples must be analyzed within 24 hours of de-colorization.

10 Procedure

10.1 Water and liquid sample preparation.

10.1.1 Using a balance, weigh 25 ± 0.1 g of the well-mixed sample (or an aliquot diluted with reagent water to 25 ± 0.1 g) into a labeled 40-mL glass VOA vial.

10.1.2 Add 1.25 mL of concentrated H_2SO_4 acid and mix well.

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10. 1.3 Add 0.625 mL of concentrated HNO_3 acid and mix well.

10.1.4 Add 2 mL of 5% $K_2S_2O_8$ solution using a Finnpipette Digital Pipettor and mix well.

10.1.5 Add approximately 3.8 mL of 5% $KMnO_4$ solution using a Finnpipette Digital Pipettor and mix well. Wait 15 minutes to determine if purple color persists. If the color does not remain purple, use less of the sample and bring to a volume of 25 mL. Add the 5% $KMnO_4$ solution and wait 15 minutes. Record sample amount in logbook.

10.1.6 Cap loosely and place in a hot water bath for 2 hours at 95°C ± 1°C.

10.1.7 Remove from water bath and cool to room temperature and deliver to metals lab for analysis.

10.1.8 Complete logbook page and verify the completion of testing by entering the batch into the Laboratory Information Management System (LIMS). For batching instructions refer to Section 12.

10.2 Water calibration standards and Laboratory Control Sample (LCS) solution preparation.

10.2.1 To prepare the calibration blanks and standards, transfer 0, 0.2, 1.0, 2.0, 4.0 and 10.0 mL aliquots of the 25 ppb Hg standard (Section 6.6.3) to labeled 40-mL VOA vials using the Finnpipette Digital Pipettors. Dilute the standards with reagent water to a total volume of 25 mL. Prepare the blanks (25 mL reagent water) in triplicate so that they can also be used as initial and continuing calibration blanks (ICB/CCB). Follow steps 10.1.2 through 10.1.8 from above to finish preparing the standards.

10.2.2 To prepare the LCS solution, transfer a 2.0 mL aliquot of the 25 ppb Hg standard (Section 6.6.3) to labeled 40-mL VOA vials using a Finnpipette Digital Pipettor. Add reagent water using the Finnpipette Digital Pipettor to a total volume of 25 mL. Follow steps 10.1.2 through 10.1.8 from above to finish preparing the LCS.

10.3 Water Initial/Continuing Calibration Verification Standard (ICV/CCV) preparation.

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10.3.1 ICV: Transfer a 4.0 mL aliquot of the 25 ppb Hg QC or second source standard (Section 6.7.3) to labeled 40-mL VOA vials using a Finnpipette Digital Pipettor. Add reagent water using the Finnpipette Digital Pipettor to a total volume of 25 mL. Follow steps 10.1.2 through 10.1.8 from above to finish preparing the ICV. Repeat twice to form three aliquots.

10.3.2 CCV: Transfer 4.0 mL of 25 ppb Hg Working Standard (Section 6.6.3) to a labeled 40-mL VOA vial using a Finnpipette Digital Pipettor. Add reagent water using the Finnpipette Digital Pipettor to a total volume of 25 mL. Follow steps 10.1.2 through 10.1.8 from above to finish preparing the CCV's. Repeat twice to form three aliquots.

10.4 Method Blank preparation

10.4.1 Prepare a method blank with each batch of samples by transferring 25 mL of reagent water to labeled 40-mL VOA vial. Follow steps 10.1.2 through 10.1.8 to prepare the method blank.

10.5 Water matrix spike preparation - 5.0 µg/L.

10.5.1 For samples that are to be spiked, pipette 25 mL of sample and 0.125 mL of a 1.0 ppm Hg standard spiking solution (Section 6.8) using a Finnpipette Digital Pipettor into two labeled 40- mL VOA vials. Spikes are prepared in duplicate. Follow step 10.1.2 through 10.1.8 from above to digest the spikes as samples.

11 Calculations

11.1 Not applicable

12 Reporting Results

12.1 BATCHING –Instructions for pre-digestion sample entries in LIMS

12.1.1 Select the BATCHING menu in the LIMS, then, select NEW BATCH and enter MDIG to obtain the samples requiring Mercury Digestion.

12.1.2 Select one of the following test codes 245.1 PREP; 245.1D PREP.

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12.1.3 Select up to 20 samples to make the batch, select BUILD BATCH, at this point a Method Blank, LCS and MS/MSD will be generated. Upon SAVING the batch, the LIMS system will generate the numbers that are to be assigned to all QC.

12.2 POSTING – Instructions for post-digestion sample entries in LIMS

12.2.1 Upon the completion of digestion, select the OPERATION menu in the LIMS. Select POSTING – BY BATCH.

12.2.2 Enter the Batch Number and test code.

12.2.3 Enter the date and time that digestion was completed and make any necessary volume changes.

12.2.4 When entering data into Horizon LIMS do not round off results; Horizon will automatically perform rounding appropriate to the method.

12.2.4 Save the Batch. Samples are now available for analysis in the META portion of the LIMS.

12.2.5 A second review of the digestion Log is performed by a peer before the analysis of the samples.

13 Waste Disposal

13.1 Refer to ALSI SOP 19-Waste Disposal.

14 Pollution Prevention

14.1 Pollution prevention encompasses any technique that reduces or eliminates the quantity or toxicity of waste at the point of generation. Numerous opportunities for pollution prevention exist in laboratory operations. Management shall consider pollution prevention a high priority. Extended storage of unused chemicals increases the risk of accidents. The laboratory shall consider smaller quantity purchases which will result in fewer unused chemicals being stored and reduce the potential for exposure by employees. ALSI tracks chemicals when received by recording their receipt in a traceable logbook. Each chemical is then labeled according to required procedures and stored in assigned locations for proper laboratory use.

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15 Definitions

15.1 Refer to ALSI QA Plan under Laboratory Quality Control Checks for general definitions.

15.2 Method Specific Definitions include:

15.2.1 Initial Calibration Verification (ICV) is prepared by the analyst by combining compatible elements from a standard source different than that of the Calibration Standard and at concentrations within the linear working range of the instrument.

15.2.2 Continuing Calibration Verification (CCV) is prepared in the same acid matrix using the same standards used for the calibration at a concentration near the mid-point of the calibration curve.

15.2.3 Calibration Blank a volume of reagent water acidified with the same acid matrix as in the calibration standards. The calibration blank is a zero standard and is used to auto-zero the instrument.

15.2.4 Stock Standard Solution is a concentrated solution containing one or more method analytes prepared in the laboratory using assayed reference materials or purchased from a reputable commercial source.

16 Troubleshooting

16.1 Refer to maintenance logs and instrument manuals for guidance for troubleshooting specific problems related to the apparatus used in this method.

Appendix A

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MERCURY SAMPLE PREPARATION

Method: _____ Hot Water Bath/Autoclave ID#: _____
WLSI SOP: _____ Initial Temp. Of Bath: _____ Time: _____
Date: _____ Final Temp. Of Bath: _____ Time: _____
Time: _____ Thermometer ID#: _____
Technician: _____ Batch #: _____

Line#	Sample #	Sample Amount X=25ml or as noted	Additional KMnO4 (ml)	Final Volume X=25ml	Spike Amount (ml)	Spiking Std Used	Prep Type	Pipette ID #
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								
11								
12								
13								
14								
15								
16								
17								
18								
19								
20								
21								
22								
23								
24								
25								
26								
27								
28								

Reagents and working standards	Calibration and check standards
Working Std:_____ml of _____ into_____ml	*S0(ICB,CCB):# of S0's made:_____ Pipette ID#_____
Working QC:_____ml of _____ into_____ml	*S0.2:_____ml of Working Std into_____ml
5% $KMnO_4$:_____ Pipette ID#_____	*S1.0:_____ml of Working Std into_____ml
5% $K_2S_2O_8$:_____	*S2.0:_____ml of Working Std into_____ml
c. H_2SO_4:_____	*S4.0:_____ml of Working Std into_____ml
c. HNO_3:_____	*S10.:_____ml of Working Std into_____ml
	*ICV:_____ml of Working QC into_____ml
	*CCV:_____ml of Working Std into_____ml
	# of CCV's made_____

*All standards are prepared daily prior to analysis of samples in the same matrix as the samples to be analyzed

Revision 4/05 Page #:____ Approved By:_____Date:_____

SOP Change History Sheet

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Section No.	Section	Reason for Change
1.2	Scope and Application	Correction to current SOP
6	Reagents	Correction to current SOP
8.3	Procedure	PADEP Audit Revision
9.2	Quality Control	PADEP Audit Revision
11	Reporting Results	Update for Horizon LIMS
15	Definitions	Added per NELAC
Appendix A	Mercury Sample Prep Logbook	Added
5.3	Apparatus and Materials	A2LA audit response
7	Sample Handling	Change to SOP 4/28/05
Revision 9: 02/22/2006		
1.6	Scope and Application	Project requirements verbiage added
2.1	Summary of Method	Transfer detail added
3.2	Interferences	Vessel detail added
4	Safety	Entire section expanded
5	Apparatus and Materials	Material additions made and detail added
6	Reagents	Storage parameters, logging and labeling added
6.1	Reagents	Reagent water details added
6.2-6.8 section	Reagents	Major revisions/additions throughout

SOP Change History Sheet (continued)

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Section No.	Section	Reason for Change
7	Glassware Cleaning	Added
8.2	Quality Control	Sample batch size indicated, revisions to table
8.3-8.5	Quality Control	DOC and MDL parameters expanded
9	Sample Collection…	Section added
10	Procedure	Numerous details added to reflect lab practice and to fulfill DoD audit response
10.3.2	Procedure	Revised CCV volume
12	Reporting Results	Section clarifications made plus second review requirement added
16	Troubleshooting	Addition as DEP/DoD audit response

Revision 10: 10/22/07

Spelling, grammar, and formatting changes made throughout SOP for clarity, correctness, and site conformity.

1.5	Scope and Application	Update to MDL information
4.2	Safety	Update to MSDS verbiage
4.4, 4.5	Safety	Added sections
6	Reagents	Added NOTE
6.6, 6.7	Reagents	Update reagent formulation
9.1	Sample Collection, Preservation…	Added section

SOP Change History Sheet (continued)

Section No.	Section	Reason for Change

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9.5	Sample Collection, Preservation…	Added secton
10.1.5	Procedure	Update reagent amount
12.2.4	Reporting Results	Added section
15.2.3, 15.2.4	Definitions	Added sections

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SOP Concurrence Form
for the Distribution and Revision of Standard Operating Procedures

I have read, understood, and concurred with the Standard Operating Procedure (SOP) described above and will perform this procedure as it is written in the SOP.

Print Name	Signature	Date

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Document Title: Closed-System Purge-and-Trap and Extraction for Volatile Organics in Soil and Waste Samples

Document Control Number: _____

Organization Title: ANALYTICAL LABORATORY SERVICE, INC. (ALSI)

Address: 34 Dogwood Lane
Middletown, PA 17057

Phone: (717) 944-5541

Approved by:

_____ _____
Helen MacMinn, Date
Quality Assurance Manager

_____ _____
Christopher Kahler, Date
Validator/GC/MS Supervisor

Annual Review:

_____ _____
Reviewed By Date Reviewed

_____ _____
Approved By Date Approved

_____ _____
Reviewed By Date Reviewed

_____ _____
Approved By Date Approved

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Annual Review (continued):

Reviewed By	Date Reviewed
Approved By	Date Approved

Reviewed By	Date Reviewed
Approved By	Date Approved

Reviewed By	Date Reviewed
Approved By	Date Approved

Reviewed By	Date Reviewed
Approved By	Date Approved

Reviewed By	Date Reviewed
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1 Scope and Application

1.1 This standard operating procedure is adapted from SW-846, Method 5035A-1, Draft Revision 1, July 2002, "Closed-System Purge-and-Trap and Extraction for Volatile Organics in Soil and Waste Samples".

1.2 Method 5035A-1 was designed for use with solid materials (e.g., soils, sediments, and solid waste) containing low levels of volatile organic compounds (VOCs) using a closed-system purge-and-trap process. Procedures for collecting and preparing solid and oily waste samples containing high levels of VOCs are also included in the method. In regards to the high level concentration of VOCs, sample introduction is performed using Method 5030, which is used in conjunction with SOP 02-8260 and 02-8021. For a list of compounds that are determined by this method, refer to the SOP 02-8260 and 01-8021.

1.3 This sample vial preparation procedure is restricted for use by or under the supervision of analysts trained for volumetric and gravimetric procedures. The analysis portion of the procedure is restricted for use by or under the supervision of analysts trained on the use of the GC and/or GC/MS.

1.4 This method covers the determination of volatile organics compounds in soil and waste samples.

1.5 The applicable concentration range of the low-concentration procedure is dependent on the determinative method, matrix, and compound; however, it will generally fall in the 0.5 to 200 µg/kg range. The high-concentration procedure is intended for samples containing VOCs greater than 200 µg/kg.

1.6 Method Detection Limits (MDLs) are available on the ALSI network and are maintained and updated by the QA department. The detection limits for a specific sample may differ from those listed due to the nature of interferences in a particular sample matrix. MDL studies must be performed according to SOP 99-MDL or the reference method, whichever is more frequent.

1.7 This document states the laboratory's policies and procedures established in order to meet requirements of all certifications/accreditations currently held by the laboratory, including the most current NELAC standards.

1.8 Individual project requirements may override criteria listed in this SOP.

2 Summary of Method

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2.1 Volatile organic compounds are determined by collecting a 5 gram solid sample and placing it in a pre-weighed vial. For low-concentration samples, the vial contains a stirring bar and 5 mL of sodium bisulfate preservation solution. For high-concentration samples, the vial contains 5 mL of methanol only. The sample may be collected as a bulk sample in a soil jar without preservative. Once in the laboratory, an aliquot of that sample would be weighed and extracted in the proper preservative within 48 hours of collection.

2.2 For low-concentration solid samples, the entire vial is then placed into the instrument auto-sampler. Immediately before analysis, organic-free water, surrogates, and internal standards are automatically added without opening the sample vial.

2.3 The vial containing the sample is heated to 40°C and the volatiles purged into an appropriate trap using an inert gas combined with agitation of the sample. When purging is complete, the trap is heated and back flushed with helium to desorb the trapped sample components into a gas chromatograph for analysis by an appropriate determinative method such as 8021 or 8260.

2.4 For high concentration solid samples, the sample is extracted with a water-miscible solvent such as methanol or polyethylene glycol and purged via method 5030C. Surrogates will be added prior to analysis to determine if matrix effects are present. An aliquot of the solution is added to 5 mL of reagent water and the sample is purged under the same conditions as described under SOP 02-8260.

NOTE: The method allows surrogates to be spiked into the solvent at the time of extraction or into the reagent water containing the aliquot prior to analysis. Since we are concerned with matrix effect or extraction efficiencies more than analytical efficiencies, we spike the surrogates into the solvent containing the soil and then take an aliquot out to add to reagent water for purging. The only exception to this would be an oily solvent, which could require dilutions large enough to dilute the added surrogates out of solution. In this case, the Archon Autosampler would add the surrogates at the time of analysis.

2.5 For high concentration oily waste samples, the sample is collected as a bulk sample without any type of preservation. The sample is tested for solubility and is then diluted with the appropriate solvent. An aliquot of the dilution is added to 5 mL of reagent water. The sample is then analyzed using the conditions described in SOP 02-8260.

2.6 Samples that contain oily materials that are not soluble in water-miscible

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solvents must be extracted according to Method 3585 prior to the determinative procedure.

3 Interferences

3.1 Impurities in the purge gas and from organic compounds out-gassing from the plumbing ahead of the trap are a potential contamination problem. The analytical system must be demonstrated to be free from contamination under the conditions of the analysis by running method blanks.

3.2 Samples can be contaminated by diffusion of volatile organics through the septum seal of the sample vial during shipment and storage. A trip blank prepared from organic-free reagent water and carried through sampling and handling protocols serves as a check on such contamination. Storage blanks are also analyzed monthly to ensure absence of contamination in the storage location.

3.3 Contamination by carryover can occur whenever high-concentration and low-concentration samples are analyzed in sequence. Where practical, samples with unusually high concentrations of analytes shall be followed by an analysis of organic-free reagent water to check for cross-contamination.

3.4 Sample bottle preparation and volatile analysis shall be performed in a laboratory area that is free of solvents which interfere with the analytes being measured.

4 Safety

4.1 The toxicity or carcinogenicity of each reagent used in this method has not been fully established. Each chemical shall be regarded as a potential health hazard and exposure shall be as low as reasonably achievable. Cautions are included for known extremely hazardous materials or procedures.

4.2 ALSI maintains material safety data sheets (MSDS) on all chemicals used in this procedure. ALSI recommends that all individuals performing this SOP familiarize themselves with the MSDS associated with the procedure prior to SOP performance. MSDS are available to all staff and are located in hard copy in the QA reference library and electronically on the ALSI server in the MSDS folder.

4.3 Since the chemical makeup of the samples is not known, analysts shall treat the samples with extreme caution. Precautionary steps shall include using chemical resistant gloves, wearing a fully buttoned lab coat and safety glasses, but analysts shall not limit themselves to these minimums.

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4.4 The following chemicals have the potential to be highly toxic or hazardous. Consult MSDS: methanol, polyethylene glycol, sodium bisulfate, benzene, carbon tetrachloride, chloroform, 1,4-dichlorobenzene and vinyl chloride

5 Apparatus and Materials

5.1 40-mL, screw-cap, PTFE lined, septum-sealed vials. VWR #IRS136-0040, or equivalent

5.2 4 or 8 ounce wide-mouth glass bottle with PTFE lined screw-cap. VWR #IRV220-0125 or IRV220-0250, or equivalent

5.3 Balance - ACCULAB VI-200; 200 gm capacity; 0.01 gm resolution, or equivalent.

5.4 Volumetric flasks: Class A, various volumes, with ground-glass stoppers.

5.5 Disposable pipettes: Pasteur, VWR 5 ¾" #14672-200, or equivalent.

5.6 Magnetic stir bars – PTFE or glass coated, methanol rinsed. VWR #58949-036, or equivalent.

5.7 Syringes: 5 and 1 mL Hamilton Gastight: VWR #60376-321/285, or equivalent.

5.8 Microsyringes: Hamilton gastight, various volumes between 10 µL and 100 µL: VWR #60376-220,230,241,252,263,274, or equivalent.

5.9 Disposable pipettes: Pasteur, VWR 5 ¾" #14672-200, or equivalent.

5.10 Spatulas – stainless steel. VWR #57952-107, or equivalent.

5.11 Vials: 20-mL I-CHEM: VWR #IRS126-0020, or equivalent.

5.12 Purging device – closed system–Archon 5100, or equivalent. The purging device must be capable of accepting a vial large enough to contain a 5-gram soil sample plus a magnetic stirring bar and up to 10 mL of water. The device must also be capable of heating a soil vial to 40ºC and holding it at that temperature while the inert purge gas is allowed to pass through the sample. The device shall also allow for the addition of internal and surrogate standards via the addition of 5 mL of reagent water while trapping the displaced headspace vapors. The device must be able to agitate the sample during the purging process. The analytes being purged must be quantitatively

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transferred to an absorbent trap. (See SOP for the determinative procedure for the types of traps used, GC/MS, and data system information.)

5.13 Pre-weighed 40-mL vials with 5 mL of methanol: C&G Containers, Inc. #R-B-1, or equivalent.

6 Reagents

NOTE: Unless otherwise noted in this section all chemicals are stored at room temperature and labeled with an expiration date of five years from receipt. Manufacturer's labeled expiration dates, when provided, take precedent over all other expiration dates.

6.1 Reagent grade inorganic chemicals shall be used in all tests. Unless otherwise indicated, it is intended that all inorganic reagents shall conform to the specifications of The Committee on Analytical Reagents of the American Chemical Society, where such specifications are available. Other grades may be used, provided it is first ascertained that the reagent is of sufficiently high purity to permit its use without lessening the accuracy of the determination.

6.2 Organic-Free Reagent Water- Reagent water is water in which interference is not observed with the analytes of interest. For this purpose, tap water is used. De-ionized water may also be used for this method if it has been shown to be free from interferences due to cartridge bleed. NOTE: If interferences are detected in the de-ionized source, tap water must be used until the water source is again clean.

6.3 Methanol, Purge-and-Trap quality or equivalent. EM Science Purge & Trap grade, #MX0482-6, or equivalent.

6.4 Polyethylene Glycol (PEG) - free of interferences at the detection limit of the target analytes. Fisher #P167-1, or equivalent.

6.5 Sodium Bisulfate - J.T. Baker #3534-01, or equivalent.

6.6 Hexadecane - free of interferences at the detection limit of the target analytes, for oily samples processed by method 3585. Aldrich #H6703-500ML, or equivalent.

6.7 Internal Standards and Surrogates are specified in the determinative procedure SOP.

6.7.1 8021B Methanol extraction solution: Prepare a 3 µg/mL solution of α, α, α-trifluorotoluene from the 2000 µg/mL Ultra Scientific stock solution cat. #STS-220 or equivalent. Add 150 mL to 175 mL of purge and trap grade

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methanol to a 200-mL class A volumetric flask. Using a 500 µL gas tight syringe, transfer 300 µL of the purchased surrogate solution (STS-220) to the flask. When adding the α, α, α-trifluorotoluene stock to the volumetric flask, ensure that the needle of the syringe is below the surface of the methanol. Dilute to volume with methanol.

6.7.2 8260B Methanol extraction solution: Refer to Section 10.

6.8 Calibration Solutions are listed in the determinative procedure SOP; 02-8260 for method 8260 and 01-8021 for method 8021.

6.9 Quality control sample solutions are listed in the determinative procedure SOP; 02-8260B for method 8260 and 01-8021 for method 8021.

7 Instrument Calibration

7.1 Refer to the standard operating procedure for the determinative methodology (SOP 01-8021 or 02-8260).

7.2 Instruments processing samples for the low-concentration samples shall be calibrated from approximately 0.5 to 200 µg/kg, when possible to do so without over-saturating the detector.

NOTE: For low level soil analysis by 8260/5035, the calibration range is 2-200 µg/kg for most compounds of interest. At this time, we do not analyze for low level soils using 8021 methodology. SOP 02-8260 has instructions to calibrate in a range of 1-200 ppb. To prepare a 2 ppb standard, simply double the amount of standard added for the 1 ppb standard.

7.2.1 All calibration samples are prepared by adding 5 mL of the calibration solution to a 40-mL vial with 1 g of sodium bisulfate and a magnetic stirring bar before placing on the Archon auto sampler.

8 Quality Control

8.1 All policies and procedures in the most current revision of the ALSI QA Plan shall be followed when performing this procedure.

8.2 A trip blank must be prepared with each set of bottles. This blank will accompany the samples to the collection site and back to the laboratory. It will be analyzed to determine if any contamination has occurred during preparation of the sample

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containers. The trip blank shall consist of two (2) 40-mL vials. Prepare one for the low-concentration procedure by adding 5 mL of reagent water, 1 g of sodium bisulfate, and a magnetic stirring bar into a 40-mL vial. The other vial shall be prepared for the high-concentration procedure by adding 5 mL of methanol to a 40 mL vial.

8.3 For information on method blanks, duplicates, matrix spikes, internal standards, surrogates, QC standards, proficiency tests, DOCs, ongoing proficiency and MDLs, refer to the standard operating procedure for the determinative procedure; 02-8260 for method 8260 and 01-8021 for method 8021.

8.3.1 Associated method blanks and LCSs are prepared in the same manner as samples, using 5 g of inert material in place of sample. Currently, glass boiling beads, PTFE chips, and muffle furnaced sand are the forms of inert material that may be used.

8.3.2 For low level concentration soils, all QC samples are prepared by adding 5 mL of QC solution to a 40-mL vial with 1 g of sodium bisulfate and a magnetic stir bar before placing on the Archon auto sampler.

9 Sample Collection, Preservation and Handling

9.1 Sample collection containers are prepared by the Sample Receiving department. NOTE: Method 5035 bottle prep log sheets will be kept in a spreadsheet file in the Sample Receiving Department entitled 5035 Bottle Prep.

9.1.1 Because volatile organics will partition into the headspace of the vial from the aqueous solution and will be lost when the vial is opened, surrogates, internal standards, and matrix spikes (if applicable) shall only be added to the vials after the sample has been added to the vial. The matrix spike solution needs to be added manually through the septum using a small gauge needle while the surrogates and internal standards will be added by the Archon Autosampler at the time of analysis. The exception to this rule would be for New Jersey pre-weighed vials, which require 25 mL of methanol containing surrogates in the vial as it leaves the laboratory.

9.2 Samples may also be collected in devices such as the EnCore sampler. See Section 10.4 for more information concerning the preparation of EnCore samples collected.

9.3 All samples collected for volatiles analysis shall be stored above the freezing point of water up to 6ºC until analysis. See SOP 02-8260 or 01-8021 for sample holding

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times.

9.4 When collecting samples that are not in pre-weighed vials, be sure to fill soil to top of jar. Headspace can cause loss of analytes of interest.

10 Procedure

10.1 Low-Concentration Samples

10.1.1 Upon return of the samples to the laboratory for analysis, the final sample weights shall be determined by the sample-receiving department. Do not add any additional labels to the vials until the final weight is determined.

10.1.2 The final vial weight shall be determined on a top-loading balance accurate to 0.01 grams. The final weight shall be recorded on the "Method 5035 Bottle Preparation Log-Sheet". Subtracting the initial and final vial weights will yield the sample size. A copy of the completed log-sheet shall be forwarded to the GC and GC/MS departments. The sample size shall be recorded on the vial as well.

10.1.3 In the event that the samples were collected and submitted in devices such as the EnCore sampler, the GC or GC/MS department must, within 48 hours of sample collection, transfer the sample to low-concentration vials. See Section 10.4 for the procedure.

10.1.4 In the event that the samples were collected and submitted in sample collection jars, the GC or GC/MS department must, within 48 hours of sample collection, transfer 5 g of the sample to the appropriate pre-weighed vial described in Section 9.

NOTE: If the extraction does not occur within the 48 hours of collection, but the soil sample was received by the laboratory within that time, a JAR comment is used in the Horizon LIMS. If the soil sample was received by the laboratory after 48 hours and extraction occurs, a JAX comment is used in the Horizon LIMS.

10.1.5 Within 14 days of sample collection, samples must be purged in the closed system purge-and-trap and analyzed.

10.1.6 The customer shall provide 2 low-concentration vials preserved with sodium bisulfate, containing 5 grams of sample and 1 high-concentration vial

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preserved with methanol, containing 5 grams of sample. In the event that analyte concentrations exceed 200 µg/kg, the sample shall be re-analyzed using the High-concentration procedure.

10.2 High-Concentration Samples

10.2.1 Samples with analyte concentrations that exceed the calibration range of the low-concentration procedure, or are greater than 200 µg/kg, shall be processed by the methanol extraction procedure, purged and analyzed according to the standard operating procedure for method 8021 or 8260. Polyethylene glycol may be substituted for methanol.

10.2.2 Weigh the prepared vial to the nearest 0.01 gram and write the weight on the sample bottle label. (When the vials are returned to the laboratory for analysis, do not add any additional labels to the vial until the final weighing is completed). Calculate the sample size by subtracting initial weight from final weight. Record the sample size on the sample vial label.

10.2.3 Record the vial number, final weight and sample size on "Method 5035 Bottle Preparation Log-Sheet". After recording the initial information, a copy of the log-sheet shall be furnished to the customer. The original shall be filed in the sample-receiving department to await the return of the sample containers.

10.2.4 Prior to analysis, the GC/MS department will add surrogates to the methanol-preserved vials if the sample requires 8260 methodology or, the GC department will add appropriate surrogates if 8021 methodology is requested.

NOTE: See Section 10.4.2 for amounts and type of surrogate solution to be added.

10.2.5 In the event that the samples were collected and submitted in an EnCore device, the GC or GC/MS department must, within 48 hours of sample collection, transfer the samples to high concentration vials. See Section 10.4 for the appropriate procedure.

10.2.6 In the event that the samples were collected and submitted in sample collection jars, the GC or GC/MS department must, within 48 hours of sample collection, transfer 5 g of the sample to the appropriate pre-weighed vial described in Section 9.

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NOTE: If the extraction does not occur within the 48 hours of collection, but the soil sample was received by the laboratory within that time, a JAR comment is used in the Horizon LIMS. If the soil sample was received by the laboratory after 48 hours and extraction occurs, a JAX comment is used in the Horizon LIMS.

10.2.7 Within 14 days of sample collection, a portion of the methanol extract with surrogates present is added to reagent water to make a 1:50 final dilution. This dilution is added to the Archon auto sampler and analyzed according to the determinative procedure.

NOTE: Larger dilutions of the methanol extract may be required to ensure that the analytes of interest are within the curve limits. See the SOP for the determinative procedure on preparations of dilutions. If the surrogates are diluted below the limit of the curve, and recovery cannot be quantitated, a SDO comment is used in the Horizon LIMS.

10.3 Oily Samples

10.3.1 Oily, non-water-miscible samples shall be extracted with hexadecane according to the standard operating procedure for method 3585. (See Section 10.4.4)

10.4 EnCore Procedure

10.4.1 Low concentration soil samples

10.4.1.1 Add a clean, methanol rinsed and dried, magnetic stirring bar to each clean, 40-mL vial needed. With cap removed, place vial with stir bar on the balance and tare.

10.4.1.2 Add approximately 1 gram of sodium bisulfate to the vial. Again, tare the vial.

10.4.1.3 Open the EnCore sample device with pliers or a screwdriver, and insert the soil plug into the tared 40-mL vial containing sodium bisulfate and a stir bar. Carefully and quickly clean off the lip of the vial and the threads of the vial with a Kimwipe to remove any dirt, which could cause a leak resulting in lower recoveries than actually present. Weigh the vial and record the weight in the 8260 Extraction Logbook. This must be done within 48 hours of

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collecting the sample.

NOTE: Soil samples that contain carbonate minerals may effervesce upon contact with the acidic preservative solution. If the amount of gas generated is very small, any loss of volatiles may be minimal if the vial is sealed quickly. However, if larger amounts of gas are generated, the sample may lose significant amounts of VOCs and may even cause the vial to shatter once the vial is closed. To avoid this, when samples are known or are discovered to contain high levels of carbonates, the sample shall be placed in unpreserved reagent water and a comment shall be placed on the lab report stating why the sample is unpreserved. The sample must be analyzed within seven days if unpreserved.

10.4.1.4 Label the vial with the corresponding COC# of the sample that is to be prepared. If two EnCore plugs are sent in for low-level analysis, label the COC#s with a B and a C at the end of the number. (Ex: 123456-1B)

10.4.1.5 Add 5.0 mL of organic-free reagent water to each vial and snugly cap the vial. The vial will not be reopened until after the analysis is completed. The Archon Auto sampler adds internals and surrogates at the time of the analysis.

10.4.1.6 For samples not collected in an EnCore sampling device, an aliquot of soil (approximately 5 g) shall be taken from the soil jar and prepped according to the instructions found in Sections 10.4.1.1 – 10.4.1.5. The prep needs to be done within 14 days of collection as well as the analysis.

NOTE: Sample aliquots taken from the soil jar shall be prepared as soon as possible to avoid loss of volatiles and contamination that may occur during the percent moisture determination step.

10.4.2 High concentration soil samples

10.4.2.1 Remove the cap from a clean 20-mL vial, place the vial on the balance and tare to zero. 20-mL vials are preferred over the 40-mL size because they have less headspace than the 40-mL vials.

10.4.2.2 Label the vial with the corresponding COC# of the sample that is to

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be prepared. Usually one EnCore plug is sent in for high concentration analysis. Label the COC# with an "A" at the end of the number.

10.4.2.3 Open the EnCore sample device with pliers or a screwdriver, and insert the soil plug into the tared 20-mL vial. Weigh the vial and record the weight in the 8260 Extraction Logbook or the 8021 extraction logbook.

10.4.2.4 Preparation for 8260 analysis. Unlike the low-level soil preparation, the high level preparation gets surrogates added to the vial at the time of preparation, not at the time of analysis if the sample is to be analyzed by GC/MS. This is accomplished using one of the following methods.

10.4.2.4.1 5.0 mL of purge and trap grade methanol containing surrogates, MED826SS, is added to the vial. The portion of methanol must be prepared so that the addition of 5.0 mL of MED826SS will yield a concentration of 30 µg/kg when analyzed at a 50 fold dilution. MED826SS is prepared by adding 0.6 mL of Restek 8260A Surrogate Mix (2500 ppm), catalog #30240, to purge and trap grade methanol to a final volume of 1000 mL. Cap and shake. This is the preferred method of preparation.

10.4.2.4.2 After addition of 5.0 mL of unfortified methanol, add 3 µL of Restek 8260A Surrogate Mix (2500 ppm), catalog #30240, to the vial, which will yield a concentration of 30 ppb when analyzed. Cap and shake. This method shall be used when MED826SS is not available or when pre-weighed methanol vials are submitted by the client. If more than five mL of methanol is added, the 8260A surrogate mix added shall be increased to keep the ratio to 3 µL added for every 5 mL of methanol.

10.4.2.5 Preparation for 8021 analysis: Unlike the 8260 low level soil preparation, the high level preparation requires surrogates to be added to the sample at the time of preparation, not at the time of analysis. This is accomplished using one of the following methods:

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10.4.2.5.1 Add 5.0 mL of the 8021B fortified methanol extraction solution to the VOA vial containing the weighed soil from the Encore sampler or other sample device or container. Cap the VOA vial and shake**.** Store above the freezing point of water up to 6ºC and analyze within fourteen days of sample collection.

10.4.2.5.2 If pre-weighed VOA vials of methanol are submitted to the laboratory with unfortified methanol, use the following procedure. Using a 10 µL gas tight syringe, transfer 7.5 µL of 2000 µg/mL α, α, α-trifluorotoluene purchased stock (Ultra Scientific, catalog #STS-220, or equivalent) to the methanol. Ensure that the needle of the syringe is below the surface of the methanol when adding the surrogate solution. Cap the VOA vial and shake. Store above the freezing point of water up to 6ºC and analyze within fourteen days of when the soil sample was collected.

10.4.3 Method for deciding how EnCores shall be prepared:

10.4.3.1 Normally, a client will submit three EnCore plugs per COC#. Two plugs shall be prepared in sodium bisulfate for low level analysis and one plug shall be prepared in methanol for high level analysis to be used in the event that the low level analysis contains over-range compounds. The high level preparation will be labeled as the "A" sample, and the low level preparations will be labeled as the "B" and "C" samples.

10.4.3.2 In the event that the client sends in only two EnCore plugs, prepare one in sodium bisulfate and one in methanol.

NOTE: Some clients sending in 2 EnCores want both prepared in sodium bisulfate to be analyzed as low level soils. See Project Coordinators for information on these specific clients.

10.4.3.3 If only one EnCore plug is submitted, it will be prepared in methanol only.

10.4.4 To determine if the soils submitted get 8260 or 8021, consult the LIMS, the

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chain of custody, or speak to the project manager. If in doubt, or if low-level detections are required, prepare for analysis by 8260.

10.4.5 Oily Samples

10.4.5.1 For most of the cases this laboratory deals with, oily samples are submitted in 4 oz. jars or larger and therefore this SOP will not cover encore prep directions.

10.4.5.2 To prepare an oil sample that is soluble in methanol or PEG (polyethylene glycol), take a 20-mL volatile vial and add 10 mL of methanol. Mark the bottom of the meniscus with a permanent marker to indicate the 10 mL volume mark. Discard the methanol. In the marked vial, weigh out 1 gram of sample (wet weight) and record the weight in the extraction logbook. Add methanol to marked line to achieve an initial dilution of 1:10 (weight: volume) ratio.

10.4.5.3 Analyze the sample by diluting up to 1 mL of the extract into a final volume of 50 mL. Put the solution into a 40-mL VOA vial and put the vial into the archon autosampler to be analyzed per SOP 02-8260. Since many oil samples need dilutions high enough that surrogates would be diluted out of solution, we allow the archon to add the surrogates.

11 Calculations

11.1 See SOP 02-8260 or 01-8021, as appropriate.

12 Reporting Results

12.1 See SOP 02-8260 or 01-8021, as appropriate.

13 Waste Management

13.1 Refer to ALSI SOP 19-Waste Disposal.

14 Pollution Prevention

14.1 Pollution prevention encompasses any technique that reduces or eliminates the quantity or toxicity of waste at the point of generation. Numerous opportunities for pollution prevention exist in laboratory operations. Management shall consider

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pollution prevention a high priority. Extended storage of unused chemicals increases the risk of accidents. The laboratory shall consider smaller quantity purchases which will result in fewer unused chemicals being stored and reduce the potential for exposure by employees. ALSI tracks chemicals when received by recording their receipt in a traceable logbook. Each chemical is then labeled according to required procedures and stored in assigned locations for proper laboratory use.

15 Definitions

15.1 Refer to ALSI QA Plan under Laboratory Quality Control Checks for general definitions.

16 Troubleshooting

16.1 Refer to maintenance logs and instrument manuals for guidance in troubleshooting specific problems related to the instrumentation used in this method.

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Appendix A

Work continued from page:____

8260
EXTRACTION LOG

Work continued to page:____

Date	Time	Initials	Sample Number	Sample Amount	Solvent Type		Solvent Lot Number	Amount of Solvent	Lot # of Surrogate	Lot # of Spike	Comments
					MeOH/TGDE	H2O & NaBis.					

Revision 9/05

Page: _____

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Appendix B

METHANOL EXTRACTION LOG

Date	Initials	Sample Number	Sample Amount	Solvent Type		Solvent Lot Number	Amount of Solvent	Lot # of Surrogate	Lot # of Spike	Comments
				Methanol	Tetraglyme					

Date reviewed:_____

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SOP Change History Sheet

Section #	Section Description	Reason for Change
Revision 0: 01/22/2007		New SOP
Revision 1: 6/13/08		

Spelling, grammar, and formatting changes may have been made throughout SOP for clarity, correctness, and site conformity.

6	Reagents	Added NOTE
8.3.1	Quality Control	Added section per DEP audit
9	Sample Collection…	Section revised to only include information relevant to MS dept.
Appendix A and B		Replaced with current Benchsheets
Appendix C		Removed section

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SOP Concurrence Form
for the Distribution and Revision of Standard Operating Procedures

I have read, understood, and concurred with the Standard Operating Procedure (SOP) described above and will perform this procedure as it is written in the SOP.

Print Name	Signature	Date

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Document Title: Analysis of Total Metals by Inductively Coupled Plasma Using the TJA IRIS ICP

Document Control Number: _____

Organization Title: ANALYTICAL LABORATORY SERVICE, INC. (ALSI)

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_____ _____
Jason Knight, Date
Validator

Annual Review:

_____ _____
Reviewed By Date Reviewed

_____ _____
Approved By Date Approved

_____ _____
Reviewed By Date Reviewed

_____ _____
Approved By Date Approved

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Annual Review (continued):

Reviewed By	Date Reviewed
Approved By	Date Approved

Reviewed By	Date Reviewed
Approved By	Date Approved

Reviewed By	Date Reviewed
Approved By	Date Approved

Reviewed By	Date Reviewed
Approved By	Date Approved

Reviewed By	Date Reviewed
Approved By	Date Approved

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1 Scope and Application

1.1 This method is adapted from the U.S. EPA SW846 Method 6010C Revision 3, February 2007, "Inductively Coupled Plasma - Atomic Emission Spectroscopy." This method is applicable to a wide variety of matrices including ground water, aqueous samples, TCLP and EP extracts, industrial and organic wastes, soils, sludges, sediments, and other solid wastes.

1.2 The specific elements which ALSI analyzes by this method are listed in Table 1. This table lists the detection limits and the wavelengths used for the appropriate elements. The reporting limits shown were determined on relatively interference-free matrices. The actual reporting limits achieved on a given sample will depend highly on its individual matrix.

1.3 This method is restricted to use by or under the supervision of analysts experienced in the use of an ICP. Each analyst must also be skilled in the interpretation of raw data, including quality control data.

1.4 All samples, except those filtered and acidified aqueous samples being analyzed for dissolved elements, are digested using appropriate sample preparation techniques.

1.5 This document states the laboratory's policies and procedures established in order to meet requirements of all certifications/accreditations currently held by the laboratory, including the most current NELAC standards.

1.6 Method Detection Limits can be found on the ALSI network and are maintained and updated by the QA department. The detection limits for a specific sample may differ from those listed due to the nature of interferences in a particular sample matrix. MDL studies must be performed according to SOP 99-MDL or the reference method, whichever is more frequent.

1.7 The primary instrument for 6010C soil analysis is the TJA IRIS ICP. When the IRIS is down for maintenance or repair, the TJA TRACE ICP will be used as a backup. The associated 6010C soil MDLs will be changed to the TRACE levels.

1.8 Individual project requirements may override criteria listed in this SOP.

2 Summary of Method

2.1 This method measures element-emitted light by optical spectrometry. The ICP instrument contains a torch through which flows argon gas. A spark is used to initiate a plasma of ionized argon that is then maintained by a radio-frequency field. Samples are pulled into the system by a peristaltic pump and nebulized. The resulting aerosol is transported into the plasma torch. The excited atoms or ions on their return to the ground

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state produce element specific atomic- and ionic-line emission spectra. The emission spectra are dispersed by a grating spectrometer, and a Charge Injection Device (CID) monitors the intensities of the lines. The instrument averages the 2 replicate results, and displays a non-prep factor corrected result on the raw printout.

NOTE: Three (3) exposure replicates are averaged to obtain a result for all sequence runs involving samples for the Department of Defense **(DoD**).

2.2 Background correction is used for all element determinations. Background intensity is measured adjacent to the analytical lines from the samples during analysis in an area free from spectral interferences. It's then subtracted from the intensity measured at these lines.

2.3 The possibility for additional interferences such as spectral, chemical, and physical interferences, does exist. Appropriate corrections for these interferences must be made.

3 Interferences

3.1 Spectral interferences are caused by (1) overlap of a spectral line from another element at the analytical or background measurement wavelengths; (2) unresolved overlap of molecular band spectra; (3) background from continuum or recombination phenomena; and (4) stray light from the line emission of high concentration elements.

3.1.1 Background contribution and stray light are normally compensated for by the background correction.

3.1.2 Unresolved overlap requires the selection of an alternate wavelength or an alternate method of analysis such as graphite furnace or ICP-MS.

3.1.3 Spectral overlap is compensated for in the IRIS instrument by automatic correction of the raw data after monitoring and measuring the interfering elements. A linear relationship between the interferant levels and the false interferences they cause can be assumed. Inter-element correction factors are checked daily by analysis of an interference check solution and updated every six-months, or whenever indicated by failure of the interference check solution.

3.2 Physical interferences are effects associated with the sample introduction and flow through the instrument. These interferences are brought about due to differences in viscosity and surface tension. Physical interferences are most commonly seen in samples containing high dissolved solids or high acid concentrations. To reduce physical interferences, ALSI uses a peristaltic pump for sample introduction, dilutions of problem samples, and matrix matching of standards to samples. Internal standard addition and the method of standard additions may also be used to compensate for physical interferences.

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3.2.1 Another problem that can occur while analyzing samples with high dissolved solids is salt build-up at the tip of the nebulizer, which affects aerosol flow rate and causes instrument drift. This problem is controlled by regular maintenance and by wetting the argon prior to nebulization using a humidifier.

3.3 Chemical interferences include molecular compound formation, ionization effects, and solute vaporization effects. Normally, these are not significant with the ICP. If they are encountered, they can be minimized by carefully selecting the operating conditions (RF power, torch position, and nebulizer flow rate), buffering the sample, matrix matching, and performing standard addition procedures. Chemical interferences are highly dependant on matrix type and the specific analyte of interest.

3.4 Memory Interferences result when analytes from a previous sample contribute to the signals measured in a new sample. Memory effects can result from sample deposition on the uptake tubing to the nebulizer and from the build up of sample material in the plasma torch and spray chamber. This problem can be minimized by flushing the system with rinse blank between samples. If memory interference is suspected, the sample must be reanalyzed after a rinse period.

4 Safety

4.1 The toxicity or carcinogenicity of each reagent used in this method has not been fully defined; however, each chemical compound shall be treated as a potential health hazard.

4.2 ALSI maintains material safety data sheets (MSDS) on all chemicals used in this procedure. ALSI recommends that all individuals performing this SOP familiarize themselves with the MSDSs associated with the procedure prior to SOP performance. MSDS are available to all staff and are located in hard copy in the QA reference library and electronically on the ALSI server in the MSDS folder.

4.3 Precautions shall be taken when handling samples and/or chemicals in the lab. The use of chemical resistant gloves, safety glasses, and lab coats is required when working with samples.

4.4 Contamination Control: Lead dust wipe sampling must be performed in all associated areas of the lab on a quarterly basis to determine surface concentrations of lead. Sample preparation and analysis is not to proceed until surface contamination is less that the specified maximum allowable limit of 40 micrograms per square foot.

5 Apparatus and Materials

5.1 Thermo Jarrell Ash IRS Advantage ER/S Duo ICP Emission Spectrophotometer with the following options:

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5.1.1 IBM compatible Pentium II-450
ThermoSPEC/CID software v.
Axial / Radial Dou Torch, SPC Catalog #020-051-192, or equivalent
Computer controlled emission with background correction.
Computer inter-element correction ability
Radio frequency generator coupled to a water-cooled induction coil
Echelle optic system
Adjustable variable speed peristaltic pump
Mass flow controllers for argon flow rate
HP LaserJet Printer
TJA 300 automatic liquid sampler

5.2 Sample pump tubing - CPI, catalog #4062-535, or equivalent.

5.3 Internal Standard pump tubing - CPI, catalog #4062-5015, or equivalent.

5.4 Rinse pump tubing - CPI, catalog #4062-545, or equivalent.

5.5 17 x 100 polypropylene tubes – VWR, catalog # 60818-618, or equivalent.

5.6 13 x 100 polystyrene tubes – VWR, catalog #60818-849, or equivalent.

5.7 Internal Standard Mixing Kit - CPI, catalog #4062-910, or equivalent.

5.8 Various Class A volumetric dispensing pipets. – VWR, catalog #'s 53515-020, 53515-044, 53515-050, or equivalent.

5.9 Disposable Pasteur pipets - VWR, catalog #14670-103, or equivalent.

5.10 Class A volumetric flasks (10- mL) – VWR, catalog # 29620-142, or equivalent.

6 Reagents

NOTE: Unless otherwise noted in this section all chemicals are stored at room temperature and labeled with an expiration date of five years from receipt. Manufacturer's labeled expiration dates, when provided, take precedent over all other expiration dates.

6.1 Concentrated Nitric Acid (HNO_3) - Baker Instra-analyzed Reagent Grade, VWR, catalog #JT9598-34 or equivalent. Label as expiring one year from date opened.

6.2 Concentrated Hydrochloric Acid (HCl) - Baker Analyzed Reagent Grade, VWR catalog #JT9535-33 or equivalent. Label as expiring one year from date opened.

6.3 Reagent water - a Filson water purification system produces analyte free greater than

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16.0 megohm water on demand.

6.4 Liquid Argon Supply - High purity grade, purchased from MG Industries, or equivalent.

6.5 Stock Standard Solutions are purchased as commercially prepared NIST traceable certified solution. When received in the lab each is assigned a unique log number and is recorded in the Standard Preparation Logbook along with the manufacturer, date of receipt, expiration date, and analyst's initials.

6.5.1 SCP P/N 901-6A5-800 Stock Solution in 5% HNO_3. Purchased from SCP Science, or equivalent NIST certified standard. This standard contains the following elements:

ELEMENT	CONCENTRATION
Antimony (Sb)	40 mg/L
Arsenic (As)	40 mg/L
Beryllium (Be)	40 mg/L
Cadmium (Cd)	20 mg/L
Chromium (Cr)	20 mg/L
Manganese (Mn)	20 mg/L
Silver (Ag)	20 mg/L
Strontium (Sr)	20 mg/L
Thallium (Tl)	100 mg/L
Titanium (Ti)	20 mg/L
Vanadium (V)	20 mg/L

6.5.2 SCP P/N 901-6A5-803 Stock Solution in 5% HNO_3. Purchased from SCP Science, or equivalent NIST certified standard. This standard contains the following elements:

ELEMENT	CONCENTRATION
Aluminum (Al)	200 mg/L
Boron (B)	200 mg/L
Barium (Ba)	200 mg/L
Cobalt (Co)	200 mg/L
Copper (Cu)	200 mg/L
Lead (Pb)	200 mg/L
Lithium (Li)	200 mg/L
Molybdenum (Mo)	200 mg/L
Nickel (Ni)	200 mg/L
Selenium (Se)	200 mg/L
Zinc (Zn)	200 mg/L
Calcium (Ca)	1000 mg/L
Iron (Fe)	2000 mg/L
Magnesium (Mg)	1000 mg/L
Potassium (k)	1000 mg/L
Sodium (Na)	1000 mg/L

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6.5.3 Sn Soil Calibration stock solution in 20% HCL. This standard is made up in-house from the single element tin solution (Section 6.5.12), or equivalent NIST certified solution. To a 200-mL class A volumetric add a small portion of reagent water, 40 mL of concentrated HCl, and 8.0 mL of single element tin solution. This standard contains the following element:

ELEMENT	CONCENTRATION
Tin (Sn)	40 mg/L

6.5.4 Bi Soil Calibration stock solution in 50% HNO_3. This standard is made up in house from our single element bismuth solution (Section 6.5.13), or equivalent NIST certified solution. To a 200-mL class A volumetric add a small portion of reagent water, 10 mL of concentrated HNO_3, and 40.0 mL of single element bismuth solution. This standard contains the following element:

ELEMENT	CONCENTRATION
Bismuth (Bi)	200 mg/L

6.5.5 QC26 Stock Solution in 5% HNO_3. High Purity, catalog #QCS-26, or equivalent. This standard contains the following elements:

ELEMENT	CONCENTRATION
Sb, As, Be, Cd, Ca, Cr, Co, Cu, Fe, Pb, Mg, Mn, Mo, Ni, Se, Tl, Ti, V, Zn, Al, Ba, B, Si, Ag, and Na.	all at 100 mg/L
K	at 1000 mg/L

6.5.6 Scandium Stock Standard (1000 ppm) in 2% HNO_3. CPI, catalog #4400-1000481, or equivalent NIST certified standard.

6.5.7 INTER18 (Solution A) in 5% HNO_3. CPI, catalog #4400-INTR18-100 - Solution A, or equivalent NIST certified standard. This standard contains the following elements:

ELEMENT	CONCENTRATION

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K	20000 mg/L
Se	500 mg/L
As, Pb, Tl	1000 mg/L
Ba, Cd, Cr, Co, Cu, Ni, V, Zn,	300 mg/L
Mn	200 mg/L
Be	100 mg/L
Hg	50 mg/L

6.5.8 INTR18 (Solution B) in 5% HNO_3. CPI, catalog #4400-INTR18-100 – Solution B, or equivalent NIST certified standard. This standard contains the following elements:

ELEMENT	CONCENTRATION
Ag	300 mg/L

6.5.9 INTER5 in 2% HNO_3. CPI, catalog #4400-INTR5-500, or equivalent.

ELEMENT	CONCENTRATION
Al	1200 mg/L
Ca	6000 mg/L
Fe	5000 mg/L
Mg	3000 mg/L
Na	1000 mg/L

6.5.10 Cesium Chloride (100%). VWR catalog #4042-02, or equivalent NIST certified standard.

6.5.11 Strontium Stock Standard (1000 ppm) in 4% HNO_3. SCP, catalog #140-051-382, or equivalent NIST certified standard.

6.5.12 Tin Stock Standard (1000 ppm) in 20% HCl. SCP, catalog #140-052-502, or equivalent NIST certified standard.

6.5.13 Bismuth Stock Standard (1000 ppm) in 4% HNO_3. SCP, catalog #140-051-832, or equivalent NIST certified standard.

6.5.14 Silver Stock Standard (1000 ppm) in 4% HNO_3. SCP catalog #140-051-472, or equivalent NIST certified standard.

6.5.15 Aluminum Stock Standard (1000 ppm) in 4% HNO_3. SCP catalog #140-051-132, or equivalent NIST certified standard.

6.5.16 Arsenic Stock Standard (1000 ppm) in 4% HNO_3. SCP catalog #140-051-332, or equivalent NIST certified standard.

6.5.17 Barium Stock Standard (1000 ppm) in 4% HNO_3. SCP catalog #140-051-562, or

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equivalent NIST certified standard.

6.5.18 Beryllium Stock Standard (1000 ppm) in 4% HNO_3. SCP catalog #140-051-042, or equivalent NIST certified standard.

6.5.19 Calcium Stock Standard (1000 ppm) in 4% HNO_3. SCP catalog #140-051-202, or equivalent NIST certified standard.

6.5.20 Cadmium Stock Standard (1000 ppm) in 4% HNO_3. SCP catalog #140-051-482, or equivalent NIST certified standard.

6.5.21 Cobalt Stock Standard (1000 ppm) in 4% HNO_3. SCP catalog #140-051-272, or equivalent NIST certified standard.

6.5.22 Chromium Stock Standard (1000 ppm) in 4% HNO_3. SCP catalog #140-051-242, or equivalent NIST certified standard.

6.5.23 Copper Stock Standard (1000 ppm) in 4% HNO_3. SCP catalog #140-051-292, or equivalent NIST certified standard.

6.5.24 Iron Stock Standard (1000 ppm) in 4% HNO_3. SCP catalog #140-051-262, or equivalent NIST certified standard.

6.5.25 Magnesium Stock Standard (1000 ppm) in 4% HNO_3. SCP catalog #140-051-122, or equivalent NIST certified standard.

6.5.26 Manganese Stock Standard (1000 ppm) in 4% HNO_3. SCP catalog #140-051-252, or equivalent NIST certified standard.

6.5.27 Molybdenum Stock Standard (1000 ppm) in H_2O. SCP catalog #140-050-422, or equivalent NIST certified standard.

6.5.28 Nickel Stock Standard (1000 ppm) in 4% HNO_3. SCP catalog #140-051-282, or equivalent NIST certified standard.

6.5.29 Lead Stock Standard (1000 ppm) in 4% HNO_3. SCP catalog #140-051-822, or equivalent NIST certified standard.

6.5.30 Selenium Stock Standard (1000 ppm) in 4% HNO_3. SCP catalog #140-051-342, or equivalent NIST certified standard.

6.5.31 Titanium Stock Standard (1000 ppm) in H_2O/Trace HF. SCP catalog #140-050-222, or equivalent NIST certified standard.

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6.5.32 Thallium Stock Standard (1000 ppm) in 4% HNO_3. SCP catalog #140-051-812, or equivalent NIST certified standard.

6.5.33 Vanadium Stock Standard (1000 ppm) in 4% HNO_3. SCP catalog #140-051-232, or equivalent NIST certified standard.

6.5.34 Zinc Stock Standard (1000 ppm) in 4% HNO_3. SCP catalog #140-051-302, or equivalent NIST certified standard.

6.5.35 Antimony Stock Standard (1000 ppm) in 4% HNO_3. SCP catalog #140-051-512, or equivalent NIST certified standard.

6.5.36 Boron Stock Standard (1000 ppm) in H_2O. SCP catalog #140-050-052, or equivalent NIST certified standard.

6.6 Working Standard Solutions. Prepare in an acid matrix similar to the samples being analyzed. This is most often a 10% HNO_3 matrix, but is dependent on the type of digestion performed on the samples, and shall be adjusted to match the samples being analyzed. After preparation, each standard is assigned a unique log number and is recorded in the standard preparation logbook along with the stock solution used, the concentration of that stock, the volume used, the final volume, the matrix, the date prepared, the date it will expire, and the preparer.

6.6.1 Calibration Reagent Blank (< detection limit (DL)). To 1000-mL volumetric flask, add 100 mL HNO_3 (or that which matches the samples) and bring up to volume using reagent water. Transfer to a labeled polyethylene bottle. The reagent blank is stable for 3 months when stored at room temperature.

NOTE: All calibrations that involve the analysis of samples for the Dept. of Defense (**DoD**) must have a reagent blank concentration less than 2x the method detection limit for each analyte.

6.6.2 **S1**. To a 25-mL calibration vessel, add 1 mL of S4 to a total volume of 20 mL, using reagent blank. The formulation of this standard must be documented in the Iris analysis logbook. This standard must be prepared daily, held at room temperature, and is stable for no longer than 24 hours.

6.6.3 **S2**. To a 25-mL calibration vessel, add 2 mL of S4 to a total volume of 20 mL, using reagent blank. The formulation of this standard must be documented in the Iris analysis logbook. This standard must be prepared daily, held at room temperature, and is stable for no longer than 24 hours.

6.6.4 **S3**. To a 25-mL calibration vessel, add 4 mL of S4 to a total volume of 20 mL, using reagent blank. The formulation of this standard must be documented in the

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Iris analysis logbook. This standard must be prepared daily, held at room temperature, and is stable for no longer than 24 hours.

6.6.5 **S4**. (High Calibration Standard) To a 100-mL volumetric flask containing 10 mL HNO_3 (or that which matches the sample) in reagent water, add 5 mL of the reagents in Sections 6.5.1, 6.5.2, 6.5.3, and 6.5.4. Bring up to volume using reagent water. The formulation of this standard must be documented in the IRIS Analysis logbook. This standard must be prepared daily, held at room temperature, and is stable for no longer than 24 hours.

Element	S4	S3	S2	S1
Aluminum	10	2	1	0.5
Antimony	2	0.4	0.2	-
Arsenic	2	0.4	0.2	0.1
Barium	10	2	1	0.5
Beryllium	2	0.4	0.2	0.1
Bismuth	10	2	1	0.5
Boron	10	2	1	0.5
Cadmium	1	0.2	0.1	-
Calcium 1840	-	10	5	2.5
Calcium 3179	50	10	5	2.5
Chromium	1	0.2	0.1	0.05
Cobalt	-	2	1	0.5
Copper	10	2	1	-
Iron 3719	100	20	10	5
Lead	10	2	1	0.5
Magnesium	50	10	5	2.5
Manganese	1	0.2	0.1	0.05
Molybdenum	10	2	1	0.5
Nickel	-	2	1	0.5
Potassium	50	10	5	2.5
Selenium	10	2	1	0.5
Silver	1	0.2	0.1	0.05
Sodium	50	10	5	-
Strontium	1	0.2	0.1	0.05
Thallium	5	1	0.5	0.25
Tin	2	0.4	0.2	-
Titanium	1	0.2	0.1	-
Vanadium	1	0.2	0.1	0.05
Zinc	10	2	1	0.5

6.6.6 Initial Calibration Verification Standard QC26. To a 100-mL volumetric flask containing 10 mL HNO_3 (or that which matches the sample) in reagent water, add 1 mL QC26 Stock Solution (Section 6.5.5), 0.1 mL Strontium stock standard (Section 6.5.11), 0.1 mL Tin stock standard (Section 6.5.12), and 0.1 mL Bismuth

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stock standard (Section 6.5.13). Bring up to volume using reagent water. This standard needs be made on a daily basis, held at room temperature, and is stable for no longer than 24 hours.

6.6.7 Working Interference Check Solution (ICSAB). To a 1000-mL volumetric flask containing 50 mL HNO_3 and 50 mL HCL (or that which matches the sample) in reagent water, add 2.5 mL INTER18 Stock Solution A (Section 6.5.7), 2.5 mL INTER18 Stock Solution B (Section 6.5.8), and 25 mL INTER5 Stock Solution (Section 6.5.9). Bring up to volume using reagent water. Transfer to a labeled polyethylene bottle. Working standard solutions are stable for 90 days, when stored at room temperature.

ELEMENT	CONCENTRATION
Ag	0.75 mg/L
Al	30 mg/L
As	2.5 mg/L
Ba	0.75 mg/L
Be	0.25 mg/L
Ca	150 mg/L
Cd	0.75 mg/L
Co	0.75 mg/L
Cr	0.75 mg/L
Cu	0.75 mg/L
Fe	125 mg/L
Mg	75 mg/L
Mn	0.25 mg/L
Ni	0.75 mg/L
Tl	2.5 mg/L
V	0.75 mg/L
Zn	0.75 mg/L
Pb	2.5 mg/L
Se	1.25 mg/L
Na	25 mg/L
K	25 mg/L

6.6.8 Working Interference Check Solution (ICSA). To a 1000-µL volumetric flask containing 50 mL HNO_3 and 50 mL HCl in reagent water, add 50 mL INTER5 Stock Solution. Bring up to volume using reagent water. Transfer to a labeled polyethylene bottle. Working Solution is stable for 90 days when stored at room temperature.

ELEMENT	CONCENTRATION
Al	60 mg/L
Ca	300 mg/L
Fe	250 mg/L
Mg	150 mg/L
Na	50 mg/L

6.7 Rinse Solution. To the rinse reservoir containing reagent water, add 300 mL HNO_3 (or

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that which matches the samples). Bring up to volume (3 L) using reagent water. Prepare as needed and hold at room temperature.

6.8 Working Internal Standard Solution (10.0 mg/L Sc). To a 2000-mL volumetric flask containing 40 mL HNO_3 in reagent water, add 20 mL of Scandium Stock Solution (Section 6.5.6) and 50 g cesium chloride (Section 6.5.10). Bring up to volume using reagent water. Transfer to a labeled polyethylene bottle. Working standard solutions are stable for 90 days when stored at room temperature.

6.9 Continuing Calibration Verification Solution (CCV). To a 25-mL polyethylene analysis tube, add 10 mL of 10% HNO_3 reagent blank (or that which matches the sample), and 10 mL of High Calibration Standard (S4) (Section 6.6.5). Bring up to volume using reagent water. This working calibration standard shall be prepared daily with every analysis calibration and held at room temperature. The standard is stable for no longer than 24 hours and contains the following elements:

ELEMENT	CONCENTRATION (mg/L)
Ag	0.50
Al	5.00
As	1.00
B	5.00
Ba	5.00
Be	1.00
Bi	5.00
Ca	25.0
Cd	0.50
Co	5.00
Cr	0.50
Cu	5.00
Fe	50.0
K	25.0
Li	5.00
Mg	25.0
Mn	0.50
Mo	5.00
Na	25.0
Ni	5.00
Pb	5.00
Sb	1.00
Se	5.00
Sn	1.00
Sr	0.50
Ti	0.50
Tl	2.50
V	0.50
Zn	5.00

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6.10 Report Limit Standard (RPL / CRI) is prepared by adding the following amounts of single element standards to a 200-mL volumetric flask containing 5 mL conc. HNO_3. This working standard is stable for three months when stored at room temperature.

ELEMENT	Volume of 1000 ppm Single Element Solution in 200 mL.	Final Concentration mg/L.
Aluminum	4.0 mL	20
Antimony	0.8 mL	4.0
Arsenic	0.8 mL	4.0
Barium	0.4 mL	2.0
Beryllium	0.4 mL	2.0
Bismuth	2.0 mL	10.0
Boron	4.0 mL	20.0
Cadmium	0.2 mL	1.0
Calcium	4.0 mL	20.0
Chromium	0.4 mL	2.0
Cobalt	0.4 mL	2.0
Copper	0.8 mL	4.0
Iron	4.0 mL	20.0
Lead	0.4 mL	2.0
Magnesium	4.0 mL	20.0
Manganese	0.4 mL	2.0
Molybdenum	0.8 mL	4.0
Selenium	2.0 mL	10.0
Silver	.20 mL	1.0
Nickel	0.8 mL	4.0
Tin	2.0 mL	10.0
Strontium	0.4 mL	2.0
Titanium	0.8 mL	4.0
Thallium	1.2 mL	6.0
Vanadium	0.4 mL	2.0
Zinc	0.8 mL	4.0
Potassium	20.0 mL	100.0
Sodium	20.0 mL	100.0

7 Instrument Calibration

7.1 Immediately preceding calibration, the subarray of each spectral line must be centered. Maintaining this optical alignment during operation is called auto peak adjust.

7.1.1 To do an auto peak adjust, place the sample probe into the highest standard in your calibration for the method that is to be run. The standard must contain all of the analytes in that method.

7.1.2 Click on the instrument pull-down menu, and then click on auto peak adjust. A box will pop up. Highlight *all lines* and click run. This will run through a series of reads. Once the reads are complete, click OK.

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7.1.3 With the sample probe still in the high standard, click the run unknown icon (icon with a "?"). A box will pop up. Click run and the instrument will run the standard as a sample. Once the reads are complete, the data will be displayed on the screen.

7.1.4 Double-click on the first element displayed on the screen and a graphic of the subarray will appear for that element, along with a list of the elements also in the method. Check that the subarray is centered within the peak. The width of the subarray can be either a value of 2 or 3. This can be changed to center the subarray. Once the first element is centered, click on the next element in the list and repeat the process.

7.2 The instrument prepares a daily standard curve by analyzing four levels of calibration standards and a calibration blank. Starting with the blank and working toward the high standard, the standards are aspirated and emission intensity readings are recorded.

7.3 All calibration standards are analyzed in duplicate and an average intensity to internal standard ratio is reported and used by the data system to prepare the calibration curve.

NOTE: For all analysis runs involving samples from The Dept. of Defense **(DoD)**, triplicate exposures are required.

7.4 A calibration curve is created by plotting the average emission intensity readings on the y-axis and concentration readings on the x-axis. The software of the data system plots the curve in a linear configuration. The calibration curve occurring most immediately preceding a particular sample is used to calculate the concentration for that sample.

7.4.1 When the instrument has finished running the calibration points, it automatically calculates the correlation coefficients for each analyte. The analyst must check these coefficients prior to running QC standards. If the correlation coefficients are not 0.995 or better, the instrument must be recalibrated.

7.5 The calibration curve is validated using instrument check solutions prepared at known concentrations from a different source than that of the calibration standards. Validation occurs immediately following calibration and then at a frequency of 10% throughout the analysis run.

8 Quality Control

8.1 Initial demonstration of performance

8.1.1 Linear Dynamic Range (LDR) - The upper limit of linearity must be established for each element being analyzed. Analyze succeeding higher concentrations of

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the analyte until the percent recovery falls under 90%. The last concentration maintaining greater or equal to 90% recovery is considered the upper limit of linearity. Samples containing analytes greater than 90% of the upper limit of linearity must be diluted and reanalyzed for those analytes. The LDRs are verified every six months or any time a change in operating conditions occurs that may change the LDR.

NOTE: When analyzing samples from **DoD** (Dept. of Defense), the upper linearities must be verified in every analytical run. A verification standard can be analyzed either before or after the DoD samples in your analysis run. If the analyte recoveries are within 10% of their known value, the upper linear ranges can be used. Otherwise, all samples must be diluted to analyte concentrations that fall within the calibration curve.

8.1.2 Method Detection Limits (MDL) – MDL studies must be performed and verified according to SOP 99-MDL or the referenced method, whichever is more frequent, or any time a change in operating conditions occurs that may change the MDL (reference 99-MDL). Dept. of Defense (**DoD**) sample analysis requires annual performance of MDL studies followed by an MDL Verification Check Standard analyzed at 2X the MDL. If the MDL verification standard is not recovered within at least 3X the instrument's noise level, a new MDL verification standard will be analyzed at a higher concentration. Once the MDL levels have been established, the Lower Quantitation Limits / Reporting Limits (RPL) can be set. The RPL shall be at least 3X the MDL.

8.1.2.1 MDL levels are instrument specific. If the TJA IRIS is not available for analysis, the TJA TRACE ICP serves as the backup instrument. The MDL reporting levels must then be modified to match those of the TRACE.

8.1.3 Demonstration of Capability (DOC)

8.1.3.1 Analysts must perform DOCs prior to performing this method.

8.1.3.2 Ongoing proficiency must be established annually as part of the QA Plan, Technical Training, and any time there is a significant change in the analysis procedure. This demonstration can be a part of the analysis of proficiency testing materials or quality control samples associated with routine sample runs.

8.1.3.3 Individual training records must be updated as these DOCs and recertifications are performed and approved.

8.1.3.4 DOCs are prepared as four separate laboratory control samples, and the

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involved batch has all of the necessary QC. The DOCs are analyzed, and the data is placed into an analytical spreadsheet. The analyte recoveries must be within the method requirements of 80-120%, and their relative percent difference must be less than or equal to 10%, 75% of the time. If the DOC recoveries fall outside these method requirements, the analyst must repeat the study until he/she is deemed proficient.

8.1.4 Inter-element correction factors must be verified and updated every six months or at any time a change in instrument operating conditions occurs which may change the inter-element correction requirements.

8.1.4.1 The IECs are calculated while performing the bi-yearly linear dynamic ranges (Section 8.1.1). When the upper limit for each analyte is established, the recovery effects on the remaining analytes must be updated. Any effect, whether positive or negative the analyte detection limit, must be corrected in the method IEC table. The IEC correction is calculated by dividing the affected analytes recovery by the concentration of the linear range standard being analyzed. The resulting correction must then be manually added or subtracted to the existing IEC. (ex. An upper limit is established for Fe at 900 ppm. The Pb recovery is -0.006 ppm when Fe is 900 ppm. Since the Pb reporting limit is 0.005 ppm, the IEC is in need of correction. The -0.006 ppm result is divided by 900 yielding a correction factor of -0.000000666.)

8.1.5 Prior to performing analysis on NELAP samples (IH), analysts will have read through the latest A2LA lead requirements, and have demonstrated ability to produce reliable results through accurate analysis of standard reference material (i.e. PAT rounds or ELPAT studies), or in-house quality control samples. Their performance must be documented in their training records.

8.1.6 Analysts/Technicians involved in IH Lead analysis shall re-demonstrate their ability to adequately analyze certified reference materials (i.e. PAT rounds or ELPAT studies), on a quarterly basis. Their performance may be used in their training records.

8.1.7 Instrument Detection Limit (IDL). The IDLs for the IRIS will be performed quarterly. This study is performed following a standard calibration, and includes analyzing ten calibration blanks on three non-consecutive days. Each measurement must be performed as though it were a separate analytical sample. (i.e., each measurement must be followed by a rinse and/or any other procedure normally performed between the analyses of separate samples. The IDL responses are then manually entered off the raw data into an excel spreadsheet which then calculates the Standard Deviation. This number shall then be used as a starting point for setting up your MDL standards. (NOTE: The IDL limits shall

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be less than the MDL limits. If they are not, the IDL and MDL studies must be reviewed for errors, and redone if necessary.)

8.2 Daily demonstration of instrument performance

8.2.1 Quality Control Sample (QC26) - Initial and periodic verification of calibration standards is necessary to verify instrument performance. To verify the calibration standards, the Working Quality Control Sample QC26 must be within ± 10% of the true value immediately following the daily calibration. If outside of this acceptable range for target elements, the problem must be corrected by re-analysis, preparation, recalibration, or instrument maintenance. Samples may not be analyzed until the problem has been corrected and a second source metals have been recovered within their acceptable range.

8.2.2 A laboratory method blank (MB) is prepared with every batch of samples or one per every 20 samples digested, if the batch contains more than 20 samples. If the method blank concentration is greater than or equal to the reporting limit AND is greater than $^{1}/_{10}$ the sample concentration, the source of contamination must be investigated and measures taken to minimize or eliminate the problem and affected samples reanalyzed. If reanalysis is not possible, data shall be reported with a qualifying statement.

NOTE: For **DoD** samples: If the method blank concentration is greater than or equal to ½ the reporting limit AND is greater than $^{1}/_{10}$ the sample concentration, the source of contamination must be investigated and measures taken to minimize or eliminate the problem and affected samples reanalyzed. If reanalysis is not possible, data shall be reported with a qualifying statement.

8.2.3 A laboratory fortified blank (LFB/LCS) is processed with every batch of samples, or one every 20 samples if the batch contains more than 20 samples. The LFB must be subjected to all sample preparation steps, such as digestion if necessary. The percent recovery must be 80-120% of the true spike value. If the recovery falls outside of the acceptable range, the LFB may be reanalyzed one time. If the recovery is still outside acceptable limits, the source of the problem shall be identified and resolved. All associated project samples need to be redigested and reanalyzed.

NOTE: Sample results are not to be reported until their associated LFB is found to be within acceptable control limits. LFB results are documented in the ALSI LIMS system.

8.2.3.1 To prepare a laboratory fortified blank while analyzing samples which do not require digestion, add 1.0 mL of SCP P/N 901-6A5-800 Stock Solution, 1.0 mL of Sn calibration Standard, and 0.5 mL of each bottle of

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SCP P/N 901-6A5-803, and Bi calibration standard Stock Solution to 100 mL of sample. This will result in a mid-level concentration for the LFB.

8.2.3.2 Calculating LCS Recoveries:

% Recovery = $(C_m/C_n) \times 100$
where: C_m = measured concentration of LCS
C_n = spiking concentration

8.2.4 Reporting Limit Standard (CRI / RPL). A standard spiked at the reporting limit of each element must be analyzed to verify accuracy. Recoveries must be within ± 50% of the true value. If recoveries fall outside of this range the source of the problem shall be identified and resolved before continuing analyses. See Section 6 for formulation of this standard.

NOTE: When analyzing samples from the **DoD**, the Reporting Limit Standard must be recovered within ± 30%

8.2.5 Instrument Performance Check Solution (IPC) is analyzed following the calibration, after every 10 samples and at the end of the run. The results of the analytes in the check solution immediately following calibration must be within ± 10% of the true value with <5% RSD between replicates. Subsequent analyses of the IPC solution must be within ± 10% of the true value. If the result falls outside of this range for any element, the IPC may be rerun for that element. If the results still fall outside of this range, the problem must be corrected by reprofiling, preparation of new IPC, recalibration, or instrument maintenance. Samples following the last acceptable IPC requiring the elements that failed must be reanalyzed after correction of the problem and successful analysis of the IPC. All results of IPCs are documented in the ALSI LIM system.

8.2.6 The Working Interference Check Solutions (ICSA and ICSAB) are analyzed to provide an adequate test of the inter-element and background correction factors. They must be analyzed at the beginning and end of an analytical run or twice during every 8-hour shift, whichever is more frequent. Standard ICSA (see 6.6.8) contains only Al, Ca, Fe, Mg, and Na. These are considered to be the main interferences on the ICP. When analyzing the ICSA, the interferent metals must be recovered within 20% of there true value. All other non-spiked target metals must have a concentration less <2 x the MDL. If the results fall outside of this range, the interference check solution may be rerun. If it is still outside this range for any element, the problem must be corrected by preparation of new working interference solution, recalibration, or adjustment of inter-element and background correction factors. Any sample requiring an element that fails must be rerun for that element after the problem had been corrected and the interference check successfully meets the criteria.

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8.2.6.1 Standard ICSAB contains all or most of the target analytes and the interferences at known and detectable values. The result must be within ± 20% of the true value. If the results fall outside of this range, the interference check solution may be rerun. If it is still outside this range for any element, the problem must be corrected by preparation of new working interference solution, recalibration, or adjustment of inter-element and background correction factors. Any sample requiring an element that fails must be rerun for that element after the problem had been corrected and the interference check successfully meets the criteria.

8.2.7 Calibration blanks are analyzed directly after each IPC. The result for every element being analyzed must be less than 2x the MDL. If the result does not meet this requirement for any element, the calibration blank may be rerun for that element. If the result is still not acceptable, the problem must be corrected by preparation of new blank, recalibration, or instrument maintenance. Samples following the last acceptable calibration blank requiring the elements that failed must be reanalyzed after correction of the problem and successful analysis of the calibration blank. If reanalysis is not possible, data shall be reported with a qualifying statement.

NOTE: For analysis runs involving samples from The Dept. of Defense (**DoD**), the calibration blanks must have analyte concentrations less than 2x the MDL. Otherwise, the source of the contamination must be investigated, and measures taken to minimize or eliminate the problem before the samples can be reanalyzed. If reanalysis is not possible, data shall be reported with a qualifying statement.

8.3 Daily demonstration of data quality

8.3.1 A matrix spike sample is processed at a frequency of 10% of the routine samples. The percent recovery must be 75-125% of the true spike value. Recovery calculations are not required if the concentration of the spike added is greater than ten times the sample background and a comment must be placed on the lab report. If the recovery falls outside of the acceptable range, and the system is found to be in control, the recovery problem is judged to be matrix related and not system related. To determine if the method of standard additions is necessary, the sample must be post spiked or diluted as described below. Results of all matrix spikes are documented in the ALSI LIM system.

NOTE: When analyzing samples from the Dept. of Defense (**DoD**) the matrix spike must be recovered at 80-120% of the true spiked value.

% Recovery = MS recovery – Sample / Actual Spike Concentration x 100

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8.3.2 Analyte Addition Test. To prepare a post spike, add an amount of high standard that will produce a minimum level of 20x and a maximum level of 100x the MDL and analyze. The percent recovery must be 75-125% of the true value as determined by the following formula. If the result is outside of this range, make successive dilutions of the sample and re-spike until the recovery falls within this range. The reporting limit of the sample must then be raised to reflect the dilution used. If this raises the reporting limit higher than the client needs, the method of standard additions shall be performed. NOTE: If the analyte concentration is greater than ten times the matrix spike concentration, post-spikes are not required, but a comment must be added to the lab report ("NSC").

$$A = \frac{B - (\frac{E}{F})(C)}{(\frac{E}{F})(D)} \times 100$$

where:
A = Post spike percent recovery
B = Resulting spike concentration
C = Sample concentration
D = Working calibration standard concentration
E = Amount of spike added (mL)
F = Final volume spike solution + sample

NOTE: When analyzing samples from the Dept. of Defense (**DoD**) the post digestion spikes must be recovered at 80-120% of the true spiked value.

8.3.3 Dilution Test. If (100 x MDL) <20% of the sample concentration, prepare a $^1/_5$ dilution on the sample and reanalyze. The resulting corrected concentration shall be within ± 10% of the original sample concentration. If not, a matrix effect shall be suspected, and the sample diluted until the matrix problem has been eliminated. If this raises the reporting limit higher than the client needs, the method of standard additions shall be performed.

8.3.3.1 Dilution Test for DoD QSM samples – A $^1/_5$ serial dilution test is required with every preparation batch or whenever a new or unusual matrix is encountered. All analytes with a concentration >50x the MDL must be recovered within 10% of the straight analysis. If the recoveries are outside this range, a post digestion spike must be performed. The post digestion spike must be recovered within 25% of the true value. If the post digestion spike is recovered outside 25%, the sample must be diluted and post spiked at that dilution as well. This process will continue until an acceptable post spike recovery is obtained. The detection limit on the sample will than be raised to reflect the dilution.

8.3.4 A matrix spike duplicate or sample duplicate is processed at a frequency of 5% of

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the routine samples or 10% of all North Carolina samples. The relative percent difference (RPD) must be within 20%. If the RPD falls outside of the acceptable range, and the system is found to be in control, the precision problem is judged to be matrix related and not system related. A comment must be added to the lab report. Results of all duplicate analyses are documented in the ALSI LIMS.

RPD (Relative Percent Difference) = Difference / Average X 100

8.4 Method of Standard Additions - The method of standard additions is used when sample dilution and spikes fail to produce good recoveries. In the standard addition technique, two identical aliquots (Volume Vx) of the sample solution are taken. To the first, (labeled A), is added a small a volume (Vs) of a standard analyte solution of concentration Cs. To the second (labeled B), is added the same volume Vs of the matrix blank. The intensity counts of A and B are measured and corrected for non-analyte intensity counts. The unknown sample concentration (Cx) is calculated as follows:

$$Cx = \frac{S_B\, V_S\, C_S}{(S_A - S_B)\, V_X}$$

where:

S_A = intensity counts of A corrected for the blank
S_B = intensity counts of B corrected for the blank

Vs and Cs shall be chosen so that S_A is roughly twice S_B on the average. It is best if Vs is much less than Vx, and thus Cs is much greater than Cx, to avoid excess dilution of the sample matrix. If a concentration or separation step is used, the additions are best made first and carried through the entire procedure. For results from this technique to be valid, the following limitations must be taken into consideration:

8.4.1 The analytical curve must be linear.

8.4.2 The chemical form of the analyte added must respond the same as the analyte in the sample.

8.4.3 The interference effect must be constant over the working range of concern.

8.4.4 The signal must be corrected for any additive interference.

8.5 Samples resulting in high negative (|conc.| > reporting limit) concentrations must be post-spiked to determine if there exists a negative interference. If multiple samples containing the same matrix (from the same source or client) show the same negative trend, only one sample of this matrix needs to be post-spiked.

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8.6 When analyzing using a scandium internal standard, the intensity of scandium in each sample must be within ± 30% of the intensities in the initial calibration blank. If the intensities fall outside of this range, re-analyze the sample at a dilution to eliminate matrix interferences.

8.7 Each sample, QC check, and calibration standard is analyzed in duplicate and the results averaged. The relative standard deviation (RSD) between sample replicates must be less than 20% for all concentrations greater than the reporting limit to be accepted. If the RSD is greater than 20% and the sample concentration is above the reporting limit, the sample must be reanalyzed.

NOTE: When analyzing samples from the Dept. of Defense (**DoD**), three replicates are required for all standards, samples, and QC checks.

8.8 It is recommended that whenever a new or unusual sample matrix is encountered, either of the following tests be performed to determine if either positive or negative matrix interferences are present to distort the accuracy of the reported values.

8.8.1 Serial dilution. If the analyte concentration is at least 40x the detection limit, a 1:4 dilution shall agree within ± 10% of the original determination. If not, a chemical or physical interference shall be suspected and must either be diluted out and the detection level raised or the sample may be analyzed by the method of standard addition.

8.8.2 Post digestion spike. A post digestion spike prepared as directed in Section 8.3.2, shall be recovered within 75-125% of the true value. If the spike is not recovered and the necessary sample dilution to recover the analyte concerned raises the detection limit of the sample above the limit needed by the client, the method of standard additions must be used.

8.9 ALSI participates regularly in applicable performance evaluation studies conducted by various certifying organizations.

8.10 All policies and procedures in the most current revision of the ALSI QA Plan shall be followed when performing this procedure.

8.11 All mechanical pipettes used in this digestion process must be calibrated annually to verify the entire range of use. Select four to five settings throughout the pipette range, and perform a full calibration at each setting. This calibration data must be recorded in the metals autopipette calibration logbook. See 09-AP SOP for calibration procedure.

8.11.1 A single setting pipette calibration is also required on a weekly basis to verify dispensing volumes. Select a mid-range volume to perform this calibration, and

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be sure to document the procedure in the metals autopipette logbook. See 09-AP SOP for calibration procedure.

8.12 The ALSI Lab I.D. number of all mechanical pipettes used in this analysis process must be documented in the analysis logbook or the IRIS Run Case Narrative.

8.13 Quality Control Requirements

(Specific Project Requirements may override these requirements)

Parameter	**Concentration**	**Frequency**	**Control Limits**	**Corrective Action**
Calibration Blank	--	Beginning of run, after every 10 samples, and at the end of the run.	< 2.2 x MDL < 2X the MDL for runs involving samples from the Dept. of Defense (**DoD**)	Reanalyze the blank, prepare new blank and analyze, perform maintenance on instrument, recalibrate, reanalyze any samples since the last acceptable blank. If reanalysis is not possible, report with a qualifying comment.
Method Blank (LRB)	--	One per batch of no more than 20 samples. Analyze with associated sample batch.	<Reporting Limit or < ½ reporting limit for **DoD** QSM samples	Reanalyze the blank. Samples in the batch must be < the reporting limit or ≥ 10x the method blank. If not, samples must be redigested and reanalyzed. If reanalysis is not possible, report with a qualifying comment.
High Calibration Standard	See Section 6.6.5	After calibration and before analysis of samples.	90-110%	Reanalyze the High Standard. If the standard is still not acceptable, perform instrument maintenance, and prepare a new calibration.
**Laboratory Fortified Blank (LCS)	Listed in Table 3	One per batch of no more than 20 samples. Analyze with associated sample batch.	80-120%	Reanalyze the LCS. If still outside of acceptable range, samples must be redigested and reanalyzed. If reanalysis is not possible, report with a qualifying comment.
Quality Control Sample (QC26)	1.0 mg/L	Immediately after calibration.	90-110%	Reanalyze the QCS. If the standard is still not acceptable, perform instrument maintenance, and prepare a new calibration.
Instrument Performance Check Solution (IPC) (CCV) Same Source	See Section 6.9	Beginning of run, after every 10 samples, and at the end of the run.	90-110%	Reanalyze the IPC. If the standard is still not acceptable, perform instrument maintenance, and prepare a new calibration. Reanalyze any samples since the last acceptable IPC. If reanalysis is not possible, report with a qualifying comment.
Reporting Limit Standard	Listed in Table	Beginning of run,	50-150%	Reanalyze the RPL. If the standard is still

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(RPL)	2	after calibration.	**DoD:** *(70-130%)*	not acceptable, recalibrate.
* Matrix Spike (MS)	Listed in Table 3	One every 10 samples with at least one per batch.	75-125% **DoD:** (*80-120%)*	Post Spike the sample for the failing analyte. If the post spike recovery is outside of the acceptable 75-125% limit, the sample will need to be analyzed at a 1:1 dilution and post spiked at a 1:1 dilution. If the post spike recovery is still outside acceptable limits, the sample will need to be further diluted and post spiked until an acceptable recovery has been reached. Report the results with a qualifying comment. If the matrix interference is identified, and the batch LCS was recovered within acceptable limits, report with a qualifying statement. (example: The sample in question contains % level iron.)
*Duplicate or matrix spike duplicate (MSD)	--	One every 10 samples with at least one per batch.	RPD ≤ 20%	Reanalyze the duplicate. If the RPD is still >20% or if reanalysis is not possible, report the results with a qualifying comment.
Sample replicates	--	Every sample	RSD < 20% for all samples > reporting limit	Reanalyze the sample. If the RSD is still > 20% check to see if the relative percent difference of the four obtained exposures is less than 20%. If so, average the four exposures, and report the result with a qualifying comment. If the RPD is greater than 20%, reanalyze the sample a third time, and average all six exposures. Report the results with a qualifying comment.
Samples with high negative concentration	--	--	|conc.| < reporting limit	Post-spike sample to determine if there exists a negative interference. If multiple samples containing the same matrix (from the same source or client) show the same negative trend, only one sample of this matrix needs to be post-spiked.
Scandium Internal Standard	--	Every sample	Intensity must be within 30% of the intensity of the initial calibration blank	Reanalyze the sample at a dilution to eliminate sample matrix interference.

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Interference Check Solution	See Section 6.6.7	Beginning and end of every run, or every 8 hours.	80-120%	Rerun the interference check solution, prep of new solution, recalibrate, or adjustment of inter-element correction factors. Rerun any samples requiring an element that fails, or if re-analysis is not possible, report the results with a qualifying comment.
Interference Check Solution (ICSA)	See Section 6.6.8	Beginning and end of every run, and at least once every 8 hours.	80-120% for all interference analytes, and <2x the MDL for all non-spiked analytes	Rerun the interference check solution, preparation of new solution, recalibrate, or adjustment of inter-element correction factors. Rerun any samples requiring an element that fails, or if re-analysis is not possible, report the results with a qualifying comment

* Samples selected for duplicate and matrix spike analysis shall be rotated among client samples so that various matrix problems may be noted and/or addressed. Poor performance in a duplicate or spike may indicate a problem with the sample composition and shall be reported to the client whose sample produced the poor recovery.

** LCS recoveries and duplicate precision limits stated in the QC Chart are also used for all IH analyses.

9 Sample Collection, Preservation and Handling

9.1 Samples must be collected in plastic or glass containers. A minimum of 3.00 g for soil samples, and 150 mL for water samples must be supplied by the sampler in order for the laboratory to perform analysis.

9.2 Preserve aqueous samples using HNO_3 to a pH<2. Sample preservation shall be performed immediately upon sample collection. If this is not possible, then samples shall be preserved ASAP when received by the laboratory. Water samples and sample digestates shall be stored at room temperature both before and after analysis. Soil samples must be preserved above the freezing point of water up to 6°C until analysis.

NOTE: Aqueous samples that arrive to the lab in an unpreserved state must be acidified prior to metals analysis. The Sample Receiving Dept. checks the pH of all preserved samples that arrive at the lab. If the pH is > 2, an aliquot of nitric acid is added to the sample and shall be marked with an orange sticker on the lid. The sticker displays the time and date of the initial preservation. The pH of these samples must then be verified after 24-hours. If the pH is < 2, the sample is considered available for processing. If the pH is still > 2, additional nitric acid must be added and the pH verified < 2 after another 24-hour period. All pH readings must be documented in the Sample Receiving Preservation Log, which is found on the ALSI server in the Sample Receiving folder.

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See SOPs 19-BOTTLE and 19-Rec/Han.

9.3 All samples must be analyzed within 180 days of collection. All samples not analyzed within this time frame must be discarded and re-sampled for analysis, unless permission is given by the client to run the sample past its hold time. If this occurs, it must be clearly noted on the laboratory report.

9.4 All samples and digestates must be held by the laboratory for a minimum of two weeks after the lab reports have been sent to the client.

9.5 For samples requiring digestion, refer to the Sample Preparation SOPs for procedures.

9.6 See SOP 20-Field Services Sampling Plan for collection procedures.

10 Procedure

10.1 Initial Set-up and Analysis for the TJA IRIS ICP

10.1.1 Perform the daily and as needed maintenance.

10.1.1.1 Refill the rinse solution.

10.1.1.2 Replace the sample and rinse pump tubing.

10.1.1.3 Inspect all other autosampler tubing for clogs and/or visible leaks.

10.1.1.4 Inspect the nebulizer for clogs and position in the spray chamber.

10.1.1.5 Inspect the spray chamber for cleanliness and clean if needed.

10.1.1.6 Set the incoming Argon pressure to 60 psi.

10.1.1.7 Clean the torch and tip if needed.

10.1.1.8 Adjust the tension on the pump tubing in the peristaltic pump.

10.1.1.9 Check the reagent water level in the argon humidifier and refill if necessary.

10.1.2 Once the computer is on, double-click on the Thermospec icon. The TJA software will load after a few seconds.

10.1.3 Click on the ignite icon (it looks like a flame), and a box will appear. Click the button labeled Reset Controller. Another box will appear. Click the button

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labeled Hard Reset. This will take about twenty seconds to synchronize the instrument with the software.

10.1.4 This box will automatically disappear. Click on the ignite button and a box will appear. Click OK and the ignition process will begin. There is a ninety-second flush that will automatically take place upon the first ignition attempt.

10.1.5 Allow the instrument to become thermally stable before beginning. This requires at least 30 minutes of running while aspirating rinse solution.

10.1.6 Optimize the instrument using the High Standard Solution as described in Section 7.1. When an acceptable profile is reached, you are ready to calibrate.

10.1.7 The following parameters shall also be checked while still in Methods. When everything has been set correctly, save any changes made to the method. After checking the method settings, go to the RUN tab on the main menu, and select automated output. This is where the Analysis File Date is created. Change the default date to the current days date. If more than one analysis run is performed on the same day, the sequence date must be followed by a sequential lettering system. (ex. 11306, 11306A, 11306B……) After entering the analysis file date, go to the METHOD tab and select SAVE. After saving, go back into the METHOD tab and select print. You will be prompted to enter the analysis file date and the method name, then Press print.

Sample Analysis Type: Quantitative (Standard Analysis)
Number of Repeats: 2 (3 Replicates are required for **DoD**)
Time Delay: 0.0
Flush Time: 58.0 sec
ICAP View Selection: Line Selection
CID Max. Integration Times:
- Low Wavelength Range (axial): 40.0
- High Wavelength Range (axial): 25.0
- Low Wavelength Range (radial): 20.0
- High Wavelength Range (radial): 20.0

Include repeats: YES
Include Image: YES
Virtual File: results.dat
Export File: results.txt
Auto-inc. Samplenames: YES
Override MTD Plasma Control: NO
Auto-Store Analysis Data: Yes
Autoprint Standardization Report: Yes
Autoprint Analysis Data: Yes

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REPORT PREFERENCES
Output Mode: Concentration
Print Limits: No
Sig. Figures: YES
Blank Subtract: No
Line Switch: YES
IECs: YES
Correction Factor: 1

PLASM CONDITIONS
Auxiliary Gas: LOW
RF Power: 1150
Nebulizer Flow (LPM): 0.45
Analysis Pump Rate (rpm): 140
Flush Pump Rate (rpm): 130
Relaxation Time (sec): 0

10.1.8 After selecting, saving, and printing the required method, you will need to create an autosampler table. On the Desktop, select the Autosampler Tables icon. From the menu that appears, select "samples". A blank table will appear. To edit the table press the tab that has a picture of a test tube with a plus sign next to it. You will be prompted to enter sample names, comments, and an operator ID. You must enter the Horizon batch # off your analysis batch sheet into the comment field. Immediately following this batch #, a T or D must be typed in. The T represents samples requiring a total metals analysis, and the D represents samples requiring a dissolved metals analysis. If this T or D is not entered properly, the automatic download of data in to horizon will not function. Build the table and "save-as" the analysis file date.

10.1.9 Go back into the IRIS analysis software and open the autosampler tab. Import the autosampler file you just created by right clicking and then left clicking on the first available sample. The file that opens will default to the last file that was saved. Click OK.

10.1.10 If your standards are all in their appropriate spots, go to the RUN tab on the autosampler, and select START RUN. The instrument shall start standardizing at this time.

10.2 Analyze by the method of standard additions for any samples containing matrix interferences that cannot be eliminated by dilution.

10.3 For the inter-element spectral interference correction factors to remain valid, the interferant concentration must not exceed its limit of linearity. Sample dilution is

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necessary in these cases, and the reporting limit must be raised to reflect the dilution.

11 Calculations

11.1 Sample results are reported directly from the readout of the instrument (from the calibration curve), and input into the LIMS. Appropriate prep factors are applied to the result at the time of supervisor approval.

11.2 Any sample result requiring dilution to bring the sample into the linear range, is multiplied by the dilution factor before being entered into the LIMS using the following equation:

$$A = \frac{Z\,(B)}{C}$$

where A = concentration of element in sample
Z = concentration of element in diluted sample
B = final volume of dilution (mL)
C = volume of sample aliquot used in dilution (mL)

12 Reporting Results

12.1 Report results in the Horizon LIMS system: The IRIS Advantage is set up to automatically download analysis results in to a system called NuGenesis. The NuGenesis system reads the raw data and compiles it into a form that the Horizon LIMS system will understand. The NuGenesis files can be accessed by logging on to horizon and selecting "Autopost pipe" under OPERATIONS. A box labeled Advanced Find will appear. You must enter the Queue "META", and enter the analysis batch # off your batch sheet. (DO NOT enter the T or D after the batch number.) The sample ID's that will then appear in NuGenesis, will match the sample ID's that you typed in the autosampler table (Section 10.1.8) Therefore, if the sample ID was incorrectly entered in the autosampler table, it will be wrong in NuGenesis as well. Scroll down through the samples in NuGenesis, and make sure the results match your raw data. Once you have checked for errors, hit the AUTOPOST tab and select all.

12.2 Checking results in Horizon LIMS system: Once sample results have been autoposted from NuGenesis, you must enter the OPERATIONS tab and select POSTING-by Worklist. Enter the HBN (Horizon Batch Number) from the analysis batch sheet. The analyst must go through this worklist and double check to make sure that all results autoposted correctly.

12.3 Choosing sample Condition Codes in Horizon LIMS system: The column to the right of the sample name is CC, which stands for Condition Code. The CC will read OK if Horizon received data from NuGenesis. If any sample in the analysis run required an additional dilution, or some kind of rerun while analyzing, it will appear more than once

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in your analysis batch. If the results were left as is, the lab report would have duplicate results. Therefore, you must change the condition code on the sample so that you can determine which analytes are taken from which run. There are three CCs that can be used in this case. They are **LR, LX**, and **RP**. The **LR** condition code is to be used only if an analyte was not able to be completed in the current analysis run. (ex. Ag did not pass in your calibration QC). The **LX** condition code is to be used if a sample was analyzed more than once in the same run, and all reruns have been completed. (ex. A sample had a high RSD for Pb, and it was successfully reanalyzed later in the same run.) The **RP** condition code is to be used if the digestion QC associated with the sample did not pass method criteria, and needs to be sent back up to the Prep Dept. to be redigested. (ex. The LCS failed high for cadmium, and the sample in question required a cadmium analysis).

12.4 Choosing analyte Condition Codes in Horizon LIMS system: After one of the condition codes listed in Section 12.3 has been entered next to the sample, another condition code needs to be placed after the individual analytes in order for the analyst to be able to determine which analytes are used or not used. The three available condition codes are: **MO**, **NO**, and **RP**. The **MO** condition code is used for analyte results that you want to be taken from the current sample. The **NO** condition code is used for analytes that you do not want to be taken from the current sample. The **RP** condition code is used for analytes that need to be redigested by the prep dept. (ex. A sample is analyzed for cadmium, silver, and zinc. The cadmium result was fine, the silver result was no good because the digestion method blank failed for silver, and zinc was over your linear range and requires an additional dilution. In this case, cadmium would be MO, silver would be RP, and zinc would be NO.)

12.5 All raw data used for reporting results must dated and initialed by the qualified laboratory personnel performing the first and second reviews. Use the Trace Run Case Narrative sheets located next to the PC to record this information.

12.6 If you need to hand enter results into Horizon due to problems with the automatic download, be sure not to round off results. Horizon will automatically perform rounding appropriate to the method. Horizon LIMS results are reported to three significant figures but limited to the number of decimal places in the reporting limit for the individual compound or analyte.

12.7 Report the actual result, even if it is less than the reporting limit. Any sample with a result less than the reporting limit will automatically be reported as ND (non-detectable); LIMS will automatically report the appropriate detection limit.

13 Waste Management

13.1 Refer to ALSI SOP-19 Waste Management Disposal

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14 Pollution Prevention

14.1 Pollution prevention encompasses any technique that reduces or eliminates the quantity or toxicity of waste at the point of generation. Numerous opportunities for pollution prevention exist in laboratory operations. Management shall consider pollution prevention a high priority. Extended storage of unused chemicals increases the risk of accidents. The laboratory shall consider smaller quantity purchases which will result in fewer unused chemicals being stored and reduce the potential for exposure by employees. ALSI tracks chemicals when received by recording their receipt in a traceable logbook. Each chemical is then labeled according to required procedures and stored in assigned.

15 Definitions

15.1 Refer to ALSI QA Plan under Laboratory Quality Control Checks for general definitions.

16 Troubleshooting

16.1 Monitoring instrument trends for requesting service. By monitoring the peak intensities obtained from your As Optimization, the Optimization average recoveries, and the Hg profile throughout your analytical runs, you can often tell when service will soon be needed. The instruments RF tuning is checked annually during the PM Service; however, it is not uncommon for the tuning to require further adjustment throughout the year. By recording the information listed above in your analysis logbook, a trend will be more easily monitored. If a definite trend is detected, a service call to Thermo Elemental shall be placed. The reason for the service call must be documented in the maintenance logbook. Following the field service, an additional note shall be made that shows that the problem was corrected, and what was done to correct it.

16.2 Recording instrumentation problems in the maintenance logbook.

16.2.1 Any daily service or issue involving the instrument must be noted in the maintenance logbook. The logbook is then a good source to refer to if problems develop. Usually the current issue with the instrument has occurred sometime in the past. The analyst can then look to see what if any corrective actions were performed. Refer to maintenance logs and instrument manuals for guidance in troubleshooting specific problems related to the instrumentation used in this method.

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TABLE 1
(Recommended Elemental Wavelengths)

Element	Wavelength
Ag	328.068
Al	308.215
As	189.042
B	182.641
Ba	413.066
Be	313.042
Bi	223.061
Ca	184.006
Ca	317.933
Cd	214.438
Co	228.616
Cr	267.716
Cu	324.754
Fe	296.690
Mg	518.362
Mo	202.030
Mn	260.569
Ni	231.604
Pb	220.353
Sb	206.838
Se	196.090
Sn	189.989
Sr	407.771
Ti	323.452
Tl	190.864
V	292.402
Zn	206.200
Na	589.592
K	766.490

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TABLE 2
(Reporting Limit Standard)

Element	Concentration (ppm)
As	0.02
Al	0.10
Sb	0.01
Ba	0.01
Be	0.01
Bi	0.05
B	0.10
Cd	0.005
Ca	0.10
Cr	0.01
Co	0.01
Cu	0.02
Fe	0.10
K	0.50
Pb	0.01
Mg	0.10
Mn	0.01
Mo	0.02
Ni	0.02
Se	0.05
Ag	0.005
Na	0.50
Sr	0.01
Tl	0.03
Sn	0.05
Ti	0.02
V	0.01
Zn	0.02

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TABLE 3
(Laboratory Fortified Blank)

Element	Concentration (ppm)
As	0.40
Al	1.00
Sb	0.40
Ba	1.00
Be	0.40
Bi	1.00
B	1.00
Cd	0.200
Ca	5.00
Cr	0.20
Co	1.00
Cu	1.00
Fe	10.0
K	5.00
Pb	1.00
Mg	5.00
Mn	0.20
Mo	1.00
Ni	1.00
Se	1.00
Ag	0.200
Na	5.00
Sr	0.20
Tl	1.00
Sn	0.40
Ti	0.20
V	0.20
Zn	1.00

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APPENDIX A

IRIS ICP ANALYTICAL WORKSHEET

Acid Matrix:___%HNO3 + ___%HCl

Instrument Method:_____
Sequence Number:_____
Date Started:_____
Analyst:_____
PS= 10ml sample + 0.1 ml each of

high standard component
Pipette ID#_____
Pipette ID#_____
Pipette ID#_____

S0:_____ml (ICB, CCB)
S___:_____ml of_____._____._____into_____ml
S___:_____ml of_____into_____ml CRI:_____ml of_____into_____ml
S___:_____ml of_____into_____ml ICSAB:_____
S___:_____ml of_____into_____ml
S___:_____ml of_____into_____ml
ICV:____ml of_____+_____ml of_____._____._____into_____ml
ICV2:_____ml of_____._____+_____ml_____._____into_____ml
CCV:_____ml of_____._____._____into_____ml
HNO3 Lot #:_____ HCl Lot#:_____

	D/F		D/F		D/F
S0					
				71	
				72	
		31		73	
		32		74	
		33		75	
		34		76	
		35		77	
		36		78	
		37		79	
		38		80	
		39			
		40			
				81	
				82	
		41		83	
		42		84	
1		43		85	
2		44		86	
3		45		87	
4		46		88	
5		47		89	
6		48		90	
7		49			
8		50			
9					
10					
				91	
				92	
		51		93	
		52		94	
11		53		95	
12		54		96	
13		55		97	
14		56		98	
15		57		99	
16		58		100	
17		59			
18		60			
19					
20					
				101	
				102	
		61		103	
		62		104	
21		63		105	
22		64		106	
23		65		107	
24		66		108	
25		67		109	
26		68		110	
27		69			
28		70			
29					
30					

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Change History Summary

Section	Section Title	Reason for Change
Revision 2		
2.1	Summary of Method	Army Corp Audit
6.6.7	Reagents	SOP Update
6.6.8	Reagents	SOP Update
5.1.5	Apparatus and Materials	SOP Update
5.1.6	Apparatus and Materials	SOP Update
6.5	Reagents	SOP Update
6.5.1	Reagents	SOP Update
6.5.2	Reagents	SOP Update
6.5.3	Reagents	SOP Update
6.5.4	Reagents	SOP Update
6.6.1	Reagents	SOP Update
6.6.6	Reagents	SOP Update
6.6.7	Reagents	SOP Update
6.6.8	Reagents	SOP Update
6.8	Reagents	SOP Update
8.1.3	Quality Control	SOP Update
8.2.1	Daily Demonstration in Instr. Performance	SOP Update
8.1.2.1	Quality Control	New Jersey Audit Response
8.2.3	Daily Demonstration in Instr. Performance	SOP Update
8.34	Daily Demonstration of Data Quality	SOP Update

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Change History Summary (continued)

Section	Section Title	Reason for Change
1.7	Scope and Application	New Jersey Audit Response
6.6.1	Reagents	SOP Update
8.3.1	Quality Control	SOP Update
6.6.1	Reagents	Army Corp Audit
8	Quality Control Requirements (RPL)	Army Corp Audit
8.1.1	Quality Control	Army Corp Audit
8.2.2	Quality Control	Army Corp Audit
	Appendix A	

Revision 3

6.1	Reagents	SOP Update 04/21/05
6.2	Reagents	SOP Update 04/21/05
6.5.1	Reagents	SOP Update 04/21/05
6.5.2	Reagents	SOP Update 04/21/05
6.5.3	Reagents	SOP Update 04/21/05
6.5.4	Reagents	SOP Update 04/21/05
6.5.5	Reagents	SOP Update 04/21/05
8.1.1	Quality Control	A2LA Response 04/21/05
8.2.3	Quality Control	SOP Update 04/21/05
8.2.4	Quality Control	A2LA Response 04/21/05
8.11	Quality Control	A2LA Response 04/21/05
8.11.1	Quality Control	A2LA Response 04/21/05
8.12	Quality Control	A2LA Response 04/21/05

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Change History Summary (continued)

Section	Section Title	Reason for Change
Revision 4: 01/22/2007:		
1.8	Scope and Application	Project requirements update
2.1	Summary of Method	DoD Audit Response
3.1.2	Interferences	Removed flame AA as alternate method
3.1.3	Interferences	Frequency change for IECs
3.4	Interferences	Added memory interferences
4.2	Safety	Directive to read MSDS sheets and their availability
5.8 & 5.10	Apparatus and Materials	SOP Materials update
6.4	Reagents	Added "or equivalent"
6.5.1 & 6.5.2	Reagents	Changed supplier
6.5.3 & 6.5.4	Reagents	Preparation revision
6.5.6	Reagents	Removed QCS 2 ref., added Scandium Stock standard
6.5.7	Reagents	Added of "Solution A", removed silver from element list
6.5.8	Reagents	Added of INTR18 (Solution B)
6.5.10	Reagents	Changed supplier for cesium chloride
6.5.12 thru 6.5.36	Reagents	Added of all single element standards
6.6	Reagents	Working solutions preparation update
6.6.1	Reagents	DoD audit Response
6.6.2 thru 6.6.4	Reagents	Formulation and expiration update
6.6.5	Reagents	Formulation and expiration update, updated high standard levels for barium, nickel, and sodium.
6.6.6	Reagents	Removed QCS 2 ref., and updated formulation

Change History Summary (continued)

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Section	Section Title	Reason for Change
6.6.7	Reagents	Added ICS formulation, removed ICSAB ref.
6.8	Reagents	Updated standard concentration, and ref. site
6.9	Reagents	Preparation update, edited expiration time
6.10	Reagents	Added Reporting Limit Standard preparation
7.2	Instrument Calibration	Edited number of Cal. Curve points
7.3	Instrument Calibration	DoD Audit Response
8.1.1 & 8.1.2	Quality Control	DoD Audit Response
8.1.4.1	Quality Control	Added IEC calculations
8.1.5 thru 8.1.8	Quality Control	AALA lead req. updates
8.1.9	Quality Control	Added IDL requirements
8.2.2	Quality Control	DoD Audit Response
8.2.3.1	Quality Control	LCS preparation update
8.2.3.2	Quality Control	Added calculating LCS recoveries
8.2.4	Quality Control	DoD Audit Response
8.2.7	Quality Control	DoD Audit Response
8.3.1 & 8.3.2	Quality Control	DoD Audit Response
8.7	Quality Control	DoD Audit Response
8.13	Quality Control	Reference to QA Plan
Quality Control Requirements (Calibration Blank)		DoD Audit Response
Quality Control Requirements (Method Blank)		DoD Audit Response
Quality Control Requirements (High Calibration Standard)		Removed reference to re-profiling
Quality Control Requirements (Laboratory Fortified Blank)		Changed FB/LFB to LCS

Change History Summary (continued)

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Section	Section Title	Reason for Change
Quality Control Requirements (Quality Control Sample)		Removed reference to QCS2
Quality Control Requirements (Reporting Limit Standard)		DoD Audit Response
Quality Control Requirements (Matrix Spike)		DoD Audit Response
Quality Control Requirements (Sample Replicates)		Updated replicate requirements
9.1.3	Sample Collection…	Added minimal sample size for soils
9.3.3 thru 9.3.5	Sample Collection…	Storage updates
10.1.7	Procedure	Added Instrument Parameters
10.1.8 thru 10.1.10	Procedure	Added autosampler setup and method saving steps
10.2	Procedure	Changed Reference
12.1 thru 12.7	Reporting Results	Major Revisions throughout
16	Troubleshooting	DoD Audit Response
TABLE 2 (Reporting Limit Standard)		Changed Selenium concentration

Revision 5: 02/4/08

Spelling, grammar, and formatting changes may have been made throughout SOP for clarity, correctness, and site conformity.

1.1, 1.7	Scope and Application	Updated reference method
4.2	Safety	Updated MSDS availability
6	Reagents	Added NOTE
8.2.6	Quality Control	Updated procedure
8.2.6.1	Quality Control	Added section
8.3.3.1	Quality Control	Added section
8.13	Quality Control	Updated chart per DoD audit
9	Sample Collection…	Updated format, added NOTE per DoD audit.

SOP Concurrence Form
for the Distribution and Revision of Standard Operating Procedures

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I have read, understood, and concurred with the Standard Operating Procedure (SOP) described above and will perform this procedure as it is written in the SOP.

Print Name	Signature	Date

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Document Title: Microwave Assisted Acid Digestion of Aqueous Samples and Extracts for Total Metals Analysis by ICP or ICP-MS Spectroscopy

Document Control Number: _____

Organization Title: ANALYTICAL LABORATORY SERVICE, INC. (ALSI)
Address: 34 Dogwood Lane
Middletown, PA 17057

Phone: (717) 944-5541

Approved by:

_____ _____
Helen MacMinn, Date
Quality Assurance Manager

_____ _____
Lisa Hampe-Miller, Date
Validator/Metals Department Supervisor

Annual Review:

_____ _____
Reviewed By Date Reviewed

_____ _____
Approved By Date Approved

_____ _____
Reviewed By Date Reviewed

_____ _____
Approved By Date Approved

Annual Review (continued):

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Reviewed By _____ Date Reviewed _____

Approved By _____ Date Approved _____

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1 Scope and Application

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1.1 This digestion procedure is used for the preparation of aqueous samples, mobility-procedure extracts, and wastes that contain suspended solids for analysis by inductively coupled argon plasma spectroscopy (ICP) and inductively coupled argon plasma mass spectroscopy (ICP-MS). The procedure is an acid digestion for determining total available metals on samples requiring digestion by Method 3015A of EPA SW846 "Test Methods for Evaluating Solid Waste Physical/Chemical Methods," Revision 1, February 2007.

1.2 This document states the laboratory's policies and procedures established in order to meet requirements of all certifications/accreditations currently held by the laboratory, including the most current NELAC standards.

1.3 Samples prepared by Method 3015 may be analyzed by ICP or ICP-MS for the following metals:

Aluminum	Magnesium
Antimony	Manganese
Arsenic	Molybdenum
Barium	Mercury
Beryllium	Nickel
Boron	Potassium
Cadmium	Selenium
Calcium	Silver
Chromium	Sodium
Cobalt	Strontium
Copper	Thallium
Iron	Vanadium
Lead	Zinc

1.4 Individual project requirements may override criteria listed in this SOP.

2 Summary of Method

2.1 A representative 45 mL aqueous sample is digested with 5 mL of concentrated nitric acid in a 75-mL Teflon digestion vessel for 20 minutes using microwave heating. The sample is transferred to a clean sample bottle for analysis.

3 Interferences

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3.1 In order to identify problem matrices and method error, blanks, spikes, spike duplicates and check samples are run at regular intervals, as specified in each relevant analytical method.

3.2 Samples that are oily or continuously vent in the microwave shall be digested by an alternate hot plate digestion method (see prep SOP 09-3050B).

4 Safety

4.1 The toxicity or carcinogenicity of each reagent used in this method has not been precisely defined. Therefore, each chemical shall be treated as a potential health hazard.

4.2 ALSI maintains material safety data sheets (MSDSs) on all chemicals used in this procedure. ALSI recommends that all individuals performing this SOP familiarize themselves with the MSDSs associated with the procedure prior to SOP performance. MSDSs are available to all staff and are located in hard copy in the QA reference library or electronically on the ALSI server in the MSDS folder.

4.3 Since the chemical make-up of the samples is not known, analysts shall treat the samples with extreme caution. Proper protective equipment must be used including PVC gloves, lab coats, safety glasses and a fume hood.

4.4 Although there are many safety features built into the microwave, technicians must remember that the samples will be acidified to 10% nitric acid, heated to approximately 170°C and will be under pressures of 70 psi. All parts of the digestion vessels must be examined to ensure that there are no visible faults that could release the sample during digestion.

4.5 Analysts must be familiar with the proper assembly and use of the vessels and all related safety equipment. Information regarding the safe use of the MD09111 can be found in the *MD09111 Operation Manual* to be found in the microwave supplies drawer in the Inorganic Prep Lab.

4.6 The addition of Conc. Nitric acid to water in Sections 7.2 and 10.7 may cause significant heat generation or a vigorous chemical reaction. The analysts must always add acid to water, not water to acid. This step must also be performed in a fume hood.

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5 Apparatus and Materials

5.1 Microwave, Mars Express, serial # MD09111 with advanced composite digestion vessels.

5.2 100-mL graduated cylinder, Class A or Class B.

5.3 75-mL Teflon vessels with caps and corks, Catalog # or equivalent.

5.4 8 fl-oz. Polyethylene bottles, disposable, VWR #16059-068 or equivalent.

5.5 Acid Dispensers (Finnpipettes), from Thermo capable of dispensing 0.5 mL to 10 mL of acid.

5.6 Thermo Finntip tips, VWR catalogue #53515-050 or equivalent.

5.7 Balance, capable of weighing to 0.01 g, Mettler PM4800 Delta Range or equivalent.

6 Reagents

NOTE: Unless otherwise noted in this section all chemicals are stored at room temperature and labeled with an expiration date of five years from receipt. Manufacturer's labeled expiration dates, when provided, take precedent over all other expiration dates.

6.1 Reagent water - A Filson Water Purification System is used which provides analyte-free, >16.0 megohm-cm deionized water on demand.

6.2 Nitric Acid (HNO_3):

6.2.1 Method 6010; concentrated. J.T. Baker 'Baker analyzed' grade, Cat. #JT-9598-34 purchased from VWR or equivalent.

6.2.2 Method 6020, Omni Trace Ultra High Purity Concentrated Nitric Acid, Catalog # NX0408/6 from EMD or equivalent.

NOTE: Acid bottles must be contained inside Teflon carriers at all times.

6.3 Spiking solutions – All spiking solutions below are aliquoted into 250-mL

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plastic bottles to use as a working solution. Label each working solution with an expiration date of 7 days.

6.3.1 Method 6010:

6.3.1.1 Standard Mix #1-R purchased from, High Purity Standards, Cat. #SM-1339-001, or equivalent NIST certified standard. This is a pre-mixed standard of Al, Ba, Ca, Li, Mg, and Se at 100 mg/L, As, Cd, Cr, Pb, and Sr at 10 mg/L, K and Na at 2000 mg/L, Be at 20 mg/L, and V at 5 mg/L in 5% HNO_3.

6.3.1.2 Spiking Solution Standard Mix #2 purchased from High Purity Standards, Cat. #SM-1339-002, or equivalent NIST certified standard. This is a pre-mixed standard of Bi, B, Co, Cu, Fe, Mo, and Ni at 100 mg/L, Mn, Ag, Tl, Sn, and Ti at 10 mg/L, Sb at 20 mg/L, and Zn at 50 mg/L in 5% HNO_3.

6.3.2 Method 6020:

6.3.2.1 Standard Mix A purchased from, CPI, Cat. #P/N 4400-130597, or equivalent NIST certified standard. This is a pre-mixed standard of Al, As, Be, Cd, Co, Cr, Cu, Mn, Mo, Ni, Pb, Sb, Se, Tl, V and Zn at 10 mg/L in 1% HNO_3 + tr HF.

6.3.2.2 Spiking Solution Standard Mix B purchased from CPI, Cat. #P/N-130775, or equivalent NIST certified standard. This is a pre-mixed standard of Ag, Ba, Mg, Fe, Ca, B and Sr at 10 mg/L, in 1% HNO_3 + tr HF.

7 Glassware Cleaning

7.1 Glassware used in this procedure is to be cleaned as noted in SOP 19-GLWH. This procedure includes the acid washing of all glassware used for metal digestions.

7.2 Glassware used in this procedure is stored in metals prep area and rinsed with a 10% HNO_3 solution before use. Exact measurements are not necessary to produce this cleaning reagent. Production is approximately 100 mL concentrated HNO_3 into 900 mL of reagent water.

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NOTE: Some heat will be generated from the addition of acid to water.

7.3 For determination of trace elements, contamination and loss are of prime consideration. Potential contamination sources include improperly cleaned laboratory glassware and apparatus and general contamination within the laboratory environment from dust, etc. A clean laboratory work area designated for trace element sample handling must be used. Sample containers can introduce positive and negative errors in the determination of trace elements by (1) contributing contaminants through surface adsorption or leaching, (2) depleting element concentrations through adsorption processes. All reusable lab ware (glass, quartz, polyethylene, PTFE, FEP, etc.) shall be sufficiently clean for the task objectives.

8 Quality Control

8.1 All policies and procedures in the most current revision of the ALSI QA Plan shall be followed when performing this procedure.

8.2 Demonstration of Capability (DOC) – DOCs must be performed by each analyst prior to performing this method and repeated at any time there is a significant change in instrument type. To perform DOCs, four consecutive Laboratory Control Samples (LCSs), with a matrix matching that of the calibration standards, are analyzed. The recoveries obtained must be within 85-115% of the known values for each associated metal, and consecutive reads must have an RSD less than 10%. If the DOCs are outside these acceptance limits, a new set of LCS's must be digested and analyzed. This process is repeated until the DOCs are completed successfully.

8.2.1 Ongoing proficiency must be established annually as specified in the QA Plan, Technical Training.

8.3 For each analytical batch of samples processed, a method blank shall be carried throughout the entire sample preparation and analytical process. These blanks will be useful in determining if samples are being contaminated. A method blank is a 45 mL aliquot of reagent water digested as a sample.

8.4 Spiked samples or standard reference materials shall be employed to determine accuracy. A spike and spike duplicate must be prepared for every batch.

Note: Some client contracts (ex. DoD) require the preparation of matrix spikes

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for every new matrix received. The Horizon LIMS will designate that these samples are to be prep spiked. The 1 per batch spiking rule will not always be applicable to these samples. If the LIMS designates a sample MS/MSD, it is not to be disregarded by the analyst.

8.4.1 Samples selected for duplicate and matrix spike analysis shall be rotated among client samples so that various matrix problems may be noted and/or addressed. Poor performance in a duplicate or spike may indicate a problem with the sample composition and shall be reported to the client whose sample produced the poor recovery.

Note**:** The final volume for spiked samples will be 51 mL.

8.5 A Laboratory Control Sample (LCS) is to be run with every batch. The LCS is a 45 mL aliquot of reagent water spiked as noted in Section 10. Special projects may require more frequent analysis of the LCS.

Note: The final volume for LCS's spiked in this manner will be 51 mL.

8.6 The size of any digestion batch cannot exceed 20 samples.

8.7 The ALSI Lab I.D. number of all mechanical pipettes used in this digestion process must be documented in the prep logbook.

8.8 All mechanical pipettes used in this digestion process must calibrated annually to verify the ***entire*** range of use. Select four to five settings throughout the pipette range, and perform a full calibration at each setting. This calibration data must be recorded in the metals autopipette calibration logbook. See 09-AP SOP for calibration procedure.

8.8.1 A single setting pipette calibration is also required on a weekly basis to verify dispensing volumes. Select a mid-range volume to perform this calibration, and be sure to document the procedure in the metals autopipette logbook. See 09-AP SOP for calibration procedure.

8.9 The Mettler balance used to weigh the digestion vessels must be calibrated each day. Prior to use, the analyst must verify that daily calibration has been recorded in the appropriate Balance Calibration Logbook. The procedure for calibrating the balance can be found in SOP 09-PM2000.

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8.10 All QC spiking solutions used in this method must be stored in area separate from samples and sample digestates. If the spiking solutions are going to be kept in the same room as samples, then a separate drawer or enclosed cabinet must be designated for their storage.

8.11 MDL studies must be performed according to SOP 99-MDL or the reference methods, whichever is more frequent.

9 Sample Collection, Preservation and Handling

9.1 Both plastic and glass containers are suitable.

9.2 Aqueous waste waters must be acidified to a pH of < 2 with HNO_3 at the time of sampling as a means of preservation. NOTE: Aqueous samples that arrive to the lab in an unpreserved state must be acidified prior to metals analysis. The Sample Receiving Dept. checks the pH of all preserved samples that arrive at the lab. If the pH is > 2, an aliquot of nitric acid is added to the sample and shall be marked with an orange sticker on the lid. The sticker displays the time and date of the initial preservation. The pH of these samples must then be verified after 24-hours. If the pH is < 2, the sample is considered available for processing. If the pH is still > 2, additional nitric acid must be added and the pH verified < 2 after another 24-hour period. All pH readings must be documented in the Sample Receiving Preservation Log, which is found on the ALSI server in the Sample Receiving folder. See SOPs 19-BOTTLE and 19-Rec/Han.

9.3 Samples and sample digestates must be stored separately from prep spiking solutions.

9.4 Sample must be digested within 6 months of collection and are stored at room temperature.

9.5 Digestates must be analyzed within 6 months of digestion and are stored at room temperature.

9.6 See SOP 20-Field Services Sampling Plan for collection procedures.

10 Procedure

10.1 Any apparatus coming into contact with the sample (containers, graduated

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cylinders, etc) must be rinsed with both 10% HNO_3 and reagent water.

10.2 ALSI holds a service contract with CEM Corporation for our MARS XPRESS microwave. As per that agreement, a service technician performs routine maintenance and calibrates the unit twice a year. A certificate of calibration is provided and stored in the metals prep area. It is the responsibility of the lab tech to check these certificate records, and make sure the microwave calibration is performed once every six months. If the calibration is older than six months, the lab tech shall schedule a field service visit immediately. If needed, digestions may continue until the field service rep. has a chance to service the unit. There is also a record of the calibration documented on the side of the microwave.

10.3 The MARS XPRESS is capable of holding up to 40 digestates at one time. Due to the volume of sample used for this procedure, the microwave can only digest 30 samples at one time. This enables the lab tech to digest up to 20 samples and all required batch QC. The microwave carrousel has 40 available positions in two separate rings. The outer ring has 24 available slots, and the inner ring has 16. The outer ring is the ring that is fully utilized and the inner ring is used for the last six samples when 30 samples are being digested.

10.4 The microwave carrousel itself contains Kevlar liners for each available digestion slot. This Kevlar liner serves as a shield in case a digestion vessel ruptures. The vessels themselves have been designed with the pressure release system, so rupturing should be rare, but it is possible with different matrices.

10.5 Using a Class A or Class B graduated cylinder, transfer a 45 mL representative aliquot of the well-mixed sample to a digestion vessel. Fill two digestion vessels with 45 mL of DI to be used for the MB and the LCS. NOTE: The number of the digestion vessel must be documented with COC# of the sample it contains in the microwave digestion logbook. This is necessary because there is no place to record the sample number on the digestion vessel itself. Also, record the sample volume used in the "sample amount" column of the microwave digestion logbook. (Appendix A)

10.6 Spike LCS and MS/MSD samples as described below. Record spike amounts and lot numbers in the designated columns in the microwave digestion logbook.

10.6.1 Samples to be spiked for (ICP) analysis shall be spiked in the following

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manner. Using a Finnpipette, add 500 µL of Standard Mix #1-R and 500 µL of Standard Mix #2 to the samples before the addition of HNO_3.

10.6.2 Samples to be spiked for (ICP-MS) analysis shall be spiked in the following manner. Using a Finnpipette, add 500 µL of standard Mix A and 500 µL Standard Mix B to the samples before the addition of HNO_3.

10.7 Using the Finnpipette acid dispenser, add 5 mL of concentrated nitric acid to each digestion vessel. This step shall be performed in a fume hood because of the possibility of a vigorous reaction between the sample and concentrated nitric acid. If a vigorous reaction does occur, allow the sample to pre-digest before capping the vessel.

10.8 Place a cover and cap on each of the vessels remembering to include a pressure regulating cork on all of the samples. Tighten the cap just hand tight. The threads will expand during heating in the microwave.

10.9 Using an analytical balance, weigh each digestion liner/cover/cap assembly to the nearest 0.01 g and record this weight in the "initial weight of vessel" column of the microwave digestion logbook.

10.10 Transfer the weighed vessels to the microwave carrousel, being careful to ensure they are in their properly designated positions.

10.11 The carrousel then fits onto the notch in the bottom of the microwave. The proper positioning of the carrousel enables it to spin.

10.13 Recall the stored program "3015" from the stored methods menu. Review the method to make sure that changes were not inadvertently made to the program. The program calls for the samples to reach a pressure of 70 psi in less than ten minutes and then hold that pressure for 10 additional minutes.

10.13.1 From information received from the manufacturer of the microwave, the pressure of 70 psi is said to place the samples in the correct temperature range specified by Method 3015. That is, the samples will be brought to 160 ± 4°C within the first ten minutes, and allowed to slowly rise to 165ºC-170ºC for the second ten minutes.

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10.14 Verify that the fume hood is turned on and start the program.

10.15 If the carrousel of samples has reached 70 psi in the specified time frame, the microwave will sound an alert and begin an automatic cool down which lasts 15 minutes.

10.18 After the vessels have cooled to room temperature, the microwave will sound another alert to remove vessels.

10.19 Reweigh the vessels and record the weights in the "final weight of vessel" column of the microwave digestion logbook.

10.19.1 If the difference in weights from the initial weight of vessel to the final weight of vessel is greater than 5 g, the sample must be discarded and re-digested. This indicates a loss of sample through the rupture membrane. Re-evaluate the sample and consider digesting by the appropriate hot plate method if the sample cannot be digested in the microwave.

10.19.2 If the difference in weights from the initial weight of the vessel to the final weight of the vessels is less than or equal to 5 g, the "final volume" column can be filled out in the microwave digestion logbook. The final volume is the total volume of sample plus nitric acid plus any spike solutions added.

10.20 Carefully uncap and vent each sample in a fume hood.

10.21 Transfer the sample into an 8 fl-oz. Polyethylene digestion bottle that has been pre-rinsed with 10% HNO_3 and reagent water. Label the bottle with sample number, digestion type, method number, preparation factors, and batch number.

11 Calculations

11.1 Not applicable.

12 Reporting Results

12.1 Verify that all required information has been entered into the digestion logbook.

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12.2 Open the Horizon LIMS, and go to "batch posting" under the Operations TAB. Enter the Horizon Batch Number (HBN), which corresponds to MDIG digestion batch. When the batch opens, the samples will already have default initial volumes of 45 mL and final digestate volumes of 50 mL. These volumes will need to be adjusted to match the volumes in the microwave digestion logbook. Remember that the final digestate volume for all spiked samples is 51 mL.

12.3 Once the sample prep factors have been updated, the analyst initials and final prep date and time need to be entered in their appropriate fields.

12.4 When entering data into Horizon LIMS do not round off results; Horizon will automatically perform rounding appropriate to the method.

12.5 Double check that all information entered in steps 12.1 through 12.3 is correct, have information reviewed by second analyst, and hit the save TAP in the upper left corner of the Horizon page. Once the batch is saved, the prep factors are applied to the samples, the META analysis code becomes available for the Metals Dept.)

13 Waste Disposal

13.1 Refer to ALSI SOP 19-Waste Disposal.

14 Pollution Prevention

14.1 Pollution prevention encompasses any technique that reduces or eliminates the quantity or toxicity of waste at the point of generation. Numerous opportunities for pollution prevention exist in laboratory operations. Management shall consider pollution prevention a high priority. Extended storage of unused chemicals increases the risk of accidents. The laboratory shall consider smaller quantity purchases which will result in fewer unused chemicals being stored and reduce the potential for exposure by employees. ALSI tracks chemicals when received by recording their receipt in a traceable logbook. Each chemical is then labeled according to required procedures and stored in assigned locations for proper laboratory use.

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15 Definitions

15.1 Refer to ALSI QA Plan under Laboratory Quality Control Checks for general definitions.

16 Troubleshooting

16.1 Refer to maintenance logs and instrument manuals for guidance in troubleshooting specific problems related to the apparatus used in this method.

Appendix A
Microwave Digestion Logbook

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INORGANIC MICROWAVE SAMPLE PREPARATION (WATERS)

EPA Method:	3015	Date of Microwave Power Check:			Start / Finish
ALSI SOP:	09-3015	Date of Microwave Callibration:		Date	
Microwave ID#:	MARS	Was pressure reached in time required by the method?		Time	
Batch #:				Tech	
Batch #:		T: TCLP	M: 6020		
Batch #:		S: SPLP	W: 6010	Reviewed/Approved By:	
Batch #:		A: ASTM		Date Reviewed/Approved:	

Position #	Sample #	Initial Weight Of Vessel (g)	Final Weight Of Vessel (g)	Difference in Vessel Weight (g)	Spike Amount (µL of each)	Spike Lot #	Sample Amount (45 mL)	Final Volume (50 mL)	Batch Type	Pipette ID #	QC Type
1				0.00							
2				0.00							
3				0.00							
4				0.00							
5				0.00							
6				0.00							
7				0.00							
8				0.00							
9				0.00							
10				0.00							
11				0.00							
12				0.00							
13				0.00							
14				0.00							
15				0.00							
16				0.00							
17				0.00							
18				0.00							
19				0.00							
20				0.00							
21				0.00							
22				0.00							
23				0.00							
24				0.00							

Reagents
c.HNO_3:

NOTE: All TCLP matrix spikes are spiked prior to preservation as noted in the TCLP logbook.

Comments

Rev 02/08

Val 0012

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SOP Change History Sheet

Section No.	Section	Reason for Change
3.1	Interferences	SOP Update 05/1/205
3.2	Interferences	SOP Update 05/12/05
4.6	Safety	SOP Update 05/12/05
5.5	Apparatus and Materials	DOD Audit Response 05/12/05
5.6	Apparatus and Materials	DOD Audit Response 05/12/05
6.2	Reagents	SOP Update 05/12/05
6.3	Reagents	SOP Update 05/12/05
6.4	Reagents	SOP Update 05/12/05
8.2	Quality Control	SOP Update 05/12/05
8.3	Quality Control	SOP Update 05/12/05
8.4	Quality Control	DOD Audit Response 05/12/05
8.4.1	Quality Control	SOP Update 05/12/05
8.4.2	Quality Control	SOP Update 05/12/05
8.5	Quality Control	SOP Update 05/12/05
8.7	Quality Control	A2AL Audit Response 04/21/05
8.8.	Quality Control	A2LA Audit Response 04/21/05
8.8.1	Quality Control	A2LA Audit Response 04/21/05

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SOP Change History Sheet (continued)

Section No.	Section	Reason for Change
8.9	Quality Control	DOD Audit Response 05/12/05
8.10	Quality Control	DOD Audit Response 05/12/05
10.1	Procedure	SOP Update 05/12/05
10.3	Procedure	SOP Update 05/12/05
10.4	Procedure	SOP Update 05/12/05
10.6	Procedure	SOP Update 05/12/05
10.7	Procedure	SOP Update 05/12/05
10.13.1	Procedure	SOP Update 05/12/05
10.14	Procedure	SOP Update 05/12/05
10.17	Procedure	SOP Update 05/12/05
10.21	Procedure	SOP Update 05/12/05
12.1	Reporting Results	SOP Update 04/21/05
12.2	Reporting Results	SOP Update 05/12/05
12.3	Reporting Results	SOP Update 05/12/05
12.4	Reporting Results	SOP Update 05/12/05
Revision 7: 2/20/2006		
1.4	Scope and Application	Added as per DoD audit
2.1	Summary of Method	Added time parameters

SOP Change History Sheet (continued)

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Section No.	Section	Reason for Change
4.2	Safety	Added statements of MSDS availability
6.2	Reagents	Revised expiration dating
7.2	Glassware Cleaning	Added storage instructions
7.3	Glassware Cleaning	Added contamination considerations
8.2.1	Quality Control	Added ongoing DOC proficiency
8.11	Quality Control	MDL performance frequency
10.2	Procedure	Note added about microwave service contract
12.4	Reporting Results	Data entry instructions
12.5	Reporting Results	Review by second analyst
16	Troubleshooting	Section added as per DoD audit

Revision 8 11/26/2007

Spelling, grammar, and formatting changes made throughout SOP for clarity, correctness, and site conformity.

1.3	Scope and Application	Updated analyte list
4.2	Safety	Updated MSDS availability
4.6	Safety	Updated microwave information
5.1	Apparatus and Materials	Updated microwave information

SOP Change History Sheet (continued)

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Section No.	Section	Reason for Change
5.3	Apparatus and Materials	Updated digestion vessels
5.3, 5.4	Apparatus and Materials	Removed sections
5.6	Apparatus and Materials	Updated balance information
6	Reagents	Added NOTE
6.2.2, 6.3.2	Reagents	Added sections
7.1	Glassware Cleaning	Updated SOP reference
8	Quality Control	Removed table
9.4, 9.5, 9.6	Sample Collection, Preservation…	Added sections
10	Procedure	Updates to procedure made throughout section

Revision 9: 02/05/08

1.1	Scope and Application	Updated reference method
1.3	Scope and Application	Remove GFAA references
6.3	Reagents	Added criteria per DoD audit
9.2	Sample Collection…	Added NOTE per DoD audit
Appendix A		Updated logbook page

SOP Concurrence Form

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for the Distribution and Revision of Standard Operating Procedures

I have read, understood, and concurred with the Standard Operating Procedure (SOP) described above and will perform this procedure as it is written in the SOP.

Print Name	Signature	Date

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Document Title: Analysis of Total Metals by Inductively Coupled Plasma Using the TJA Trace ICP

Document Control Number: _____

Organization Title: ANALYTICAL LABORATORY SERVICE, INC. (ALSI)

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Metals Department Supervisor

_____ _____
Jason Knight, Date
Validator

Annual Review:

_____ _____
Reviewed By Date Reviewed

_____ _____
Approved By Date Approved

_____ _____
Reviewed By Date Reviewed

_____ _____
Approved By Date Approved

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Annual Review (continued):

Reviewed By	Date Reviewed
Approved By	Date Approved

Reviewed By	Date Reviewed
Approved By	Date Approved

Reviewed By	Date Reviewed
Approved By	Date Approved

Reviewed By	Date Reviewed
Approved By	Date Approved

Reviewed By	Date Reviewed
Approved By	Date Approved

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1 Scope and Application

1.1 This method is adapted from the U.S. EPA SW846 Method 6010C Revision 3, February 2007, "Inductively Coupled Plasma - Atomic Emission Spectroscopy." This method is applicable to a wide variety of matrices including ground water, aqueous samples, TCLP, SPLP, ASTM extracts, industrial and organic wastes, soils, sludges, sediments, industrial hygiene paints, wipes, airs, and other solid wastes.

1.2 The specific elements which ALSI analyzes by this method are listed in Table 1. This table lists the wavelengths used for the appropriate elements.

1.3 This method is restricted to use by or under the supervision of analysts experienced in the use of an ICP. Each analyst must also be skilled in the interpretation of raw data, including quality control data.

1.4 All samples are digested using appropriate sample preparation techniques.

1.5 This document states the laboratory's policies and procedures established in order to meet requirements of all certifications/accreditations currently held by the laboratory, including the most current NELAC standards.

1.6 Method Detection Limits can be found on the ALSI network and are maintained and updated by the QA department. The detection limits for a specific sample may differ from those listed due to the nature of interferences in a particular sample matrix.

1.7 Individual project requirements may override criteria listed in this SOP.

2 Summary of Method

2.1 This method measures element-emitted light by optical spectrometry. The ICP instrument contains a torch through which flows argon gas. A spark is used to initiate a plasma of ionized argon, which is then maintained by a radio-frequency field. Samples are pulled into the system by a peristaltic pump and nebulized. The resulting aerosol is transported into the plasma torch. Element specific atomic- and ionic-line emission spectra are produced by the excited atoms or ions on their return to the ground state. The emission spectra are dispersed by a grating spectrometer, and the intensities of the lines are monitored by photomultiplier tubes. The average of two intensity exposures, along with inter-element corrections yields the final result. **NOTE:** For all sequence runs that involve **DoD** samples, an average of three separate exposures is used to calculate the data.

2.2 Background correction is used for all element determinations. Background intensity is measured adjacent to the analytical lines from the samples during analysis in an area free from spectral interferences. It's then subtracted from the intensity measured at these

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lines.

2.3 The possibility for additional interferences such as spectral, chemical, and physical interferences, does exist. Appropriate corrections for these interferences must be made.

3 Interferences

3.1 Spectral interferences are caused by (1) overlap of a spectral line from another element at the analytical or background measurement wavelengths; (2) unresolved overlap of molecular band spectra; (3) background from continuum or recombination phenomena; and (4) stray light from the line emission of high concentration elements.

3.1.1 Background contribution and stray light are normally compensated for by the background correction.

3.1.2 Unresolved overlap requires the selection of an alternate wavelength or an alternate method of analysis such as graphite furnace or flame AA.

3.1.3 Spectral overlap is compensated for in the Trace instrument by automatic correction of the raw data after monitoring and measuring the interfering elements. A linear relationship between the interferant levels and the false interferences they cause can be assumed. Inter-element correction factors are checked daily by analysis of an interference check solution and updated every six months, or whenever indicated by failure of the interference check solution.

3.2 Physical interferences are effects associated with the sample introduction and flow through the instrument. These interferences are brought about due to differences in viscosity and surface tension. Physical interferences are most commonly seen in samples containing high dissolved solids or high acid concentrations. To reduce physical interferences, ALSI uses a peristaltic pump for sample introduction, dilutions of problem samples, and matrix matching of standards to samples. Internal standard addition and the method of standard additions may also be used to compensate for physical interferences.

3.2.1 Another problem that can occur while analyzing samples with high dissolved solids is salt build-up at the tip of the nebulizer, which affects aerosol flow rate and causes instrument drift. This problem is controlled by regular maintenance and by wetting the argon prior to nebulization using a humidifier.

3.3 Chemical interferences include molecular compound formation, ionization effects, and solute vaporization effects. Normally, these are not significant with the ICP. If they are encountered, they can be minimized by carefully selecting the operating conditions (RF power, torch position, and nebulizer flow rate), buffering the sample, matrix matching, and performing standard addition procedures. Chemical interferences are highly dependant on matrix type and the specific analyte of interest.

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3.4 Memory Interferences result when analytes from a previous sample contribute to the signals measured in a new sample. Memory effects can result from sample deposition on the uptake tubing to the nebulizer and from the build up of sample material in the plasma torch and spray chamber. This problem can be minimized by flushing the system with rinse blank between samples. If a memory interference is suspected, the sample must be reanalyzed after a rinse period.

4 Safety

4.1 The toxicity or carcinogenicity of each reagent used in this method has not been fully defined; however, each chemical compound shall be treated as a potential health hazard.

4.2 ALSI maintains material safety data sheets (MSDS) on all chemicals used in this procedure. ALSI recommends that all individuals performing this SOP familiarize themselves with the MSDSs associated with the procedure prior to SOP performance. MSDS are available to all staff and are located in hard copy in the QA reference library and electronically on the ALSI server in the MSDS folder.

4.3 Precautions shall be taken when handling samples and/or chemicals in the lab. The use of gloves, safety glasses, and lab coats is required when working with samples.

5 Apparatus and Materials

5.1 Thermo Jarrell Ash 61E Trace Simultaneous ICP Emission Spectrophotometer with the following options:

5.1.1 IBM compatible 386 computer
ThermoSPEC/AE v5.06 software
Axial Torch
Computer controlled emission with background correction.
Computer inter-element correction ability
Radio frequency generator coupled to a water-cooled induction coil
Water cooler
Vacuum Pump
Polychromatic optic system under vacuum
Adjustable variable speed peristaltic pump
Mass flow controllers for argon flow rate
HP LaserJet Printer
TJA 300 automatic liquid sampler
Argon humidifier

5.1.2 Sample pump tubing - CPI, catalog #4062-535 or equivalent.

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5.1.3 Internal Standard pump tubing - CPI, catalog #4062-5015 or equivalent.

5.1.4 Rinse pump tubing - CPI, catalog #4062-545 or equivalent.

5.1.5 13 x 100 polystyrene tubes - Perfector Scientific, catalog #2110 or equivalent.

5.1.6 Internal Standard Mixing Kit - CPI, catalog #4062-910 or equivalent.

5.2 Various Class A volumetric dispensing pipettes. – VWR, catalog #'s 53515-020, 53515-044, 53515-050 or equivalent.

5.3 Disposable Pasteur pipettes - VWR, catalog #14670-103 or equivalent.

5.4 Class A volumetric flasks (100-mL) – VWR, catalog # 29620-142 or equivalent.

6 Reagents

NOTE: Unless otherwise noted in this section all chemicals are stored at room temperature and labeled with an expiration date of five years from receipt. Manufacturer's labeled expiration dates, when provided, take precedent over all other expiration dates.

6.1 Concentrated Nitric Acid (HNO_3) - Baker Instra-analyzed Reagent Grade, VWR, catalog #JT9598-34 or equivalent. Label as expiring one year from date opened.

6.2 Concentrated Hydrochloric Acid (HCl) - Baker Analyzed Reagent Grade, VWR catalog #JT9535-33 or equivalent. Label as expiring one year from date opened.

6.3 Reagent water - a Filson water purification system produces analyte free greater than 16.0 megohm water on demand.

6.4 Liquid Argon Supply - High purity grade, purchased from AIRGAS, or an equivalent supplier.

6.5 Stock Standard Solutions are purchased as commercially prepared NIST traceable certified solutions. When received in the lab each is assigned a unique log number and is recorded in the Standard Preparation Logbook along with the manufacturer, date of receipt, expiration date, and analyst's initials.

6.5.1 SM-1339-002 (STD MIX #2) Stock Solution in 5% HNO_3/Trace HF. High Purity, or equivalent NIST certified standard. This standard contains the following elements:

ELEMENT	CONCENTRATION

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Antimony (Sb)	20 mg/L
Bismuth (Bi)	100 mg/L
Boron (B)	100 mg/L
Cobalt (Co)	100 mg/L
Cooper (Cu)	100 mg/L
Iron (Fe)	100 mg/L
Manganese (Mn)	10 mg/L
Molybdenum (Mo)	100 mg/L
Nickel (Ni)	100 mg/L
Silver (Ag)	10 mg/L
Thallium (Tl)	10 mg/L
Tin (Sn)	10 mg/L
Titanium (Ti)	10 mg/L
Zinc (Zn)	50 mg/L

6.5.2 SM-1339-001 (STD MIX #1-R) Stock Solution in 5% HNO_3. High Purity Express, or equivalent NIST certified standard. This standard contains the following elements:

ELEMENT	CONCENTRATION
Aluminum (Al)	100 mg/L
Arsenic (As)	10 mg/L
Barium (Ba)	100 mg/L
Beryllium (Be)	20 mg/L
Calcium (Ca)	100 mg/L
Cadmium (Cd)	10 mg/L
Chromium (Cr)	10 mg/L
Lead (Pb)	10 mg/L
Magnesium (Mg)	100 mg/L
Potassium (K)	2000 mg/L
Selenium (Se)	100 mg/L
Sodium (Na)	2000 mg/L
Strontium (Sr)	10 mg/L
Vanadium (V)	5 mg/L

6.5.3 QC26 Stock Solution in 5% HNO_3. QCD, catalog #QCS26K or equivalent. This standard contains the following elements:

ELEMENT	CONCENTRATION
Sb, As, Be, Cd, Ca, Cr, Co, Cu, Fe, Pb, Mg, Mn, Mo, Ni, Se, Tl, Ti, V, Zn, Al, Ba, B, Si, Ag, Na, K	all at 100 mg/L

6.5.4 Strontium Stock Standard (1000 ppm) in 4% HNO_3. SCP, catalog #140-051-382 or equivalent NIST certified standard.

6.5.5 Tin Stock Standard (1000 ppm) in 20% HCl. SCP, catalog #140-052-502 or equivalent NIST certified standard.

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6.5.6 Bismuth Stock Standard (1000 ppm) in 4% HNO_3. SCP, catalog #140-051-832 or equivalent NIST certified standard.

6.5.7 Scandium Stock Standard (1000 ppm) in 4% HNO_3. SCP, catalog #140-051-215 or equivalent NIST certified standard.

6.5.8 INTER18 (Solution A) in 5% HNO_3. CPI, Cat. #4400-INTR18-100 - Solution A, or equivalent NIST certified standard. This standard contains the following elements:

ELEMENT	CONCENTRATION
K	20000 mg/L
Se	500 mg/L
As, Pb, Tl	1000 mg/L
Ba, Cd, Cr	300 mg/L
Co, Cu, Ni	
V, Zn	
Mn	200 mg/L
Be	100 mg/L
Hg	50 mg/L

6.5.9 INTR18 (Solution B) in 5% HNO_3. CPI, Cat. #4400-INTR18-100 – Solution B, or equivalent NIST certified standard. This standard contains the following elements:

ELEMENT	CONCENTRATION
Ag	300 mg/L

6.5.10 INTER5 in 2% HNO_3. CPI, Cat. #4400-INTR5-500 or equivalent NIST certified standard. This standard contains the following elements:

ELEMENT	CONCENTRATION
Al	1200 mg/L
Ca	6000 mg/L
Fe	5000 mg/L
Mg	3000 mg/L
Na	1000 mg/L

6.5.11 Arsenic Stock Standard (1000 ppm) in 4% HNO_3. SCP, catalog # 7697-37-2 or equivalent NIST certified standard.

6.6 Working Standard Solutions. Prepare in an acid matrix similar to the samples being

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analyzed. This is most often a 10% HNO_3 matrix, but is dependent on the type of digestion performed on the samples, and shall be adjusted to match the samples being analyzed. After preparation, each standard is assigned a unique log number and is recorded in the standard preparation logbook along with the stock solution used, the concentration of that stock, the volume used, the final volume, the matrix, the date prepared, the date it will expire, and the preparer. Prior to analysis of **DoD** samples, the following calibration standards are to be prepared fresh prior to analysis. **NOTE:** The associated working standards are prepared daily, and held at room temperature. The maximum storage life is no longer than one day.

6.6.1 High Calibration Standard. To a 100-mL volumetric flask containing 10 mL HNO_3 (or that which matches the sample) in reagent water, add 5 mL SM-1339-002 (STD MIX #2) Stock Solution and 5 mL SM-1339-001 (STD MIX # 1-R) Stock Solution. Bring up to volume using reagent water. The formulation of this standard must be documented in the trace analysis logbook. This standard must be prepared daily, and is stable for no longer the 24 hrs.

6.6.2 Mid Calibration Standard. Add 4 mL of High Calibration Standard to 16 mL of calibration blank in a standard vessel for the Trace ICP. Mix solution by placing cap on vessel and inverting several times. The formulation of this standard must be documented in the trace analysis logbook. This standard must be prepared daily, and is stable for no longer the 24 hrs.

6.6.3 Low Calibration Standard. Add 2 mL of High Calibration Standard to 18 mL of calibration blank in a standard vessel for the Trace ICP. Mix solution by placing a cap on the vessel and inverting several times. The formulation of this standard must be documented in the trace analysis logbook. This standard must be prepared daily, and is stable for no longer the 24 hrs.

6.6.4 Calibration Blank (<detection limit (DL)). To 1000-mL volumetric flask, add 100 mL HNO_3 (or that which matches the samples) and bring up to volume using reagent water. Transfer to a labeled polyethylene bottle. The calibration blank standard is stable for 90 days.

NOTE: For all sequence runs that involve **DoD** samples, the calibration reagent blank must have a concentration less than 2x the method detection limit for each analyte.

Calibration Standard Concentrations (mg/L)

Element	High Cal. Std.	Mid Cal. Std.	Low Cal. Std.

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Ag	0.5	0.10	0.05
Al	5.0	1.0	0.5
As	0.5	0.10	0.05
Ba	5.0	1.0	0.5
Be	1.0	0.20	0.10
Ca	5.0	1.0	0.5
Cd	0.5	0.10	0.05
Co	5.0	1.0	0.5
Cr	0.5	0.10	0.05
Cu	5.0	1.0	0.5
Fe	5.0	1.0	0.5
Mg	5.0	1.0	0.5
Mn	0.5	0.10	0.05
Mo	5.0	1.0	0.5
Ni	5.0	1.0	0.5
Pb	0.5	0.10	0.05
Se	5.0	1.0	0.5
Sn	0.5	0.10	0.05
Sr	0.5	0.10	0.05
Ti	0.5	0.10	0.05
Tl	0.5	0.10	0.05
V	0.25	0.05	0.025
Sb	1.0	0.20	0.10
Bi	5.0	1.0	0.5
B	5.0	1.0	0.5
Zn	2.5	0.50	0.25

6.6.5 Working Profile Solution (5.0 mg/L). To a 1000-mL volumetric flask containing 100 mL HNO_3 (it is not critical for this standard to be matrix matched to the samples being analyzed) in reagent water, add 5 mL Arsenic Stock Standard. Bring up to volume using reagent water. This profile solution must be documented in the metals Standard Reagent Logbook and transferred to a labeled polyethylene bottle. Working standard solutions are stable for 90 days.

6.6.6 Initial Calibration Verification Standard QC26 (1.0 mg/L). To a 100-mL volumetric flask containing 10 mL HNO_3 (or that which matches the sample) in reagent water, add 1 mL QC26 Stock Solution, 0.1 mL Strontium Stock Standard, 0.1 mL Tin Stock Standard, and 0.1 mL Bismuth Stock Standard. Bring up to volume using reagent water. The formulation of this standard must be documented in the trace analysis logbook. This standard must be prepared daily, and is stable for no longer the 24 hrs.

6.6.7 Working Interference Check Solution (ICSAB). To a 1000-mL volumetric flask containing 100 mL HNO_3 (or that which matches the sample) in reagent water, add 2.5 mL INTER18 Stock Solution A, 2.5 mL INTER18 Stock Solution B, and

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25 mL INTER5 Stock Solution. Bring up to volume using reagent water. Transfer to a labeled polyethylene bottle. Working standard solutions are stable for 90 days.

ELEMENT	CONCENTRATION
Ag	0.75 mg/L
Al	30 mg/L
As	2.5 mg/L
Ba	0.75 mg/L
Be	0.25 mg/L
Ca	150 mg/L
Cd	0.75 mg/L
Co	0.75 mg/L
Cr	0.75 mg/L
Cu	0.75 mg/L
Fe	125 mg/L
Mg	75 mg/L
Mn	0.25 mg/L
Ni	0.75 mg/L
Tl	2.5 mg/L
V	0.75 mg/L
Zn	0.75 mg/L
Pb	2.5 mg/L
Se	1.25 mg/L
Na	25 mg/L
K	25 mg/L

6.6.8 Working Interference Check Solution (ICSA). To a 1000-mL volumetric flask containing 50 mL HNO3 and 50 mL HCl in reagent water, add 50 mL INTER5 Stock Solution. Bring up to volume using reagent water. Transfer to a labeled polyethylene bottle. Working Solution is stable for 90 days.

ELEMENT	CONCENTRATION
Al	60 mg/L
Ca	300 mg/L
Fe	250 mg/L
Mg	150 mg/L
Na	50 mg/L

6.6.9 RPL Standard (CRI). To a 25-mL polyethylene analysis tube add 0.1 mL of RPL Stock Standard. Using the 10-mL Finn pipette, add 19.9 mL 10% HNO_3 reagent blank (or that which matches the samples). This standard shall be prepared daily, and documented in the sample analysis logbook. The RPL / CRI concentrations are listed in Table 2.

6.7 Rinse Solution. To the rinse reservoir containing reagent water, add 300 mL HNO_3 (or

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that which matches the samples). Bring up to volume (3 L) using reagent water. Prepare as needed.

6.8 Working Internal Standard Solution (10.0 mg/L Sc). To a 2000-mL volumetric flask containing 40 mL HNO3 in reagent water, (or that which matches the samples), add 10 mL of Scandium Stock Solution, and 50 grams of solid cesium chloride. Bring up to volume using reagent water. Transfer to a labeled polyethylene jug. Working standard solutions are stable for 90 days.

6.9 Instrument Performance Check Solution (IPC). To a 25-mL polyethylene analysis tube add 10 mL of 10% HNO_3 reagent blank (or that which matches the sample), and 10 mL of High Calibration Standard. This standard will need to be prepared throughout the analysis run depending upon how many samples are being analyzed. This Working Calibration standard solution needs to be prepared daily with every analysis calibration. This standard contains the following elements:

ELEMENT	CONCENTRATION
Ag	0.25 mg/L
Al	2.5 mg/L
As	0.25 mg/L
Ba	2.5 mg/L
Be	0.50 mg/L
Ca	2.5 mg/L
Cd	0.25 mg/L
Co	2.5 mg/L
Cr	0.25 mg/L
Cu	2.5 mg/L
Fe	2.5 mg/L
Mg	2.5 mg/L
Mn	0.25 mg/L
Mo	2.5 mg/L
Ni	2.5 mg/L
Pb	0.25 mg/L
Se	2.5 mg/L
Sn	0.25 mg/L
Sr	0.25 mg/L
Ti	0.25 mg/L
Tl	0.25 mg/L
V	0.125 mg/L
Zn	1.25 mg/L
Sb	0.50 mg/L
Bi	2.5 mg/L
B	2.5 mg/L

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6.10 Report Limit Stock Standard (RPL / CRI) is prepared by adding the following amounts of single element standard to a 200-mL volumetric flask containing 5 mL conc. HNO3. This working standard is stable for 90 days.

ELEMENT	Volume of 1000 ppm Single Element Solution in 200 mL.	Final Concentration (mg/L)
Aluminum	4.00 mL	20
Antimony	1.00 mL	5.0
Arsenic	0.40 mL	2.0
Barium	0.40 mL	2.0
Beryllium	0.16 mL	0.8
Bismuth	2.00 mL	10.0
Boron	4.00 mL	20.0
Cadmium	0.08 mL	0.40
Calcium	4.00 mL	20.0
Chromium	0.20 mL	1.0
Cobalt	0.20 mL	1.0
Copper	0.40mL	2.0
Iron	2.40mL	12.0
Lead	0.24 mL	1.2
Magnesium	4.00 mL	20.0
Manganese	0.20 mL	1.0
Molybdenum	0.80 mL	4.0
Selenium	0.80 mL	4.0
Silver	.16 mL	0.8
Nickel	0.80 mL	4.0
Tin	0.80 mL	4.0
Strontium	0.20 mL	1.0
Titanium	0.80 mL	4.0
Thallium	0.80 mL	4.0
Vanadium	0.20 mL	1.0
Zinc	0.80 mL	4.0

6.11 Silver Stock Standard (1000 ppm) in 4% HNO_3. SCP catalog #140-051-472 or equivalent NIST certified standard.

6.12 Aluminum Stock Standard (1000 ppm) in 4% HNO_3. SCP catalog #140-051-132 or equivalent NIST certified standard.

6.13 Arsenic Stock Standard (1000 ppm) in 4% HNO_3. SCP catalog #140-051-332 or equivalent NIST certified standard.

6.14 Barium Stock Standard (1000 ppm) in 4% HNO_3. SCP catalog #140-051-562 or equivalent NIST certified standard.

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6.15 Beryllium Stock Standard (1000 ppm) in 4% HNO_3. SCP catalog #140-051-042 or equivalent NIST certified standard.

6.16 Calcium Stock Standard (1000 ppm) in 4% HNO_3. SCP catalog #140-051-202 or equivalent NIST certified standard.

6.17 Cadmium Stock Standard (1000 ppm) in 4% HNO_3. SCP catalog #140-051-482 or equivalent NIST certified standard.

6.18 Cobalt Stock Standard (1000 ppm) in 4% HNO_3. SCP catalog #140-051-272 or equivalent NIST certified standard.

6.19 Chromium Stock Standard (1000 ppm) in 4% HNO_3. SCP catalog #140-051-242 or equivalent NIST certified standard.

6.20 Copper Stock Standard (1000 ppm) in 4% HNO_3. SCP catalog #140-051-292 or equivalent NIST certified standard.

6.21 Iron Stock Standard (1000 ppm) in 4% HNO_3. SCP catalog #140-051-262 or equivalent NIST certified standard.

6.22 Magnesium Stock Standard (1000 ppm) in 4% HNO_3. SCP catalog #140-051-122 or equivalent NIST certified standard.

6.23 Manganese Stock Standard (1000 ppm) in 4% HNO_3. SCP catalog #140-051-252 or equivalent NIST certified standard.

6.24 Molybdenum Stock Standard (1000 ppm) in H_2O. SCP catalog #140-050-422 or equivalent NIST certified standard.

6.25 Nickel Stock Standard (1000 ppm) in 4% HNO_3. SCP catalog #140-051-282 or equivalent NIST certified standard.

6.26 Lead Stock Standard (1000 ppm) in 4% HNO_3. SCP catalog #140-051-822 or equivalent NIST certified standard.

6.27 Selenium Stock Standard (1000 ppm) in 4% HNO_3. SCP catalog #140-051-342 or equivalent NIST certified standard.

6.28 Titanium Stock Standard (1000 ppm) in H_2O/Trace HF. SCP catalog #140-050-222 or equivalent NIST certified standard.

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6.29 Thallium Stock Standard (1000 ppm) in 4% HNO_3. SCP catalog #140-051-812 or equivalent NIST certified standard.

6.30 Vanadium Stock Standard (1000 ppm) in 4% HNO_3. SCP catalog #140-051-232 or equivalent NIST certified standard.

6.31 Zinc Stock Standard (1000 ppm) in 4% HNO_3. SCP catalog #140-051-302 or equivalent NIST certified standard.

6.32 Antimony Stock Standard (1000 ppm) in 4% HNO_3. SCP catalog #140-051-512 or equivalent NIST certified standard.

6.33 Boron Stock Standard (1000 ppm) in H_2O. SCP catalog #140-050-052 or equivalent NIST certified standard.

6.34 Cesium Chloride (100%). VWR catalog #4042-02 or equivalent NIST certified standard.

7 Instrument Calibration

7.1 Immediately preceding calibration, each spectral line must be centered on its exit slit which is positioned in front of each photomultiplier tube. Maintaining this optical alignment during operation is called profiling.

7.1.1 Only the scandium spectral line is profiled. All other lines are preset relative to scandium.

7.1.2 To profile the instrument, aspirate the Working Profile Solution. From the main menu, enter Analysis. Enter the method name to be used and press Enter. Press F5, Profile. The profile line shall read Sc 361.384.

7.1.3 Press F3, Automatic. When the Working Profile solution has reached the plasma, press F1, Run. After scanning is complete, the scandium peak is displayed on the screen, along with the peak position, peak intensity and peak width.

7.1.4 In order to get the peak position as close to the center as possible, the peak position number shall be as close to 0.00 ± .02 as possible. This is accomplished by choosing F1, calc SS, and pressing enter. The new vernier (Hg profile) position will be displayed on the screen. Adjust the vernier knob on the instrument manually to the value displayed on the screen. Then press F9, Done/Keep.

7.1.5 Go to Section 7.1.3 and repeat the process until the peak position is as close to 0.00 ± 0.02 as possible. Then press F9, Done/Keep and F9, Done. Allow the system to rinse for 5 minutes before starting calibration.

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7.1.6 Re-profiling may be performed periodically throughout the analysis to compensate for diurnal changes, which are apparent by drifting QCs. It must only be adjusted, however, after instrument check standards and calibration blank have been analyzed.

7.2 The instrument prepares a standard curve by analyzing three levels of calibration standards and a calibration blank. Starting with the blank and working toward the high standard, the standards are aspirated and emission intensity readings are recorded by the data system.

7.3 All calibration standards are analyzed in duplicate and an average intensity is reported and used by the data system to prepare the calibration curve. **NOTE**: All runs involving **DoD** samples require three replicates for calibration standards.

7.4 A daily calibration curve is created by plotting the average intensity readings on the y-axis and concentration readings on the x-axis. The software of the data system plots the curve in a linear configuration. The calibration curve occurring most immediately preceding a particular sample is used to calculate the concentration for that sample. The acceptance criteria for a calibration curve for all analytes is a correlation coefficient of 0.995 or greater.

7.5 The calibration curve is validated using instrument check solutions prepared at known concentrations from a different source than that of the calibration standards. Validation occurs immediately following calibration and then at a frequency of 10% throughout the analysis run.

8 Quality Control

8.1 Initial demonstration of performance

8.1.1 Linear Dynamic Range (LDR) - The upper limit of linearity must be established for each element being analyzed. Analyze successively higher concentrations of the analyte until the percent recovery falls under 90%. The last concentration maintaining greater or equal to 90% recovery is considered the upper limit of linearity. Samples containing analytes greater than 90% of the upper limit of linearity must be diluted and reanalyzed for those analytes. The LDRs are verified every six months or any time a change in operating conditions occurs that may change the LDR. **NOTE**: When analyzing **DoD** samples, the upper linearities must be verified in every analytical run. A verification standard can be analyzed either before or after the **DoD** samples in your analysis run. If the analyte recoveries are within 10% of their known value, the upper linear ranges can be used. Otherwise, all samples must be diluted to analyte concentrations, which fall within the calibration curve.

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8.1.2 Method Detection Limits (MDL) - MDLs must be established and verified annually, and any time a change in operating conditions occurs that may change the MDL (reference 99-MDL). When analyzing **DoD** samples, MDL studies must be performed annually followed by an MDL Verification Check Standard analyzed at 2X the MDL. If The MDL verification standard is not recovered within at least 3X the instruments noise level, a new set of MDLs at a higher concentration will be analyzed. Once the MDL levels have been established, the Lower Quantitation Limits / Reporting Limits (RPL) can be set. The RPL shall be at least 3X the MDL. MDL studies must be performed according to SOP 99-MDL or the reference method, whichever is more frequent.

8.1.3 Demonstration of Capability (DOC) – DOCs must be performed yearly by each analyst prior to performing this method and repeated at any time there is a significant change in instrument type (See: QA Plan, technical Training). To perform DOCs, four consecutive Laboratory Control Samples (LCS), with a matrix matching that of the calibration standards, are analyzed. The recoveries obtained must be within 80-120% of the known values for each associated metal, and consecutive reads must have an RSD less than 20%. If the DOCs are outside these acceptance limits, a new calibration curve must be established, and the LCS's reanalyzed. This process is repeated until the DOCs are completed successfully.

8.1.4 Interelement correction factors must be verified and updated every six months or at any time a change in instrument operating conditions occurs which may change the interelement correction requirements. The IECs are calculated while performing the bi-yearly linear dynamic ranges. When the upper limit for each analyte is established, the recovery effects on the remaining analytes must be updated. Any effect, whether positive or negative the analyte detection limit, must be corrected in the method IEC table. The IEC correction is calculated by dividing the affected analytes recovery by the concentration of the linear range standard being analyzed. The resulting correction must then be manually added or subtracted to the existing IEC. (ex.: An upper limit is established for Fe at 900 ppm. The Pb recovery is -0.006 ppm when Fe is 900 ppm. Since the Pb reporting limit is 0.005 ppm, the IEC is in need of correction. The -0.006 ppm result is divided by 900 yielding a correction factor of -0.000000666.)

8.1.5 Prior to performing analysis on NLLAP samples (IH), analysts will have read through the latest AALA lead requirements, and have demonstrated ability to produce reliable results through accurate analysis of standard reference material (i.e. PAT rounds or ELPAT studies), or in-house quality control samples. Their performance must be documented in their training logs.

8.1.6 Analysts/Technicians involved in IH Lead analysis shall demonstrate their ability

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to adequately analyze certified reference materials (i.e. PAT rounds or ELPAT studies), on a bi-yearly basis. Their performance must be documented in their training log.

8.1.7 Contamination Control – Lead dust wipe sampling must be performed in all associated areas of the lab on a quarterly basis to determine surface concentrations of lead. Sample preparation and analysis is not to proceed until surface contamination is less that the specified maximum allowable limit of 40 micrograms per square foot.

8.1.8 Instrument Detection Limit (IDL). The IDLs for the Trace will be performed Quarterly. This study is performed following a standard calibration, and includes analyzing ten calibration blanks on three non-consecutive days. Each measurement must be performed as though it were a separate analytical sample. (i.e., each measurement must be followed by a rinse and/or any other procedure normally performed between the analyses of separate samples. The IDL responses are then manually entered off the raw data into an excel spreadsheet which then calculates the Standard Deviation. This number shall then be used as a starting point for setting up your MDL standards. (Note: the IDL limits shall be less than the MDL limits. If they are not, the IDL and MDL studies must be reviewed for errors, and redone if necessary.)

8.2 Daily demonstration of instrument performance

8.2.1 Quality Control Sample (QC26) - Initial and periodic verification of calibration standards is necessary to verify instrument performance. To verify the calibration standards, the Working Quality Control Sample QC26 must be within ± 10% of the true value immediately following the daily calibration. If outside of this acceptable range for target elements, the problem must be corrected by re-analysis, preparation, recalibration, or instrument maintenance. Samples may not be analyzed until the problem has been corrected and a QCS has been recovered within acceptable range.

8.2.2 A laboratory method blank (MB) is prepared with every batch of samples or one per every 20 samples digested, if the batch contains more than 20 samples. The method blank must be less than $^{1}/_{10}$ of the concentration of any sample in the associated batch or less than $^{1}/_{10}$ of the specific regulatory limit (MCL) if the concentration exceeds the concentration of the sample. Otherwise, the source of the contamination must be investigated and measures taken to correct, minimize, or eliminate the problem. Any sample associated with a contaminated method blank shall be reprocessed or the results reported with an appropriate data qualifier. **Note**: The method blank result must be equal to or less than ½ the reporting limit for all sequence batches that include samples from **DoD.**

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8.2.2.1 IH Lead Wipe QC. The wipe media used for the quality control samples (i.e. MB / LCS / LCSD), shall be of the same lot number or manufacturer as the wipes used for sample collection. If the samples are collected by an outside source, the lab is requesting that extra wipe media is provided to perform the required QC. If the wipe media is not provided by the client, then ALSI will use in-house wipe media purchased from Environmental Express.

8.2.3 A laboratory fortified blank (LCS) is processed with every batch of samples, or one every 20 samples if the batch contains more than 20 samples. The LCS must be subjected to all sample preparation steps, such as digestion, if necessary. The percent recovery must be 80-120% of the true spike value. If the recovery falls outside of this range, the source of the problem shall be identified and resolved before continuing analyses. LCS results are documented in the ALSI LIMS system, which can produce Control Charts that will show method recovery trends over time.

8.2.3.1 To prepare a laboratory fortified blank while analyzing samples which do not require digestion, add 1 mL SM-1339-002 (STD MIX #2) Stock Solution and 1 mL SM-1339-001 (STD MIX # 1-R) Stock Solution to 100 mL of sample. This will result in a mid-level concentration for the LCS.

8.2.3.2 Calculating LCS Recoveries:

% Recovery = (C_m/C_n) x 100
where: C_m = measured concentration of LCS
C_n = spiking concentration

8.2.4 Instrument Performance Check Solution (IPC) is analyzed following the calibration, after every 10 samples and at the end of the run. The results of the analytes in the check solution immediately following calibration must be within ± 10% of the true value with <5% RSD between replicates. Subsequent analyses of the IPC solution must be within ± 10% of the true value. If the result falls outside of this range for any element, the IPC may be rerun for that element. If the result still falls outside of this range, the problem must be corrected by re-profiling, preparation of new IPC, recalibration, or instrument maintenance. Samples following the last acceptable IPC requiring the elements that failed must be reanalyzed after correction of the problem and successful analysis of the IPC. All results of IPCs are documented in the ALSI LIMS system.

8.2.5 The Working Interference Check Solutions (ICSA and ICSAB) are analyzed to provide an adequate test of the inter-element and background correction factors. They must be analyzed at the beginning and end of an analytical run or twice during every 8-hour shift, whichever is more frequent. Standard ICSA contains

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only Al, Ca, Fe, Mg, and Na. These are considered to be the main interferences on the ICP. When analyzing the ICSA, the interferant metals must be recovered within 20% of there true value. All other non-spiked target metals must have a concentration less <2 x the MDL. If the results fall outside of this range, the interference check solution may be rerun. If it is still outside this range for any element, the problem must be corrected by preparation of new working interference solution, recalibration, or adjustment of inter-element and background correction factors. Any sample requiring an element that fails must be rerun for that element after the problem had been corrected and the interference check successfully meets the criteria.

8.2.5.1 Standard ICSAB contains all or most of the target analytes and the interferences at known and detectable values. The result must be within ± 20% of the true value. If the results fall outside of this range, the interference check solution may be rerun. If it is still outside this range for any element, the problem must be corrected by preparation of new working interference solution, recalibration, or adjustment of inter-element and background correction factors. Any sample requiring an element that fails must be rerun for that element after the problem had been corrected and the interference check successfully meets the criteria.

8.2.6 Calibration reagent blanks are analyzed directly after each IPC. The result for every element being analyzed must be less than 2.2 x the MDL. If the result does not meet this requirement for any element, the calibration blank may be rerun for that element. If the result is still not acceptable, the problem must be corrected by preparation of new blank, recalibration, or instrument maintenance. Samples following the last acceptable calibration reagent blank requiring the elements that failed must be reanalyzed after correction of the problem and successful analysis of the calibration reagent blank. If reanalysis is not possible, data shall be reported with a qualifying statement.

NOTE: For analysis runs involving **DoD** samples, the calibration blanks must have analyte concentrations less than 2x the MDL. Otherwise, the source of the contamination must be investigated, and measures taken to minimize or eliminate the problem before the samples can be reanalyzed. If reanalysis is not possible, data shall be reported with a qualifying statement.

8.3 Daily demonstration of data quality

8.3.1 A matrix spike sample is processed at a frequency of 10% of the routine samples. Per EPA Method 6010 requirements the percent recovery must be 75-125% of the true spike value. Recovery calculations are not required if the concentration of the spike added is greater than ten times the sample background and a comment must be placed on the lab report. If the recovery falls outside of the acceptable

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range, and the system is found to be in control, the recovery problem is judged to be matrix related and not system related. To determine if the method of standard additions is necessary, the sample must be post spiked or diluted as described below. Results of all matrix spikes are documented in the ALSI LIMS system. **NOTE**: When analyzing **DoD** samples, the matrix spike must be recovered at 80-120% of the true spiked value.

% Recovery *= MS Conc. – Sample Conc. / Actual Spike Concentration x 100*

8.3.2 Analyte Addition Test. To prepare a post spike, add an amount of high standard that will produce a minimum level of 20x and a maximum level of 100x the MDL and analyze. The percent recovery must be 75-125% of the true value as determined by the following formula. If the result is outside of this range, make successive dilutions of the sample and re-spike until the recovery falls within this range. The reporting limit of the sample must then be raised to reflect the dilution used. If this raises the reporting limit higher than the client needs, the method of standard additions shall be performed. **NOTE**: If the analyte concentration is greater than ten times the matrix spike concentration, post-spikes are not required, but a comment must be added to the lab report stating "No Spike Calculated".

$$A = \frac{B - \left(\frac{E}{F}\right)(C)}{\left(\frac{E}{F}\right)(D)} \times 100$$

where:
A = Post spike percent recovery
B = Resulting spike concentration
C = Sample concentration
D = Working calibration standard concentration
E = Amount of spike added (mL)
F = Final volume spike solution + sample

NOTE: When analyzing **DoD** samples, the post digestion spikes must be recovered at 80-120% of the true spiked value.

8.3.3 Dilution Test. If (100 x MDL) <20% of the sample concentration, prepare a $^1/_5$ dilution on the sample and reanalyze. The resulting corrected concentration shall be within ± 10% of the original sample concentration. If not, a matrix effect shall be suspected, and the sample diluted until the matrix problem has been eliminated. If this raises the reporting limit higher than the client needs, the method of standard additions shall be performed.

8.3.3.1 Dilution Test for **DoD** samples – A $^1/_5$ serial dilution test is required with every preparation batch or whenever a new or unusual matrix is encountered. All analytes with a concentration >50x the MDL must be recovered within 10% of the straight analysis. If the recoveries are

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outside this range, a post digestion spike must be performed. The post digestion spike must be recovered within 25% of the true value. If the post digestion spike is recovered outside 25%, the sample must be diluted and post spiked at that dilution as well. This process will continue until an acceptable post spike recovery is obtained. The detection limit on the sample will than be raised to reflect the dilution.

8.3.4 A matrix spike duplicate or sample duplicate is processed at a frequency of 5% of the routine samples. The relative percent difference (RPD) must be within 20%. If the RPD falls outside of the acceptable range, and the system is found to be in control, the precision problem is judged to be matrix related and not system related. A comment must be added to the lab report. Results of all duplicate analyses are documented in the ALSI LIMS system.

$$\boldsymbol{RPD} = \textit{Difference / Average x 100}$$

8.4 Method of Standard Additions - The method of standard additions is used when sample dilution and spikes fail to produce good recoveries. In the standard addition technique, two identical aliquots (Volume Vx) of the sample solution are taken. To the first, (labeled A), is added a small a volume (Vs) of a standard analyte solution of concentration Cs. To the second (labeled B), is added the same volume Vs of the matrix blank. The intensity counts of A and B are measured and corrected for non-analyte intensity counts. The unknown sample concentration (Cx) is calculated as follows:

$$Cx = \frac{S_B\, V_S\, C_S}{(S_A - S_B)\, V_X}$$

where:

S_A = intensity counts of A corrected for the blank
S_B = intensity counts of B corrected for the blank

Vs and Cs shall be chosen so that S_A is roughly twice S_B on the average. It is best if Vs is much less than Vx, and thus Cs is much greater than Cx, to avoid excess dilution of the sample matrix. If a concentration or separation step is used, the additions are best made first and carried through the entire procedure. For results from this technique to be valid, the following limitations must be taken into consideration:

8.4.1 The analytical curve must be linear.

8.4.2 The chemical form of the analyte added must respond the same as the analyte in the sample.

8.4.3 The interference effect must be constant over the working range of concern.

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8.4.4 The signal must be corrected for any additive interference.

8.5 Samples resulting in high negative (|conc.| > reporting limit) concentrations must be post-spiked to determine if there exists a negative interference. If multiple samples containing the same matrix (from the same source or client) show the same negative trend, only one sample of this matrix needs to be post-spiked.

8.6 When analyzing using a scandium internal standard, the intensity of scandium in each sample must be within ± 30% of the intensities in the initial calibration blank. If the intensities fall outside of this range, re-analyze the sample at a dilution to eliminate matrix interferences.

8.7 Each sample, QC check, and calibration standard is analyzed in duplicate and the results averaged. The relative standard deviation (RSD) between sample replicates must be less than 20% for all concentrations greater than the reporting limit to be accepted. If the RSD is greater than 20% and the sample concentration is above the reporting limit, the sample must be reanalyzed. **NOTE:** All runs involving **DoD** samples require three replicates for standards, samples, and QC Checks.

8.8 It is recommended that whenever a new or unusual sample matrix is encountered, either of the following tests be performed to determine if either positive or negative matrix interferences are present to distort the accuracy of the reported values.

8.8.1 Serial dilution. If the analyte concentration is at least 40x the detection limit, a 1:4 dilution shall agree within ± 10% of the original determination. If not, a chemical or physical interference shall be suspected and must either be diluted out and the detection level raised or the sample may be analyzed by the method of standard addition.

8.8.2 Post digestion spike. A post digestion spike, prepared as directed in Section 8.3.2, shall be recovered within 75 to 125% of the true value. If the spike is not recovered and the necessary sample dilution to recover the analyte concerned raises the detection limit of the sample above the limit needed by the client, the method of standard additions must be used.

8.9 ALSI participates regularly in applicable performance evaluation studies conducted by various certifying organizations.

8.10 All policies and procedures in the most current revision of the ALSI QA Plan shall be followed when performing this procedure.

8.11 Ongoing proficiency must be established annually as specified in the QA Plan.

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Quality Control Requirements

(Specific Project Requirements may override these requirements)

Parameter	Concentration	Frequency	Control Limits	Corrective Action
Calibration Reagent Blank	--	Beginning of run, after every 10 samples, and at the end of the run.	< 2.2 x MDL *< 2X the MDL for runs involving samples from the Dept. of Defense (**DoD**)*	Reanalyze the blank, prepare new blank and analyze, perform maintenance on instrument, recalibrate, reanalyze any samples since the last acceptable blank. If reanalysis is not possible, report with a qualifying comment.
Method Blank (MB)	--	One per batch of no more than 20 samples. Analyze with associated sample batch.	<Reporting Limit *or < ½ reporting limit for **DoD** QSM samples*	Reanalyze the blank. Samples in the batch must be < the reporting limit or ≥ 10x the method blank. If not, samples must be redigested and reanalyzed. If reanalysis is not possible, report with a qualifying comment. For **DoD** QSM samples the method blank must be ½ the reporting limit
High Calibration Standard	See Section 6.6.1	After calibration and before analysis of samples.	90-110%	Reanalyze the High Standard. If the standard is still not acceptable, perform instrument maintenance, and prepare a new calibration.
*Laboratory Fortified Blank (LFB or LCS)	Listed in Table 3	One per batch of no more than 20 samples. Analyze with associated sample batch.	80-120%	Reanalyze the LFB. If still outside of acceptable range, samples must be re-digested and reanalyzed. If reanalysis is not possible, report with a qualifying comment.
Quality Control Sample (QCS) Second Source Standard	1.0 mg/L	Immediately after calibration.	90-110%	Reanalyze the QCS. If the standard is still not acceptable, perform instrument maintenance, and prepare a new calibration.
Instrument Performance Check Solution (IPC) Same Source	Listed in Table 4	Beginning of run, after every 10 samples, and at the end of the run.	90-110%	Reanalyze the IPC. If the standard is still not acceptable, perform instrument maintenance, and prepare a new calibration. Reanalyze any samples since the last acceptable IPC. If reanalysis is not possible, report with a qualifying comment.
Reporting Limit Standard (RPL)	Listed in Table 2	Beginning of run, after calibration.	50-150% *Dept. of Defense samples (**DoD**)* *(80-120%)*	Reanalyze the RPL. If the standard is still not acceptable, perform instrument maintenance, prepare a new calibration, and reanalyze.

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* Matrix Spike (MS)	Listed in Table 3	One every 10 samples with at least one per batch.	75-125% *Dept. of Defense samples (**DoD**)* *80-120%* *50-150% for TCLP leachates*	Post Spike the sample for the failing analyte. If the post spike recovery is outside of the acceptable 75-125% limit, the sample will need to be analyzed at a 1:1 dilution and post spiked at a 1:1 dilution. If the post spike recovery is still outside acceptable limits, the sample will need to be further diluted and post spiked until an acceptable recovery has been reached. Report the results with a qualifying comment. If the matrix interference is identified, and the batch LCS was recovered within acceptable limits, report with a qualifying statement. (example: The sample in question contains % level iron.)
*Duplicate or matrix spike duplicate (MSD)	--	One every 10 samples with at least one per batch.	RPD ≤ 20%	Reanalyze the duplicate. If the RPD is still >20% or if reanalysis is not possible, report the results with a qualifying comment.
Sample replicates	--	Every sample	RSD < 20% for all samples > reporting limit	Reanalyze the sample. If the RSD is still > 20%, check to see if the relative percent difference of the four obtained exposures is less than 20%. If so, average the four exposures, and report the result with a qualifying comment. If the RPD is greater than 20%, reanalyze the sample a third time, and average all six exposures. Report the results with a qualifying comment.
Samples with high negative concentration	--	--	(|conc.| < reporting limit	Post-spike sample to determine if there exists a negative interference. If multiple samples containing the same matrix (from the same source or client) show the same negative trend, only one sample of this matrix needs to be post-spiked.
Scandium Internal Standard	--	Every sample	Intensity must be within 30% of the intensity of the initial calibration blank	Reanalyze the sample at the lowest possible dilution to eliminate sample matrix interference. The detection limits then need to be raised accordingly.
Interference Check Solution (ICSAB)	See Section 6.6.7	Beginning and end of every run, and at least once every 8 hours.	80-120%	Rerun the interference check solution, preparation of new solution, recalibrate, or adjustment of interelement correction factors. Rerun any samples requiring an element that fails, or if re-analysis is not possible, report the results with a qualifying comment.

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Interference Check Solution (ICSA)	See Section 6.6.8	Beginning and end of every run, and at least once every 8 hours.	80-120% for all interference analytes, and <2x the MDL for all non-spiked analytes	Rerun the interference check solution, preparation of new solution, recalibrate, or adjustment of interelement correction factors. Rerun any samples requiring an element that fails, or if re-analysis is not possible, report the results with a qualifying comment.

* Samples selected for duplicate and matrix spike analysis shall be rotated among client samples so that various matrix problems may be noted and/or addressed. Poor performance in a duplicate or spike may indicate a problem with the sample composition and shall be reported to the client whose sample produced the poor recovery.

- LCS recoveries and duplicate precision limits stated in the QC Chart are also used for all IH analyses.

9 Sample Collection, Preservation and Handling

9.1 Samples must be collected in plastic or glass containers. A minimum of 3.00 g for soil samples, and 150 mL for water samples must be supplied by the sampler in order for the laboratory to perform analysis.

9.2 Preserve aqueous samples using HNO_3 to a pH<2. Sample preservation shall be performed immediately upon sample collection. If this is not possible, then samples shall be preserved ASAP when received by the laboratory. Water samples and sample digestates shall be stored at room temperature both before and after analysis. Soil samples must be preserved above the freezing point of water up to 6°C until analysis.

NOTE: Aqueous samples that arrive to the lab in an unpreserved state must be acidified prior to metals analysis. The Sample Receiving Dept. checks the pH of all preserved samples that arrive at the lab. If the pH is > 2, an aliquot of nitric acid is added to the sample and shall be marked with an orange sticker on the lid. The sticker displays the time and date of the initial preservation. The pH of these samples must then be verified after 24-hours. If the pH is < 2, the sample is considered available for processing. If the pH is still > 2, additional nitric acid must be added and the pH verified < 2 after another 24-hour period. All pH readings must be documented in the Sample Receiving Preservation Log, which is found on the ALSI server in the Sample Receiving folder. See SOPs 19-BOTTLE and 19-Rec/Han.

9.3 All samples must be analyzed within 180 days of collection. All samples not analyzed within this time frame must be discarded and re-sampled for analysis, unless permission is given by the client to run the sample past its hold time. If this occurs, it must be clearly noted on the laboratory report.

9.4 All samples and digestates must be held by the laboratory for a minimum of two weeks

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after the lab reports have been sent to the client.

9.5 For samples requiring digestion, refer to the Sample Preparation SOPs for procedures.

9.6 See SOP 20-Field Services Sampling Plan for collection procedures.

10 Procedure

10.1 Initial Set-up and Analysis for the TJA Trace ICP

10.1.1 Perform the daily and as needed maintenance.

10.1.1.1 Refill the rinse solution.

10.1.1.2 Replace the sample and rinse pump tubing.

10.1.1.3 Inspect all other autosampler tubing for clogs and/or visible leaks.

10.1.1.4 Inspect the nebulizer for clogs and position in the spray chamber.

10.1.1.5 Inspect the spray chamber for cleanliness and clean if needed.

10.1.1.6 Set the incoming Argon pressure to 70 psi.

10.1.1.7 Clean the torch and tip if needed.

10.1.1.8 Adjust the tension on the pump tubing in the peristaltic pump.

10.1.1.9 Check the vacuum gauge. (This must read below 30 millitorr. If the pressure rises above 30, the vacuum pump oil must be changed.)

10.1.1.10 Check to be sure the water cooler is on and is filled to the proper level.

10.1.1.11 Check to be sure the hood is operating.

10.1.1.12 Empty the waste containers.

10.1.1.13 Check the reagent water level in the argon humidifier and refill if necessary.

10.1.2 Turn the computer on and using the arrow keys, move to Plasma Control Panel under Set-up. Press Enter.

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10.1.3 Press F1, Start-up and then press F9, continue. After purging for 90 sec. the torch will automatically be ignited. After the torch lights, press F2 from the menu, and scroll down to the pump speed / rate, and type in 130. Press Enter and then F9.

10.1.4 Press Esc. Use the arrow keys to move to Operation. Press Enter. After the Enter Method Name prompt, type in OPTIMIZE. The instrument will load and set the parameters, such as nebulizer pressure and pump speed, specified in this method. Put the probe of the autosampler in the rinse solution.

10.1.5 Allow the instrument to become thermally stable before beginning. This requires at least 30 minutes of running while aspirating rinse solution.

10.1.6 Profile the instrument using the Working Profile Solution as described in Section 7.1. When an acceptable profile is reached, print the screen by pressing Control F2, Print screen.

10.1.7 Leaving the probe in the profile solution, press F1, Analyze and F1, Run. The method will run 10 replicates of the Profile solution and print the %RSD. When an acceptable %RSD of less than 0.5 is achieved, print by pressing Control F2, Print Screen. Press F9, Done/Keep. You will now need to escape to the main menu and go to Analysis under the Operation tab. Next to the method command prompt type in SCICPHSB. This is the existing method set up for 6010 analysis. **NOTE**: If **DoD** samples are being analyzed, you will need to type **DoD** method name.

10.1.8 The following parameters shall also be checked while still in Methods. When everything has been set correctly, save any changes made to the method by pressing F9, Done/Keep. After checking the method settings, hit F3 (Method Info). Scroll down to the Analysis File Date, and change it to the current days date. (NOTE: a zero cannot be entered as the first digit.) If more than analysis run is performed on the same day, the sequence date must be followed by a sequential lettering system. (ex. 11306, 11306A, 11306B……) After entering the analysis file date hit F9 (Keep/Done), then F8 (OPTIONS), then F2 (PrintMTD), then F9 (Done/Print), and finally F9 2x (Done/Keep).

Sample Introduction Device: Normal
Calibration Mode: Concentration

Number of Repeats: 2 *(**3** Replicates are required for **DoD**)*
Flush Time: 65.0 sec
Auto-Store Analysis Data? Yes
Auto-Store Stdzn Data? Yes
Store Individual Repeats? No

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Autoprint Analysis Data? Yes
Autoprint Stdzn Report: None
Condensed Print Format? No

Output Mode: Concentration
Override Print Limits? Yes
Override Sig. Figures? No
Apply Background Correction? Yes
Apply Blank Subtraction? No

Torch gas: High Flow
Auxilary Gas Flow: Low (0.5 L/min)
Nebulizer Pressure: 25

Approximate RF Power: 950

Analysis Pump Rate: 150
Flush Pump Rate: 150
Relaxation Time (sec): 0
Pump Tubing Type: Tygon-Orange

10.1.9 After selecting, saving, and printing the required method, you will need to choose an autosampler table. Select OPERATION / Autosampler Setup from the main menu. Hit F8 (Filer), and select Autosampler Tables as a file type. You will need to scroll through the exiting files to find SC6010B. Place the cursor on SC6010B and hit F8 (COPY). Type in an autosampler name which matches the analysis file date you entered in (Section 10.1.8). Press Enter. **NOTE**: If **DoD** samples are being analyzed, you will need to use the DoD10 autosampler table.

10.1.10 Use the arrow keys to move to Operation, Autosampler set-up to create a sequence table for the Autosampler. Press Enter, then F1Edit Set., then press F1, Edit Samples, and ALT F2. The autosampler table will already have default QC's and sample ID's. The default sample ID's will need to be changed to match the sample ID's on your horizon analysis batch. Immediately following the sample ID, the analysts' initials in parentheses need to be entered. (If the sample requires a dilution analysis, this dilution factor must be typed inside the parentheses after the analysts' initials.) Hit Enter 2X after entering the above information so that the cursor is in the third available field from the left. The horizon batch # off your analysis batch needs to be entered in this field. Immediately following this batch #, a T or D must be typed in. The T represents samples requiring a total metals analysis, and the D represents samples requiring a dissolved metals analysis. If this T or D is not entered properly, the automatic download of data in to horizon **will not** function. Build the table and save by pressing F9, Done/Keep three times. The computer will dictate the positions for the calibration blank and

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standards as well as the QCs that the analyst has put into the sequence table. Rinse and refill the calibration standards, blanks, and QC sample wells in the Autosampler and insert them in the correct positions. **NOTE**: The correct autosampler positions can be viewed while in the autosampler edit mode.

10.1.11 Go into Operation off the main menu screen, and select Analysis. Enter the method name. Press Enter. Press F9, Autosampler. Enter the name of the Autosampler table to be used (Section 10.1.10). Press F1, Run. The instrument will, with the use of the Autosampler and peristaltic pump, start to standardize the instrument.

10.2 Analyze by the method of standard addition (Section 8.4) any samples containing matrix interferences which cannot be eliminated by dilution.

10.3 For the inter-element spectral interference correction factors to remain valid, the interferant concentration must not exceed its limit of linearity. Sample dilution is necessary in these cases, and the reporting limit must be raised to reflect the dilution performed.

11 Calculations

11.1 Sample results are reported directly from the readout of the instrument (from the calibration curve), and input into the LIMS. Appropriate prep factors are applied to the result at the time of supervisor approval.

11.2 Any sample result requiring dilution to bring the sample into the linear range, is multiplied by the dilution factor before being entered into the LIMS using the following equation:

$$A = \frac{Z\,(B)}{C}$$

where: A = concentration of element in sample
Z = concentration of element in diluted sample
B = final volume of dilution (mL)
C = volume of sample aliquot used in dilution (mL)

12 Reporting Results

12.1 Report results in the Horizon LIMS system: The TJA Trace 61E ICP is set up to automatically download analysis results in to a system called NuGenesis. The NuGenesis system reads the raw data and compiles it into a form that the Horizon LIMS system will understand. The NuGenesis files can be accessed by logging onto horizon and selecting “Autopost pipe” under OPERATIONS. A box labeled Advanced Find will appear. You must enter the Queue “META”, and enter the analysis batch # off your

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batch sheet. The sample IDs that will then appear in NuGenesis, will match the sample IDs that you typed in the autosampler table (Section 10.1.10) Therefore, if the sample ID was incorrectly entered in the autosampler table, it will be wrong in NuGenesis as well. Scroll down through the samples in NuGenesis, and make sure the results match your raw data. Once you have checked for errors, hit the AUTOPOST tab and select all.

12.2 Checking results in Horizon LIMS system: Once sample results have been autoposted from NuGenesis, you must enter the OPERATIONS tab and select POSTING-by Worklist. Enter the HBN (Horizon Batch Number) from the analysis batch sheet. The analyst must go through this work list and double check to make sure that all results autoposted correctly.

12.3 Choosing sample Condition Codes in Horizon LIMS system: The column to the right of the sample name is CC, which stands for Condition Code. The CC will read OK if Horizon received data from NuGenesis. If any sample in the analysis run required an additional dilution, or some kind of rerun while analyzing, it will appear more than once in your analysis batch. If the results were left as is, the lab report would have duplicate results. Therefore, you must change the condition code on the sample so that you can determine which analytes are taken from which run. There are three CC's that can be used in this case. They are **LR, LX**, and **RP**. The **LR** condition code is to be used only if an analyte could not be completed in the current analysis run. (ex.: Ag did not pass in your calibration QC). The **LX** condition code is to be used if a sample was analyzed more than once in the same run, and all reruns have been completed. (ex.: A sample had a high RSD for Pb, and it was successfully reanalyzed later in the same run.) The **RP** condition code is to be used if the digestion QC associated with the sample did not pass method criteria, and needs to be sent back up to the prep Dept. to be redigested. (ex.: The LCS failed high for cadmium, and the sample in question required a cadmium analysis).

12.4 Choosing analyte Condition Codes in Horizon LIMS system: After one of the condition codes listed in Section 12.3 has been entered next to the sample, another condition code needs to be placed after the individual analytes in order for the analyst to be able to determine which analytes are used or not used. The three available condition codes are: **MO**, **NO**, and **RP**. The **MO** condition code is used for analyte results that you want to be taken from the current sample. The **NO** condition code is used for analytes that you do not want to be taken from the current sample. The **RP** condition code is used for analytes that need to be re-digested by the prep dept. (ex.: A sample is analyzed for cadmium, silver, and zinc. The cadmium result was fine, the silver result was no good because the digestion method blank failed for silver, and zinc was over your linear range and requires an additional dilution. In this case cadmium would be MO, silver would be RP, and zinc would be NO.)

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12.5 All raw data used for reporting results must dated and initialed by the qualified laboratory personnel performing the first and second reviews. Use the Trace Run Case Narrative sheets located next to the PC to record this information.

12.6 If you need to hand enter results into Horizon due to problems with the automatic download, be sure not to round off results. Horizon will automatically perform rounding appropriate to the method. The actual result needs to be typed into horizon, even if it is less than the reporting limit. Any sample with a result less than the reporting limit will automatically be reported as ND (non-detect) by Horizon.

13 Waste Disposal

13.1 Refer to ALSI SOP 19-Waste Disposal.

14 Pollution Prevention

14.1 Pollution prevention encompasses any technique that reduces or eliminates the quantity or toxicity of waste at the point of generation. Numerous opportunities for pollution prevention exist in laboratory operations. Management shall consider pollution prevention a high priority. Extended storage of unused chemicals increases the risk of accidents. The laboratory shall consider smaller quantity purchases which will result in fewer unused chemicals being stored and reduce the potential for exposure by employees. ALSI tracks chemicals when received by recording their receipt in a traceable logbook. Each chemical is then labeled according to required procedures and stored in assigned locations for proper laboratory use.

15 Definitions

15.1 Refer to ALSI QA Plan under Laboratory Quality Control Checks for general definitions.

16 Troubleshooting

16.1 The ICP will often have carryover issues with silver that are confusing and difficult to remedy. Due to the chemical properties of silver, the analyte will build up inside the sample lines in the form of silver chloride. When a higher acid matrix is introduced to the system, the silver will sometimes fall back into solution, and show up as false positives. Usually the problem can be mediated by running some 20% HCL solution through the system for several minutes. Other times, the analyst will need to shut down, and clean the entire system. (NOTE: If the 20% HCL solution is run through the system for an extended period of time, the sample lines will develop a white haze. It is best to change out the lines when this occurs.)

16.2 Communication Errors or Power Outage. Often after power outages or periods of time when the computer has not been restarted for awhile, the Trace software will develop

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communication errors. If this occurs, the instrument and PC will need to be completely shut down and restarted. To shut down: extinguish the torch and exit out of TJA software, turn off the computer, turn off the one inch wide power strip located on the back of the instrument, turn off the red one inch wide switch on the front of the voltage regulator (small floor unit next to the wall.) Wait two to three minutes and then check to see if the vacuum pump is on by pressing the black start button located on the vacuum control system panel. Turn on the PC, voltage regulator, and instrument power switches. On the front of the ICP press the black RESET button located in the controller panel. Press the red RESET button on the back of the ICP. Then once again press the black RESET button on the controller panel. If the problems are still present, repeat this process. If this process is ineffective, technical support may need to be requested from Thermo Elemental.

16.3 Monitoring instrument trends for requesting service. By monitoring the peak intensities obtained from your As Optimization, the Optimization average recoveries, and the Hg profile throughout your analytical runs, you can often tell when service will soon be needed. The instruments RF tuning is checked annually during the PM Service; however, it is not uncommon for the tuning to require further adjustment throughout the year. By recording the information listed above in your analysis logbook, a trend will be more easily monitored. If a definite trend is detected, a service call to Thermo Elemental shall be placed. The reason for the service call must be documented in the maintenance logbook. Following the field service, an additional note shall be made that shows that the problem was corrected, and what was done to correct it.

16.4 Recording instrumentation problems in the maintenance logbook. Any daily service or issue involving the instrument must be noted in the maintenance logbook. The logbook is then a good source to refer to if problems develop. Usually the current issue with the instrument has occurred sometime in the past. The analyst can then look to see what if any corrective actions were performed.

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APPENDIX A

Trace ICP Analytical Worksheet

Acid Matrix: ___% HNO3 + ___% HCl

Instrument Method:_____
Sequence #:_____
Date Started:_____
Analyst:_____

*High Std:_____ml each of _____+_____ into _____ml Pipette ID #_____
*Mid Std:_____ml High Std into _____ml ICS:_____
*Low Std:_____ml High Std into _____ml RPL:_____ml_____into_____ml
*CCV/IPC:_____ml each of _____+_____ into _____ml
*Second Source:_____ml of _____+ Pipette ID #_____
_____ml each of _____+_____+_____ into _____ml
*Additional Second Source:_____ml of _____+_____ into _____ml
*Cal Blank:_____ml HNO3 Lot #:_____ HCl Lot #:_____ Pipette ID #_____

* All Standard are prepared daily prior to analysis of samples in acid matrix listed

PDS: 3.5 ml sample + 3.5 ml High Std

BLANK		
LOW STD		
MID STD		71
HIGH STD		72
SECOND SOURCE	31	73
	32	74
	33	75
	34	76
	35	77
	36	78
	37	79
	38	80
	39	
	40	
		81
		82
	41	83
	42	84
1	43	85
2	44	86
3	45	87
4	46	88
5	47	89
6	48	90
7	49	
8	50	
9		
10		
		91
		92
	51	93
	52	94
11	53	95
12	54	96
13	55	97
14	56	98
15	57	99
16	58	100
17	59	
18	60	
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20		
		101
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TABLE 1
(Element Wavelengths)

Element	Wavelength
Ag	328.068
Al	308.215
As	189.042
B	249.678
Ba	493.409
Be	313.042
Bi	223.061
Ca	317.933
Cd	226.502
Co	228.616
Cr	267.716
Cu	324.753
Fe	271.441
Mg	202.030
Mo	202.030
Mn	257.610
Ni	231.604
Pb	220.353
Sb	206.838
Se	361.384
Sn	189.989
Sr	421.552
Ti	334.941
Tl	190.864
V	292.402
Zn	213.856

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TABLE 2

(Reporting Limit Concentrations)

Element	Concentration
Ag	0.004
Al	0.10
As	0.010
B	0.10
Ba	0.010
Be	0.004
Bi	0.05
Ca	0.10
Cd	0.002
Co	0.005
Cr	0.005
Cu	0.01
Fe	0.06
Mg	0.10
Mo	0.02
Mn	0.005
Ni	0.02
Pb	0.006
Sb	0.025
Se	0.02
Sn	0.02
Sr	0.005
Ti	0.02
Tl	0.02
V	0.005
Zn	0.02

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TABLE 3
(Laboratory Fortified Blank and Matrix Spike Concentrations)

Element	Concentration (mg/L)
Ag	0.100
Al	1.00
As	0.100
B	1.00
Ba	1.00
Be	0.200
Bi	1.00
Ca	1.00
Cd	0.100
Co	1.00
Cr	0.100
Cu	1.00
Fe	1.00
Mg	0.100
Mo	1.00
Mn	0.100
Ni	1.00
Pb	0.100
Sb	0.20
Se	1.00
Sn	0.10
Sr	0.10
Ti	0.10
Tl	0.10
V	0.050
Zn	0.50

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TABLE 4
(Interference Check Solution Concentrations)

Element	Concentration
Ag	0.75
Al	30.0
As	2.50
Ba	0.75
Be	0.25
Ca	150
Cd	0.75
Co	0.75
Cr	0.75
Cu	0.75
Fe	125
Mg	75.0
Mn	0.50
Ni	0.75
Pb	2.50
Se	1.25
Tl	2.50
V	0.75
Zn	0.75

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TABLE 5
(Matrix Spike / Matrix Spike Duplicate Concentrations for TCLP and SPLP leachates)

Element	Concentration
Ag	0.90
As	0.90
Ba	9.00
Cd	0.90
Cr	4.50
Pb	4.50
Se	4.50

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SOP Change History Sheet

Section No.	Section	Reason for Change
Revision 10: 02/24/2005		
2	Summary of Method	U.S. Army Corp. audit response
6.1	Reagents	SOP Update
6.2	Reagents	SOP Update
6.5.1-6.5.2	Reagents	SOP Update
6.5.10	Reagents	SOP Update
6.6.4	Reagents	U.S. Army Corp. audit response
6.6.5	Reagents	SOP Update
6.6.6	Reagents	SOP Update
6.6.7	Reagents	SOP Update
6.6.8	Reagents	SOP Update
6.8-6.10	Reagents	SOP Update
6.9-6.11	Reagents	SOP Update
7.3	Instrument Calibration	SOP Update
7.4	Instrument Calibration	SOP Update
8.1.1	Quality Control	U.S. Army Corp. audit response
8.1.3	Quality Control	SOP Update
8.1.5	Quality Control	SOP Update
8.1.6	Quality Control	SOP Update
8.1.7	Quality Control	SOP Update
8.2.2	Quality Control	U.S. Army Corp. audit response
8.2.2.1	Quality Control	SOP Update

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SOP Change History Sheet (continued)

Section No.	Section	Reason for Change
8.3.1	Quality Control	SOP Update
8.3.4	Quality Control	SOP Update
8.7	Quality Control	SOP Update
8.12	Quality Control	Section Removed
9.3.2-9.3.4	Sample Handling	SOP Update
10.1.8	Procedure	U.S. Army Corp. audit response
12.1	Reporting Results	SOP Update
12.2 / 12.3	Reporting Results	Sections Removed
	Appendix A (Analytical Worksheet)	U.S. Army Corp. audit response
	Table 2 (RPL Concentrations)	SOP Update
	Table 3 (LCS / MS Concentrations)	SOP Update
	Table 4 (Interference Check Concentrations)	SOP Update
Revision 11: 01/26/2006		
1.1	Scope and Application	Matrices update
1.7	Scope and Application	Project requirements note
2	Summary of Method	DoD audit response
3.1.3	Interferences	Frequency change instituted for correction factors
3.4	Interferences	SOP update from Method 4.2
4.2	Safety	Directive to read MSDS sheets and their availability
5.2 & 5.4	Apparatus and Materials	SOP materials update

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SOP Change History Sheet (continued)

Section No.	Section	Reason for Change
6.1 & 6.2	Reagents	Expiration date and labeling
6.5.8	Reagents	Addition of "Solution A"
6.5.9	Reagents	Addition of "Solution B"
6.6.1	Reagents	Reagent source change, documentation and hold time additions
6.6.2	Reagents	Documentation and hold time additions
6.6.3	Reagents	Documentation and hold time additions
6.6.4	Reagents	DoD audit response
6.6.5	Reagents	Documentation statement
6.6.6	Reagents	Documentation and hold time additions
6.6.7	Reagents	Preparation revision
6.6.8	Reagent	Preparation revision
6.9	Reagents	Preparation revision
6.10	Reagents	Volume & concentration change
6.34	Reagents	Section added
7.1.1	Instrument Calibration	Scandium replaces arsenic
7.1.2	Instrument Calibration	Profile line change
7.1.3	Instrument Calibration	Scandium replaces arsenic
7.1.4	Instrument Calibration	DoD audit response
7.1.5	Instrument Calibration	DoD audit response
7.3	Instrument Calibration	DoD audit response
8.1.1	Quality Control	DoD audit response

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SOP Change History Sheet (continued)

Section No.	Section	Reason for Change
8.1.2	Quality Control	DoD audit response
8.1.3	Quality Control	Reference to QA Plan
8.1.4	Quality Control	Instructions added for IECs
8.1.8	Quality Control	DoD audit response
8.2.3	Quality Control	LCS replaces LFB
8.2.3.1	Quality Control	Change in Stock Solution
8.2.3.2	Quality Control	Section Removed
8.2.2	Quality Control	DoD audit response
8.2.6	Quality Control	DoD audit response
8.3.1	Quality Control	DoD audit response
8.3.2	Quality Control	DoD audit response
Quality Control Requirements (Calibration Blanks)		DoD audit response
Quality Control Requirements (RPL)		DoD Audit Response
Quality Control Requirements (Matrix Spike)		SOP Update
Quality Control Requirements (Sample Replicates)		SOP Update
8.6	Quality Control	Scandium intensity adjusted from ± 20% to ± 30%
10	Procedure (throughout section)	Additional instrument directions
12	Reporting Results	Major revisions throughout
16	Troubleshooting	DoD audit response

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SOP Change History Sheet (continued)

Section No.	Section	Reason for Change
Revision 12: 02/13/2007		
1.6	Scope and Application	Updated MDL file location/maintenance
4.2	Safety	Updated MSDS file locations
6.4	Reagents	Updated vendor information
6.8	Reagents	Revised Working Internal Standard Solution concentration
6.10	Reagents	Revised volumes of single element solution for some elements
8.11	Quality Control	Deleted terminology "reprofile and/or" from corrective action for High Cal Stnd, QCS, and ICP; reworded RPL corrective action and revised control limits; revised Scandium Internal Standard corrective action for greater detail; revised Internal Check Solution frequency
2	Table	Revised some of the element reporting limit concentrations

Revision 13: 02/04/08

Spelling, grammar, and formatting changes may have been made throughout SOP for clarity, correctness, and site conformity.

1.1	Scope and Application	Updated reference method
1.6	Scope and Application	Updated MDL file location
4.2	Safety	Updated MSDS availability/verbiage
6	Reagents	Added NOTE
6.6.8	Reagents	Added section
8.2.5, 8.2.5.1	Quality Control	Updated procedure
8.3.3.1	Quality Control	Added section per DoD audit
8.11	Quality Control	Updated table per DoD audit

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SOP Change History Sheet (continued)

Section No.	Section	Reason for Change
9	Sample Collection…	Updated format
9.2	Sample Collection…	Added NOTE per DoD audit
9.6	Sample Collection…	Added section

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SOP Concurrence Form
for the Distribution and Revision of Standard Operating Procedures

I have read, understood, and concurred with the Standard Operating Procedure (SOP) described above and will perform this procedure as it is written in the SOP.

Print Name	Signature	Date

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Document Title: Ultrasonication of Solids for the Analysis of Explosives by EPA Method 8330B (HPLC)

Document Control Number: _____

Organization Title: ANALYTICAL LABORATORY SERVICE, INC. (ALSI)

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Justin Hall, Date
GC Department Supervisor

_____ _____
Evan Cooper, Ph.D. Date
Validator

Annual Review:

_____ _____
Reviewed By Date Reviewed

_____ _____
Approved By Date Approved

_____ _____
Reviewed By Date Reviewed

_____ _____
Approved By Date Approved

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Annual Review (continued):

Reviewed By	Date Reviewed
Approved By	Date Approved

Reviewed By	Date Reviewed
Approved By	Date Approved

Reviewed By	Date Reviewed
Approved By	Date Approved

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Approved By	Date Approved

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1 Scope and Application

1.1 This Standard Operating Procedure is adapted from U. S. EPA Test Methods for Evaluating Solid Waste Physical/Chemical Methods (SW846), Method 8330B, Revision 2, October 2006.

1.2 This document states the laboratory's policies and procedures established in order to meet requirements of all certifications/accreditations currently held by the laboratory, including the most current NELAC standards.

1.3 This extraction procedure is appropriate for those samples requiring analysis by EPA Method 8330B, Revision 2, October 2006. The analytes cited in Section 1 of the SOP 1B-8330 are the analytes currently validated and acceptable for this procedure.

1.4 Individual project requirements may override criteria listed in this SOP.

2 Summary of Method

2.1 Solid samples are ground and extracted, using acetonitrile in an ultrasonic bath, and filtered, in preparation for HPLC analysis.

3 Interferences

3.1 Phthalate esters contaminate many types of products commonly found in the laboratory. Plastics in particular must be avoided because phthalates are commonly used as plasticizers and are easily extracted from plastic materials.

3.2 Soap residue on glassware may cause degradation of certain compounds. All glassware shall be rinsed carefully with deionized water to avoid the problem.

3.3 Interferences co-extracted from the samples will vary considerably from source to source.

3.4 Light decomposes various target analytes, in particular, tetryl. Precautions shall be taken as to not allow excessive amounts of light to reach sample.

3.5 Heat causes some analytes, in particular, tetryl, to decompose rapidly. Samples shall not be exposed to temperatures above room temperature.

4 Safety

4.1 The toxicity or carcinogenicity of each reagent used in this method has not been precisely defined; however, each chemical compound shall be treated as a potential health hazard. From this viewpoint, exposure to these chemicals must be reduced to the lowest possible level by whatever means available.

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4.2 ALSI maintains material safety data sheets (MSDS) on all chemicals used in this procedure. ALSI recommends that all individuals performing this SOP familiarize themselves with the MSDS associated with the procedure prior to SOP performance. MSDS are available to all staff and are located in hard copy in the QA reference library and electronically on the ALSI server in the MSDS folder.

4.3 All solvents and reagents used in this procedure shall be handled in a fume hood wearing a fully buttoned lab coat and chemical resistant gloves.

4.2 Solids containing a high amount of explosive analytes may be present as finely ground grayish-white material. Extreme caution shall be used with these samples. Samples containing large amounts of grayish-white material, or lumps of material that have a chemical appearance or are known to have come from a site containing high amounts of explosives shall be suspect and not ground as described in 09-8330B Grinding.

5 Apparatus and Materials

5.1 Ultrasonic Disrupter – Bronson 2510, 80 watt, or equivalent, equipped with floating tray, and a temperature-controlled bath.

5.2 Vortex Mixer.

5.3 Balance – capable of weighing ± 0.01 g.

5.4 Syringes – gastight, appropriate sizes.

5.5 Syringes – disposable 10-mL (0.90 mm x 25 mm).

5.6 Syringe Filters – Spartan #00760, 0.45-µm Teflon (PTFE) membrane, 25 mm diameter, or equivalent.

5.7 Pasteur Pipets – glass disposable.

5.8 Culture Tubes – glass, disposable with Teflon-lined (PTFE) screw caps, 16 x 125 mm.

5.9 VOA Vials – 20-mL, pre-cleaned glass.

5.10 Vials – amber, glass 2-dram.

5.11 Weigh Boats – aluminum.

5.12 Volumetric Pipets – 5-mL, 10-mL, Class A.

5.13 600-micron sieve – stainless steel.

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6 Reagents

NOTE: Unless otherwise noted in this section, all chemicals are stored at room temperature and labeled with an expiration date of five years from receipt. Manufacturer's labeled expiration dates, when less than five years, take precedent over all other expiration dates.

6.1 Acetonitrile: HPLC grade purchased from VWR Catalog #BJ015-4 or equivalent.

6.2 Methanol (MeOH): HPLC grade purchased from VWR Catalog #EM-MX0475-1 or equivalent.

6.3 Surrogate Stock Solution – 1-chloro-3-nitrobenzene (1000 µg/mL) in acetonitrile, Ultra Scientific part #IST-630, or equivalent. Store at -10ºC to -20ºC protected from light.

6.4 LCS/matrix spike stock solution – Cerilliant Method 8330 Stock Standard P/N ERE-021, or equivalent. This standard contains all 14 of the explosive compounds listed in EPA method 8330A, all at 200 µg/mL in acetonitrile. Store at -10 to -20°C protected from light.

6.5 Additional Compounds LCS/matrix spike stock solutions: The compounds Nitroglycerin (NG), Pentaerythritol tetranitrate (PETN), and 3,5-Dinitroaniline (3,5-DNA), may also be analyzed by this method. The stock standards for these compounds are purchased as separate single component solutions:

6.5.1 NG Primary Stock Solution: Cerilliant Trinitroglycerin Standard P/N T-002, or equivalent. This standard contains NG at 1000 µg/mL in acetonitrile. Store from -10°C to -20°C protected from light.

6.5.2 PETN Primary Stock Solution: Cerilliant PETN Standard P/N P-037, or equivalent. This standard contains PETN at 1000 µg/mL in acetonitrile. Store from -10°C to -20°C protected from light.

6.9.3 3,5-DNA Primary Stock Solution: Restek 3,5-DNA P/N 31661, or equivalent. This standard contains 3,5-DNA at 1000 µg/mL in acetonitrile. Store at -10°C to -20°C protected from light.

6.6 Sand - Ottawa 20-30 mesh. Fisher Scientific, Part #523-50 (1999). Muffle furnace at 400ºC for four hours. Cool and store in a glass bottle at room temperature. Label with an expiration date of 180 days.

6.7 VOA vials, 20-mL, purchased from VWR, or equivalent.

7 Glassware Cleaning

7.1 Remove surface residuals immediately after use by rinsing with tap water or the last

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solvent used.

7.2 Soak the glassware in hot water and Liquinox detergent to float most particulate material from glassware. Use a brush to scrub the glassware to aid in the removal of residual materials.

7.3 Hot water rinse the glassware.

7.4 If the glassware used was in contact with high level samples and/or there is an apparent residue remaining on the glassware after the first three steps, it will be necessary to soak the glassware in a strong oxidizing agent to destroy traces of residual compounds. The oxidizing agent currently used is Chem Solv 2157, manufactured by Mallinckrodt and distributed by Baxter Scientific (part #2157-INY, 1995). Chem Solv 2157 is a safer alternative to chromic acid solutions typically suggested for cleaning glassware. The manufacturer's instructions for the safe handling of Chem Solv 2157 shall be stored with each container and reviewed before its use. Glassware suspected or known to have been in contact with high-level samples shall soak for 1 hour in the Chem Solv solution. Rinse with copious amounts of tap water and resubmit for normal cleaning procedure (Section 7.2).

7.5 Rinse the glassware thoroughly with deionized water to remove remaining materials and any metallic deposits.

7.6 Dry the glassware in an oven at 130ºC ± 30ºC for a minimum of 30 minutes.

7.7 Allow the glassware to cool for a minimum of 30 minutes.

7.8 Wrap glassware openings with aluminum foil if stored for later use.

7.9 Flush all glassware immediately before use with the extraction solvent being used for the application.

8 Quality Control

8.1 All policies and procedures in the most current revision of the ALSI QA Plan shall be followed when performing this procedure.

8.2 Initial Demonstration of Capability: This demonstration must be successfully performed by each analyst prior to being considered proficient to analyze samples by this method. Ongoing proficiency must be established annually as specified in the QA Plan, under Technical Training,

8.2.1 Four QC check samples will be prepared: Spike four 10.0 g samples of reagent sand with 20.0 µL of the Spike Solution. Take the samples through all steps of the extraction as described in this SOP.

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8.2.2 Analyze samples by HPLC as described in ALSI SOP 1B-8330.

8.2.3 An average recovery range of 70-130% recovery will be used as guidance to assess laboratory performance. See ALSI SOP 1B-8330 for calculation of percent recovery. A precision control limit of 30% RSD for all four check samples will be used as guidance to assess laboratory performance. When sufficient data is gathered, in house control limits will be used to assess laboratory performance.

8.2.4 If one or more analytes do not meet this criterion, identify and correct source of problem and report test for those analytes that initially failed.

8.3 A method blank must be run with each batch of samples prepared. It is imperative that the blanks be subjected to exactly the same analytical procedures as those used in the actual samples. This includes grinding, the addition of the surrogate standards, and the use of sodium sulfate and other chemicals used in the extraction procedures.

8.4 A matrix spike and matrix spike duplicate or a matrix spike and duplicate must be extracted with each batch. If insufficient sample is available to perform a matrix spike or duplicate, a comment must be placed in the extraction log.

8.4.1 Samples selected for duplicate and matrix spike analysis shall be rotated among client samples so that various matrix problems may be noted and/or addressed. Poor performance in a duplicate or spike may indicate a problem with the sample composition and shall be reported to the client whose sample produced the poor recovery.

8.5 A laboratory control sample (LCS) must be extracted with every batch. The LCS is prepared similarly to a method blank but is spiked with the LCS spiking solution.

8.6 The size of any extraction batch cannot exceed 20 samples.

8.7 MDL studies must be performed according to ALSI SOP 99-MDL or the reference method, whichever is more frequent.

9 Sample Collection, Preservation and Handling

9.1 Soil samples shall be collected as per method 8330B, through the use of multi-increment sampling. No preservation is recommended. Upon receipt, samples are air dried, unexposed to light, to a constant weight. If samples are not dried immediately, they may be stored in the dark at 4ºC or lower. After air drying the sample, it can be held at ambient temperature or cooler.

9.2 It is recommended and is also the practice at ALSI that samples are dried and extracted within 14 days of collection. However, it has been demonstrated that the dried/ground

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sample remains stable for up to two months.

9.3 Sample extracts must be analyzed within 40 days of extraction. All extracts shall be stored protected from light above the freezing point of water up to 6ºC.

9.4 See SOP 20-Field Services Sampling Plan for collection procedures.

10 Procedure

10.1 Sample drying and grinding--Refer to SOP 09-8330B Grinding.

10.2 Sample Homogenization –

10.2.1 Once the sample has been dried and completely ground, an aliquot for extraction may be removed. This can be accomplished by the following steps.

10.2.1.1 Lay the entire sample out on the original tray it was dried on so that it is 1-2 cm thick. Caution needs to be taken to not spread the dust which could in turn cause analyte loss.

10.2.1.2 Place an appropriately labeled 20-mL VOA vial on a balance. Tare the balance.

10.2.1.3 Using a clean, dry, acetonitrile rinsed spatula, obtain 10 grams of the sample, using at least 30 different increments (portions ~0.3g) from randomly chosen locations collecting each in the VOA vial.

10.3 Sample Extraction

10.2.1 Record the actual weight in extraction logbook.

10.2.2 Add 10 µL of working surrogate solution to the surface of all samples, blanks, and LCS's.

10.2.3 Add 10 µL of the necessary spiking solution(s) (6.4 and/or 6.5) to all matrix spikes and LCS.

10.2.4 Using an acetonitrile rinsed, Class A, 20-mL volumetric pipet, add 20.0 mL of acetonitrile to all samples, blanks, and LCS's. Cap all tubes with clean PTFE-lined caps.

10.2.5 Vortex swirl each tube for one minute. (In larger batches, this step may take considerable time. Precautions shall be taken as to not subject tubes to excessive light or heat.)

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10.2.6 Place all tubes into the floating tray of the ultrasonic bath. (Samples shall be upright during sonication; a rubber band may be needed to hold all the tubes together and upright over the entire sonication process.) Cover the entire top of sonicator with aluminum foil so as not to allow any light to reach the samples.

10.2.7 Set the ultrasonic bath to the "run continuously" position, recording the time in the logbook. Samples are sonicated for 18 hours. (During the sonication, bath temperature must stay in a 15°C - 25ºC temperature range. To ensure this, a chilling apparatus needs to be in place. Occasional monitoring of the bath temperature needs to be done in order to ensure the water stays within this range.)

10.2.8 After 18 hours of sonication, turn the bath off and record the time. Remove the samples from the bath and place in a tube rack and allow to settle for 30 minutes.

10.3 Filtering of Supernatant

10.3.1 Assemble a 10-mL disposable syringe without the PTFE filter. Draw entire supernatant into syringe. (Depending on sample matrix, if any residual substrate is left on the syringe tip, it will need to be rinsed with a small amount of acetonitrile.) Invert syringe and attach a 0.45-µm PTFE filter.

10.3.2 Discard first 1 mL and retain remainder in a PTFE-capped 2-dram amber vial labeled with all appropriate COC information and LIMS ID. For dirtier samples, the syringe filter may need to be replaced before the entire sample is pushed through.

11 Calculations

11.1 Not applicable.

12 Reporting Results

12.1 Pre-extraction Entries (Batching).

12.1.1 In the "batching" function of the LIMS select the "appropriate" RULE under the EXTR Queue.

12.1.2 Select the desired samples for the extraction batch by placing a check beside the COC# number. Press the "build batch" button.

12.1.3 Preview the "notes" section of the batch schedule to identify client specified QC. Determine which COC#s have additional sample available for the required sample matrix QCs' and add them to the batch using the "Add QC" button.

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12.1.4 Verify all desired samples are in the batch and appropriate QCs' have been added. Save the batch. Record the HBN# in the extraction logbook.

12.2 Post Extraction Entries (Posting) and Data Review

12.2.1 Once extracts are vialed and initial sample volumes and extract final volumes have been recorded in the extraction logbook, the initial and final volumes must be posted in the LIMS.

12.2.2 In the "operations" function of the LIMS select one of the posting options.

12.2.3 Enter the technician's initials beginning the extraction and the date and time the extraction was initiated as recorded in the extraction logbook. Times must be recorded in hours and minutes. Seconds shall be recorded as "00".

12.2.4 Enter the appropriate initial and final volume in the LIMS. When entering data into Horizon LIMS, do not round off results; Horizon will automatically perform rounding appropriate to the method. Verify all entries are correct and "save" the entries.

12.2.5 Date and initial in the extraction logbook in the "approved" entry at the bottom of the page.

12.2.6 Review the labeling on all vials and deliver to the GC Department for storage at a temperature above the freezing point of water up to 6°C until analysis.

12.2.7 A second technician must verify all initials, dates, times, and volumes have been correctly transferred from the logbook to the LIMS. Date and initial in the extraction logbook in the "reviewed" entry at the bottom of the page.

13 Waste Disposal

13.1 Refer to ALSI SOP 19-Waste Disposal.

14 Pollution Prevention

14.1 Pollution prevention encompasses any technique that reduces or eliminates the quantity or toxicity of waste at the point of generation. Numerous opportunities for pollution prevention exist in laboratory operations. Management shall consider pollution prevention a high priority. Extended storage of unused chemicals increases the risk of accidents. The laboratory shall consider smaller quantity purchases which will result in fewer unused chemicals being stored and reduce the potential for exposure by employees. ALSI tracks chemicals when received by recording their receipt in a traceable logbook. Each chemical is then labeled according to required procedures and stored in assigned locations for proper laboratory use.

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15 Definitions

15.1 Refer to ALSI QA Plan under Laboratory Quality Control Checks for general definitions.

16 Troubleshooting

16.1 Refer to maintenance logs and instrument manuals for guidance in troubleshooting specific problems related to the instrumentation used in this method.

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APPENDIX A

Work continued from page:____

HPLC EXTRACTION

Work continued to page:____

EPA Method: _____ Surrogate ID: _____

ALSI SOP: _____ Surrogate Amount: _____

Extraction:	Date	Time	Tech	Sonication:	Time On	Time Off	Total Hours Sonicated	Tech

Line #	Sample ID	Sample Amount	QC Type	Spike ID	Spike Amount	Final Volume	Elution Time	Sample Specific Comments (Include weigh data for drying, if applicable.)
1.)								
2.)								
3.)								
4.)								
5.)								
6.)								
7.)								
8.)								
9.)								
10.)								
11.)								
12.)								
13.)								
14.)								
15.)								

Reagent Identification(s): _____

_____

Approved By:_____
Date Approved:_____

Page #:____

Revised 2/1/05

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SOP Change History Sheet

Section No.	Section	Reason for Change

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SOP Concurrence Form
for the Distribution and Revision of Standard Operating Procedures

I have read, understood, and concurred with the Standard Operating Procedure (SOP) described above and will perform this procedure as it is written in the SOP.

Print Name	Signature	Date

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Document Title: Standard Operating Procedure for Sample Receipt/Sample Handling

Document Control Number: _____

Organization Title: ANALYTICAL LABORATORY SERVICE, INC. (ALSI)

Address: 34 Dogwood Lane
Middletown, PA 17057

Phone: (717) 944-5541

Approved by:

_____ _____
Helen MacMinn, Date
Quality Assurance Manager

_____ _____
Anna Milliken, Date
Operations Manager

_____ _____
Steve Smith, Date
Validator

Annual Review:

_____ _____
Reviewed By Date Reviewed

_____ _____
Approved By Date Approved

_____ _____
Reviewed By Date Reviewed

_____ _____
Approved By Date Approved

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Annual Review (continued):

Reviewed By	Date Reviewed
Approved By	Date Approved

Reviewed By	Date Reviewed
Approved By	Date Approved

Reviewed By	Date Reviewed
Approved By	Date Approved

Reviewed By	Date Reviewed
Approved By	Date Approved

Reviewed By	Date Reviewed
Approved By	Date Approved

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1 Scope and Application

1.1 The purpose of this Standard Operating Procedure (SOP) is to demonstrate the procedures for receiving and handling of all samples coming into the laboratory.

1.2 This document states the laboratory's policies and procedures established in order to meet the requirements of all certifications/accreditations currently held by the laboratory, including the most current NELAC standards.

1.3 Individual project requirements may override criteria listed in this SOP.

2 Summary of Method

2.1 Samples are received from a variety of sources including ALSI field services personnel, walk-in clients, client's field personnel, and shipping carriers. Upon receipt of samples, sample receiving personnel complete the appropriate documentation. Sample receiving personnel also check for any non-conformances regarding the condition of the samples upon receipt.

3 Interferences

3.1 Not applicable.

4 Safety

4.1 ALSI maintains material safety data sheets (MSDS) on all chemicals used in this procedure. ALSI recommends that all individuals performing this SOP familiarize themselves with the MSDSs associated with the procedure prior to SOP performance. MSDS are available to all staff and are located in hard copy in the QA reference library and electronically on the ALSI server in the MSDS folder.

4.2 Incoming samples may contain a variety of unknown and potentially serious safety hazards associated with both the samples themselves and the preservatives added to them and as such, shall be treated with the utmost caution.

4.3 The minimum personal protective equipment requirements are safety glasses, a fully buttoned lab coat, and chemical resistant gloves.

4.4 Incoming coolers will be opened in or next to a ventilation hood when sample conditions or accompanying information dictate.

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5 Apparatus and Materials

5.1 pH paper (1-6 range), purchased from VWR catalog #66777-027, or equivalent

5.2 pH paper (9-14 range), purchased from VWR catalog #34175-499, or equivalent.

5.3 5-3/4" Pasteur pipettes, purchased from VWR catalog #14672-200, or equivalent.

5.4 Potassium iodide starch paper purchased from VWR catalog #60799-008, or equivalent.

5.5 Total chlorine paper, purchased from Fisher Scientific catalog #3108T34, or equivalent.

5.6 Thermometers, capable of measuring to 1°C in the range which includes -10°C to 40°C, purchased from VWR catalog #61222-504, or equivalent.

5.7 Calibrated infrared temperature gun, capable of measuring to 1°C; HB Infrared Thermometer 900LS, purchased from VWR, or equivalent.

5.8 Refrigerators. Each refrigerator used for storage of samples is maintained above the freezing point of water up to 6ºC. Temperatures are monitored 7 days a week and are recorded in the temperature logbook after the correction factor is applied. The refrigerators include:

5.8.1 Walk-in Refrigerator by AmeriKooler, Inc. with a Winland Electronics, Inc. temperature alarm located on upper level.

5.8.2 Walk-in Refrigerator by Bally, Serial #DX9101996-01 located on lower level.

5.8.3 Walk-in Refrigerator by Harford, Model DL3676W487-V located on upper level

5.8.4 Refrigerator #7 - Gibson Market Master located in the GC lab.

5.8.5 Refrigerator #10 - Gibson Market Master located in the GCMS lab.

5.8.6 Refrigerator #18 – Admiral. (Used for microbiology samples only.)

5.8.7 Refrigerator #26 – Kenmore located in the GC/MS lab.

5.8.8 Refrigerator #27 – General Electric. (Used for holding volatile samples in

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Sample Receiving before distribution to departments.)

6 Reagents

6.1 Not Applicable.

7 Instrument Calibration

7.1 Not Applicable.

8 Quality Control

8.1 All policies and procedures in the most current revision of the ALSI QA Plan shall be followed when performing this procedure.

8.2 It is the responsibility of Sample Receiving personnel to check for and document any non-conformances regarding the condition of the samples upon receipt. These non-conformances may include but not be limited to, incorrect containers, preservatives, or packaging, unacceptable sample temperatures, expired holding times, and incomplete or inaccurate documentation. These non-conformances shall be recorded on the COC and communicated to the appropriate customer Service Representative so that the client can be notified, or the client may be contacted directly by receiving personnel. Inform Customer Services of any such communications. Any non-conformances associated with sample preservation shall also be recorded in the sample preservation logbook (Appendix A).

8.3 ALSI reserves the right to reject a sample upon receipt in the laboratory if any of the following conditions occur:

8.3.1 The sample is not properly identified on the sample label and/or the Chain-of-custody form.

8.3.2 The sample has exceeded the holding time for the requested analysis.

8.3.3 The incorrect preservative was used during sample collection.

8.3.4 Incorrect sampling protocols were used during sampling.

8.3.5 Improper sample container was used.

8.3.6 Insufficient sample is present to perform the requested analysis.

8.3.7 Improper storage or transport of sample has occurred prior to receipt.

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8.3.8 Excessive amount of sample has been collected or other conditions exist which would make disposal difficult.

8.3.9 Excessive air bubbles are present in samples requiring zero headspace.

8.4 An Initial Demonstration of Capability shall be documented as follows:

8.4.1 Completion of the "New Employee Orientation: Sample Receiving Training Checklist: Checking Sample Preservatives." See Appendix F.

8.4.2 Completion of the "New Employee Orientation: Sample Receiving Training Checklist: Measuring Cooler Temperatures." See Appendix F.

8.4.3 Completion of the "New Employee Orientation: Sample Receiving Training Checklist: Receiving Samples." See Appendix F.

8.4.4 Reading, understanding and acceptance of the contents of this SOP shall be documented through the signing of the 19-Rec/Han Concurrence form.

8.4.5 Corrective action for DOC failure:

8.4.5.1 Repeat training shall be performed until all forms are successfully completed.

8.4.5.2 It shall be at the discretion of supervisory staff and management to determine at what point repeat training is no longer applicable and reassignment or company termination is appropriate.

8.5 Ongoing proficiency on an annual basis, as specified in the QA Plan, Technical Training, does not apply to this procedure.

9 Sample Collection, Preservation and Handling

9.1 Not applicable.

10 Procedure

10.1 The Sample Receiving area is staffed Monday through Friday from 08:00 to 22:00. Samples are received from a variety of sources including ALSI field services personnel, walk-in clients, client's field personnel, and shipping carriers.

10.1.1 Samples received from a carrier (Fed-Ex, UPS, etc.) shall be accepted

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through a signature by a laboratory employee upon receipt at the facility and taken to the Sample Receiving area.

10.1.2 ALSI field personnel shall deliver all samples to the Sample Receiving area.

10.1.3 Walk-in clients and other client's field personnel shall be directed to the Sample Receiving area to deliver their samples.

10.2 All samples shall be accompanied by a Chain of Custody (Appendix C). All information required in the gray shaded area of the ALSI Chain shall be filled in by the client/sampler. If the sample is accompanied by a Chain of Custody from another source, the following information shall be included: client information (name, address, contact person, and phone number), sample(s) description, date/time sampled, analyses requested, date/time results required, PWSID information (if applicable), and any special deliverable or handling instructions (if applicable). The Chain of Custody shall also be signed by each individual having possession of the samples since collection (both when they receive the sample and when they relinquish it). A representative of the sample receiving department shall sign the Chain of Custody when the samples are received at the laboratory. If a walk-in customer does not have a Chain of Custody, one must be completed before samples will be accepted.

10.2.1 If a Chain of Custody references microbiological samples that require immediate attention due to holding time restrictions, the Chain of Custody may also be signed by a representative of the microbiology department. In signing the Chain of Custody, the representative from the microbiology department shall follow the same procedures as sample receiving personnel.

10.3 The condition of the samples at the time of receipt must be documented.

10.3.1 If the sample is from an EPA project, a DC-1 form (Appendix D) must be completed to document the condition of the samples at the time of receipt.

10.3.2 If the sample is from the EPA Cincinnati UCMR2 project, an ALSI EPA UCMR2 Sample Receipt Checklist (Appendix E) must be completed.

10.3.3 Any other checklist or cooler receipt form provided by a client must be completed in its entirety.

10.3.4 The condition of all other samples at the time of receipt shall be documented in the receipt information section of the ALSI Chain of

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Custody. If the Chain of Custody is from another source other than ALSI, a receipt information label shall be affixed to the Chain to record this information.

10.3.5 If the project requires an internal Chain of Custody, this procedure must be initiated by the Sample Receiving Department at login. Refer to the Legal Chain of Custody SOP (99-LCOC) for details.

10.3.6 The appropriate customer service representative shall be notified of non-conformances so that the client can be contacted and a decision made whether to run the sample as received or to resample. If required, sample receiving personnel can also make attempts to contact the client with any question or non-conformance. All information provided by the client shall be documented on the COC. Notify the appropriate customer service representative of all communication with the client.

10.4 The temperature of the cooler/container must be taken at the time of receipt.

10.4.1 If a temperature blank is provided with the cooler, a calibrated thermometer shall be used to determine the cooler temperature. The correction factor shall be applied to the measurement and the corrected temperature along with the thermometer ID shall be recorded on the Chain of Custody in the receipt information section.

10.4.2 If a temperature blank is not provided, the temperature of the sample is taken with a calibrated IR gun held no more than one inch away from the sample bottle or temperature blank. The reading must be taken directly through the side of the bottle. It shall not be taken through the lid or through any label, etc., adhered to the bottle. The correction factor shall be applied to the measurement and the corrected temperature along with the thermometer ID shall be recorded on the Chain of Custody in the receipt information section.

10.4.3 If this protocol is not feasible, a small amount of sample shall be decanted from a non-volatile bottle and a calibrated thermometer shall be used to read the temperature of the sample as discussed in Section 10.4.1.

10.4.4 If the temperature reading does not fall within the acceptable range (above the freezing point of water up to 6ºC), multiple readings shall be taken using at least two other bottles contained in the same cooler to insure that a representative reading has been obtained. All readings shall then be recorded along with the identification of the bottles from which they were taken.

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10.4.5 Samples that are hand delivered to the laboratory on the same day that they are collected may not meet these criteria. In these cases, the samples shall be considered acceptable if there is evidence that the chilling process has begun such as arrival on ice.

10.4.6 All samples shall be observed for receipt on ice. The observation shall be documented by checking the appropriate Y/N box in the receipt information section of the Chain of Custody. The individual noting this fact shall also initial the corresponding line.

10.4.7 Samples shall remain on ice or be transferred to an appropriate refrigerator until processing. Microbiological samples shall be stored in Refrigerator 18 and volatile samples shall be stored in Refrigerator 27 to prevent contamination until transport to the appropriate departments.

10.5 All samples shall be checked for custody seals. The presence of custody seals shall be noted on the Chain of Custody by checking the appropriate Y/N box in the receipt information section of the Chain and initialing the corresponding line. If custody seals are present, the presence or absence of tampering shall be documented by checking the appropriate Y/N box in the receipt information section of the Chain. Details involving any tampering with custody seals shall be noted in the sample/COC comments section of the Chain.

10.6 All samples shall be checked for breakage/leakage. The presence or absence of damage shall be noted by checking the appropriate Y/N box under “Cont. in Good Cond.” in the receipt information section of the Chain. Details involving any breakage shall be noted in the sample/COC comments section of the Chain.

10.7 All samples shall be checked to insure that the information on the Chain of Custody agrees with the information on the container labels. This information would include sample descriptions, date/time sampled, sampler ID, and analyses requested. Whether or not the Chain of Custody and labels agree shall be documented by checking the appropriate Y/N box in the receipt information section of the Chain. Any discrepancies between the Chain and labels shall be specifically mentioned in the sample/COC comments section of the Chain.

10.8 All samples shall be checked to insure that the containers received are appropriate for the analyses requested and that a sufficient sample volume has been provided. This information shall be documented by checking the appropriate Y/N boxes under “Correct Containers” and “Correct Sample Volumes” in the receipt

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information section of the Chain. Any non-conformances shall be specifically mentioned in the sample/COC comments section of the Chain.

10.9 Samples contained in a septa-sealed container to be analyzed for volatile analytes, shall be checked for the appearance of headspace. Headspace is the appearance of air in a septum-lined container. A pea sized amount of air or smaller is allowable. Whether or not headspace is present shall be noted by checking the appropriate Y/N box in the receipt information section of the Chain. Any non-conformances shall be specifically mentioned in the sample/COC comments section of the Chain.

All volatile samples shall be held in the Sample Receiving refrigerator designated for VOC only (Refrigerator 27) and protected from contamination until the COC is entered into the LIMS system and the identifying labels are attached to each vial. The samples will then be transported to the VOC refrigerators in the organics lab for analysis.

10.10 The pH of all acid or caustic preserved bottles (with the exception of volatile containers) shall be taken using the pH paper listed in Section 5. Bottles shall be preserved according to the SOP 19-BOTTLE. See the most recent revision of the QA Manual, Appendix B, for a list of analyses that require pH testing.

10.10.1 The pH of the samples is measured by inserting a 5-3/4" Pasteur pipette into the sample. After the pipette is drawn out, a drop of the sample is placed on the pH paper. The pH is read using the color charts on each package of the pH strips. If the pH falls within the correct range, it is recorded on the lid of the sample container using a permanent waterproof marker and in the sample preservation log (see Appendix A).

10.10.2 If the pH is not within the acceptable range, the pH is adjusted by adding the appropriate preservative (refer to SOP 19-BOTTLE). The initial pH, the amount of preservative added, and the final pH are recorded on the lid of the sample container using a permanent waterproof marker and in the sample preservation log.

10.10.3 For samples requiring **DoD** certification, a small amount of sample shall be poured out of each bottle (excluding volatile samples) to check for the appropriate pH.

10.10.4 The following information must be recorded in the sample preservation log: the sample number, date received, initial pH, and the initials of

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the person taking the pH. In cases when the pH was adjusted, the amount of preservative added and the final pH are also recorded along with the lot of the preservative added. The log is generated in a Microsoft Excel spreadsheet that is protected against making any changes to the posted results. Each bottle is scanned using a Symbol Pocket PC with Pocket Excel installed.

10.10.5 Whether or not samples are preserved properly shall be documented by checking the appropriate Y/N box in the receipt information section of the Chain. Any non-conformances shall be specifically mentioned in the sample/COC comments section of the Chain.

10.10.6 If a metals bottle was acidified upon receipt at the laboratory, an orange sticker shall be placed on the bottle lid with the date and time of preservation, and shall be noted in the preservation log. The Metals Dept. shall verify the pH prior to use. NOTE: If the sample is to be analyzed for mercury, a corrective action report must be filled out.

10.11 All samples received must be checked for holding times.

10.11.1 Particular attention shall be given to any microbiological samples received, especially fecal coliforms which have a holding time of 6 hours for wastewater samples and frequently arrive at the laboratory with little time remaining prior to expiration. A representative of the microbiology department shall be notified immediately upon the arrival of these samples.

10.11.2 The presence of any other short holding time tests (less than 48 hours) that require immediate attention shall also be noted. If any short holding time tests require attention, the appropriate analytical department shall be notified. A list of holding times is maintained in the most recent revision of the QA Manual, Appendix B.

10.11.3 Particular attention shall also be given to soil samples that require any type of volatile analysis (8260, 8021, GRO, etc.). If these samples are received as encores or in soil jars they must be extracted within 48 hours of collection. Pre-weigh vials do not need any special treatment. The procedure for processing encores and soil jars is detailed in Appendix G.

10.11.4 Any samples received more than five days after the time of collection shall be evaluated for all holding times. Some extractions and wet chemistry procedure have 7 day holding times and while these would

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not normally be considered "short holds", they may be in jeopardy due to the excessive time elapsed between sampling and receipt. Analytical departments shall be notified of any such samples. Customer service personnel or a laboratory manager shall be consulted if a holding time is in question.

10.11.5 For any samples received at the laboratory with analyses that are already past hold at the time of receipt, the Chain of Custody shall be stamped with the red "EXPIRED" stamp and the expired tests noted in the stamp's box area.

10.12 The chlorine content shall be checked for samples requiring sodium thiosulfate or sodium sulfite as a preservative or samples requesting cyanide. See the most recent revision of the ALSI QA Manual, Appendix B, for a list of analyses that require sodium thiosulfate or sodium sulfite as a preservative.

10.12.1 In order to verify that the preservative has been added, the samples are tested for the absence of chlorine by inserting a 5-3/4" Pasteur pipette into the sample and placing a drop on KI paper for non drinking water samples. For drinking water samples, the residual chlorine is verified by using the total chlorine paper. If a color change to blue or violet is indicated, the chlorine in the sample shall be neutralized (see SOP 19-BOTTLE).

10.12.2 The presence/absence of chlorine must be documented in the sample preservation logbook file. Whether or not samples are preserved properly shall be documented on the Chain of Custody by checking the appropriate Y/N box in the receipt information section of the Chain and initialing the corresponding line. Any non-conformances shall be specifically mentioned in the sample/COC comments section of the Chain.

10.13 The turbidity of drinking water samples for metals analysis shall be determined by the Metals or Wet Chemistry department prior to analysis.

10.14 At this time, the samples are entered into the Horizon LIMS. See SOP for COC Entry (19-COC).

10.15 Labels generated by the Horizon LIMS are then affixed to the bottles and the bottles are stored as follows:

10.15.1 Volatile aqueous samples for GC are stored in Refrigerator #26 and #29

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located in the GC lab. Samples known to contain a high concentration of volatiles shall not be stored in this area. (Depending upon the matrix, high-concentration volatiles are often stored in the oil cabinet in Sample Receiving, or if requiring refrigeration, may be stored in the GCMS Soil Refrigerator #10.)

10.15.2 Volatile aqueous samples for GC/MS are stored in Refrigerators #26 and 29 located in the GC/MS lab. Samples known to contain a high concentration of volatiles shall not be stored in this area. (Depending upon the matrix, high-concentration volatiles are often stored in the oil cabinet in Sample Receiving, or if requiring refrigeration, may be stored in the GCMS Soil Refrigerator #10.)

10.15.3 Metals samples are stored in numerical order on shelves in the Inorganic Prep Lab excluding drinking water metals samples. Drinking water metals samples that do not require a digestion are stored in the Metals lab. Dissolved metals are stored in the Metals Department.

10.15.4 Total Organic Carbon and Total Organic Halogen samples are stored in the walk-in refrigerator on the lower level.

10.15.5 Samples requiring any sort of organic extractions are stored on the right side of the Harford walk-in refrigerator located on the upper level.

10.15.6 All other liquid samples not mentioned are stored in the sample receiving and lower level walk-in refrigerators in numerical order.

10.15.7 Solid samples are stored on the left side of the Harford walk-in refrigerator on the upper level.

10.15.8 Solid volatile samples and petroleum samples are stored in either GC or GCMS, wherever the testing is done.

10.15.9 A very limited number of samples do not require refrigeration. These are often associated with atypical analysis. Approval from a department supervisor is required to store samples without refrigeration.

10.15.10 Samples with special storage considerations like solvents or free product are stored in the oil cabinet.

10.16 All samples are stored at least two (2) weeks following the completion of the last analysis on the lab report with the exception of VOA vials and microbiology samples. Samples requiring special storage considerations are handled project by

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project by the appropriate customer service representative. Samples requiring **DoD** certification must be stored for 60 days.

10.17 Samples received over the weekend and during off-peak hours shall be handled in the manner outlined in Appendix B.

11 Calculations

11.1 Not applicable

12 Reporting Results

12.1 Not applicable

13 Waste Disposal

13.1 Refer to ALSI SOP 19-Waste Disposal.

14 Pollution Prevention

14.1 Pollution prevention encompasses any technique that reduces or eliminates the quantity or toxicity of waste at the point of generation. Numerous opportunities for pollution prevention exist in laboratory operations. Management shall consider pollution prevention a high priority. Extended storage of unused chemicals increases the risk of accidents. The laboratory shall consider smaller quantity purchases which will result in fewer unused chemicals being stored and reduce the potential for exposure by employees. ALSI tracks chemicals when received by recording their receipt in a traceable logbook. Each chemical is then labeled according to required procedures and stored in assigned locations for proper laboratory use.

15 Definitions

15.1 Refer to ALSI QA Plan under Laboratory Quality Control Checks for general definitions.

16 Troubleshooting

16.1 Refer to maintenance logs and instrument manuals for guidance in troubleshooting specific problems related to the instrumentation used in this method.

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Appendix A

Preservation Log available on the ALSI Network

Preservation Log

Container Number	pH Received	Adjustment Amount Needed	Final pH	Preservation Lot Number	Residual Chlorine	Date	Time	Initials	pH Recheck Date/Time/Recheck

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Appendix B

The following steps can be followed for samples received after hours and on weekends:

1. Sign the Chain of Custody (COC) in the "received by" section on the bottom of the COC form only after inspecting samples to ensure that all information on the COC matches the samples being submitted for client submission.

2. Tear off the gold copy of the COC (last page), and give it to the client submitting the sample.

3. Check the analyses required for the samples received on the COC for any analyses on the following list which require short holding times (HT). If any of these tests are required and there are no trained personnel available to complete the analysis within the holding time, contact the supervisor of the department that performs the analysis. If the supervisor cannot be reached, contact the Laboratory Manager or appropriate Customer Service Representative.

Analyze Immediately	24 Hour HT	48 Hour HT
Chlorine Demand	Hexavalent Chromium	BOD/CBOD
Turbidity	Total Coliform (30 hr)	Nitrate
Residual Chlorine		Nitrite
Total Chlorine		Orthophosphate
Odor		MBAS
Dissolved Oxygen		Osmotic Pressure
pH		Color
Sulfite		Settleable Solids
Fecal Coliform (6hr)		UV254
		Encore Extraction

4. Check the temperature of the samples as specified in Section 10.4

5. Place samples and COC form together in the lower level walk-in.

6. Leave an E-mail message for the appropriate Customer Service Representative letting them know what was received, and what actions were taken.

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Appendix C

Analytical Laboratory Services, Inc.
Environmental • Industrial Hygiene • Field Services
34 Dogwood Lane • Middletown, PA 17057 • 717.944.5541 • Fax: 717.944.1430

CHAIN OF CUSTODY/ REQUEST FOR ANALYSIS

ALL SHADED AREAS MUST BE COMPLETED BY THE CLIENT / SAMPLER. INSTRUCTIONS ON THE BACK.

Page ___ of ___
Courier:
Tracking #:
COC#

Co. Name:
Contact (Report to): Phone:
Address:

Bill to (if different than Report to): PO#:

Project Name/#: ALSI Quote #:

TAT: ☐ Normal-Standard TAT is 10-12 business days. Date Required:
☐ Rush-Subject to ALSI approval and surcharges. Approved By:

Email? ☐ -Y
Fax? ☐ -Y No.

***Container Type
***Container Size
*** Preservative

ANALYSES/METHOD REQUESTED

Sample Description/Location (as it will appear on the lab report)	COC Comments	Sample Date	Military Time	*G or C	**Matrix	Enter Number of Containers Per Analysis								
1														
2														
3														
4														
5														
6														
7														
8														

Receipt Information (completed by Sample Receiver)
Performed by: DATE: TIME:
Cooler Temp:
Therm. ID:
No. of Coolers:
Notes:

Circle appropriate Y or N.				
Correct containers?	N	N	N	N
Correct sample volume?	Y	Y	Y	Y
Correct preservation?	N	N	N	N
Headspace/Volatiles?	Y	Y	Y	Y
Custody seals Present?	N	N	N	N
(if present) Seals intact?	Y	Y	Y	Y
Received on Ice?	N	N	N	N
COC/Labels complete/accurate?	Y	Y	Y	Y
Container in good condition?	Y	Y	Y	Y

SAMPLED BY (Please Print):
LOGGED BY(signature): DATE: TIME:
REVIEWED BY(signature): DATE: TIME:

Relinquished By / Company Name	Date	Time	Received By / Company Name	Date	Time
1			2		
3			4		
5			6		
7			8		
9			10		

Data Deliverables: ☐ Standard ☐ CLP-like ☐ NJ-Reduced ☐ NJ-Full ☐ (other)
EDDs Required? ☐ If yes, format type:
DOD Criteria Required?

SDWA Forms?⇨ yes ☐ yes ☐ yes ☐ yes ☐
State Samples Collected In? MD ☐ NJ ☐ NY ☐ PA ☐ Other
⇨Enter PWSID No.

ALSI FIELD SERVICES
☐ Pickup
☐ Labor
☐ Composite Sampling
☐ Rental Equipment
☐ Other:

* G=Grab; C=Composite
**Matrix: AI=Air; DW=Drinking Water; GW=Groundwater; OI=Oil; OL=Other Liquid; SL=Sludge; SO=Soil; WP=Wipe; WW=Wastewater
Copies: WHITE - ORIGINAL CANARY - CUSTOMER COPY
***Container Type: AG-Amber Glass; CG-Clear Glass, PL-Plastic. Container Size: 250ml, 500ml, 1L, 8oz., etc. Preservative: HCl, HNO3, NaOH, etc.
Rev 6/07

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Appendix D
DC-1 Form

Region III
SAMPLE LOG-IN SHEET

PAGE 1 OF 2

LOG-IN DATE:
LAB NAME:
RECEIVED BY:

DAS N0.:
SDG NO.:

SIGNATURE:

CHECK THE APPROPRIATE RESPONSE:

	PRESENT	ABSENT	INTACT	BROKEN
CUSTODY SEAL(S)				
CHAIN OF CUSTODY (COC) RECORD				
TRAFFIC REPORT OR PACKING LIST				
AIRBILL / STICKER				
SAMPLE TAGS				
SAMPLE TAG NUMBERS ON CHAIN OF CUSTODY				
DATE RECEIVED BY LAB:				
TIME RECEIVED:				
DOES INFORMATION AGREE ON COC AND TAGS				
10. AIRBILL NUMBER				

SAMPLE TRANSFER		
FRACTION	DATE	BY

REVIEWED BY:
DATE:

LOGBOOK NO.:
LOGBOOK PAGE NO.:

DC-1

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Region III
DC- 1
Data Package Inventory Checklist

PAGE 2 OF2

SAMPLE LOG-IN SHEET

EPA SAMPLE #	SAMPLE TAG #	LAB ASSIGNED #	CUSTODY SEAL #	SAMPLE CONDITION

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Appendix E

ALSI EPA UCMR2 Sample Receipt Checklist

Received by name:_____ Signature: _____.
Date received: _____.

Kit ID Number								
Time received								
Temperature 527 Bottles	(1)							
Temperature 529 Bottles	(1)							
Thermometer ID								
Were samples in amber glass 1 liter bottles?	(2)	Y N	Y N	Y N	Y N	Y N	Y N	Y N
Were bottles filled to at least 80 % capacity?	(2)	Y N	Y N	Y N	Y N	Y N	Y N	Y N
Are bottles and caps unbroken and not leaking?	(2)	Y N	Y N	Y N	Y N	Y N	Y N	Y N
Is a sample tracking form included and complete?	(3)	Y N	Y N	Y N	Y N	Y N	Y N	Y N
Do the bottles in the kit match the tracking form?	(3)	Y N	Y N	Y N	Y N	Y N	Y N	Y N
Do the collection dates on the bottles match the tracking form?	(3)	Y N	Y N	Y N	Y N	Y N	Y N	Y N
Are there no manual edits on the tracking form for "sample point information" or "PWS Name"?	(3)	Y N	Y N	Y N	Y N	Y N	Y N	Y N
Were the correct preservatives used for 527 (L-Ascorbic acid, Trisodium EDTA, and Potassium dihydrogen citrate)?	(4)	Y N	Y N	Y N	Y N	Y N	Y N	Y N
Were the correct preservatives used for 529 (Tris (hydroxymethylaminomethane), Copper sulfate, and Tris (hydroxymethylaminomethane-HCl)?	(4)	Y N	Y N	Y N	Y N	Y N	Y N	Y N
For 527 is the pH ≤ 4.0?	(4)	Y N	Y N	Y N	Y N	Y N	Y N	Y N
For 527 is the DPD test negative?	(4)	Y N	Y N	Y N	Y N	Y N	Y N	Y N
For 529 does a visual comparison indicate a properly preserved sample? The sample should be bright blue and clear of precipitate.	(4)	Y N	Y N	Y N	Y N	Y N	Y N	Y N
Was the EPA notified of any nonconformance?	(5)	Y N	Y N	Y N	Y N	Y N	Y N	Y N

Date/Time EPA Notified: _____. Notified by: _____
Date/Time Samples Logged In:_____. Logged by: _____
Date/Time Reviewed:_____. Reviewed by: _____

Revision 01/29/08

(1) If samples are received above 10 ° C they must be invalidated and GLEC / EPA notified
(2) Broken bottles, bottles with missing or loosed caps, or bottles filled to less than 80 % are invalid. If a back-up is available, recollection may not be necessary, but EPA / GLEC still needs to be notified.
(3) If sample tracking forms are missing, or information is missing, conflicting, or if there are manual edits, GLEC and EPA should be notified to determine if the samples are valid.
GLEC/ EPA do not need notified if:
1) Only one date is recorded and it makes logical sense. Assume the recorded date is valid. Fill the date in the missing location and initial it ALS-XYZ where XYZ are the sample receiving technician's initials.
2) There is an obvious transcription error in year recorded. Use the logical year and make the correction by drawing a single line through the incorrect year and initializing as in "1" above.
3) One date is within the past two days and the second is some time in the future. Use the logical date and make the correction by drawing a single line through the incorrect year and initializing as in "1" above.
(4) Samples that don't meet presrvation criteria should be invalidated and GLEC / EPA notified.
(5) Notification of the problem should be e-mailed to the EPA Task Order project officer (fair.pat@epamail.epa.gov) with "Sampling Error" in the subject line. A copy should also be e-mailed to the EPA Project Officer (hautman.dan@epa.gov), the EPA UCMR2 Sampling Coordinator (Newport.bonnie@epa.gov) and the EPA's Implementation Contractor (UCMRsmall@glec.com). Include a copy

Revision 01/29/08

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Appendix F

New Employee Orientation

Sample Receiving Training Checklist

Procedure: Checking Sample Preservatives

SOP:_____

Revision:_____

	Analyst	Trainer
1) Analyst has read and understands SOP 19-Rec/Han and signed the concurrence form.	_____	_____
2) Analyst knows where to find the list of sample types that require preservation.	_____	_____
3) Analyst knows which pH paper to use for checking the pH of acidified samples and where to find it.	_____	_____
4) Analyst knows how to apply the sample to the pH paper and how to interpret the reading for acidified samples.	_____	_____
5) Analyst knows which pH paper to use for checking the pH of basic samples and where to find it.	_____	_____
6) Analyst knows how to apply the sample to the pH paper and how to interpret the reading for basic samples.	_____	_____
7) Analyst knows how to adjust the pH of any sample if the measured value is not acceptable.	_____	_____
8) Analyst knows which test papers to use for checking chlorine content and where to find them.	_____	_____
9) Analyst knows how to apply the sample to the test papers and how to interpret the reading for chlorine content.	_____	_____

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Rev. 01/08

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	Analyst	Trainer
10) Analyst knows how to properly complete the preservation logbook.	_____	_____
11) Analyst knows that DoD samples require a small amount of Sample to be poured out for sampling pH.	_____	_____
12) Analyst knows how to complete all information on the chain of custody regarding preservation including where to record non-conformances.	_____	_____
13) Analyst is aware that when metals samples are acidified upon Receipt a copy of the preservation log must accompany the sample to the metals prep department.	_____	_____
14) Analyst has demonstrated his/her ability on at least five separate projects/workorders.	_____	_____

The workorders used for demonstration are:

_____
_____
_____
_____
_____

_____	_____	_____
Analyst Name	Analyst Signature	Date
_____	_____	_____
Supervisor Name	Supervisor Signature	Date

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New Employee Orientation

Sample Receiving Training Checklist

Procedure: Measuring Cooler Temperatures

SOP:_____

Revision:_____

	Analyst	Trainer
1) Analyst read and understands SOP 19-Rec/Han and signed the concurrence form.	____	____
2) Analyst knows the location of the mercury thermometer.	____	____
3) Analyst knows where to find and how to apply the correction factor for the mercury thermometer.	____	____
4) Analyst can properly take and record a cooler temperature using a provided temperature blank.	____	____
5) Analyst knows the acceptable limits for cooler temperatures are above the freezing point of water to 6 degrees C.	____	____
6) Analyst knows the location of the IR temperature gun.	____	____
7) Analyst knows how to properly use the IR gun to take a sample temperature (i.e. where to shoot the gun through the bottle).	____	____
8) Analyst knows where to find and how to apply the correction factors for the IR temperature gun.	____	____
9) Analyst knows to take multiple temperatures if the initial bottle used is outside the acceptable limits.	____	____
10) Analyst is aware that samples received same day as sampling are acceptable if evidence exists that the chilling process was begun.	____	____

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Rev. 5/05

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	Analyst	Trainer
11) Analyst is aware that designated refrigerators are available for "holding" micro and volatile samples during processing.	____	____
12) Analyst has demonstrated this ability on at least five separate projects/workorders.	____	____

The workorders used for demonstration are:

_____
_____
_____
_____
_____

Analyst Name	Analyst Signature	Date
Supervisor Name	Supervisor Signature	Date

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New Employee Orientation

Sample Receiving Training Checklist

Procedure: Receiving Samples

SOP:_____

Revision:_____

	Analyst	Trainer
1) Analyst has read and understands SOP 19-Rec/Han and signed the concurrence form.	____	____
2) Analyst will ensure that all samples are accompanied by a chain of custody.	____	____
3) If a walk-in client attempts to drop off samples not accompanied by a chain of custody, the analyst provides a chain for them to complete on-site.	____	____
4) Analyst receives custody of the sample(s) by signing the chain of custody upon receipt of samples, including the date and time received.	____	____
5) When samples are received with a chain of custody from a source other than ALSI, the analyst will confirm client and sample information is present.	____	____
6) Analyst checks for the presence of custody seals and whether they are intact and records all findings including any non-conformances appropriately on the chain of custody.	____	____
7) Analyst checks the sample temperature and for the presence of ice and records all findings including any non-conformances appropriately on the chain of custody.	____	____
8) Analyst checks for breakage and leakage and records all findings including any non-conformances appropriately on the chain of custody.	____	____

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	Analyst	Trainer
9) Analyst compares the information on the chain of custody to the information on the bottle labels and records all findings including any non-conformances on the chain of custody.	____	____
10) Analyst checks to see that the sample containers are appropriate for the analyses requested and records all findings including any non-conformances on the chain of custody.	____	____
11) Analyst checks all volatile containers for headspace and records all findings including any non-conformances on the chain of custody.	____	____
12) Analyst properly checks for preservatives and records all findings including any non-conformances on the chain of custody.	____	____
13) Analyst knows what analytes have short holding times and notifies the appropriate departments upon receipt.	____	____
14) Analyst has demonstrated this ability on at least five separate projects/workorders.	____	____

The workorders used for demonstration are:

_____
_____
_____
_____
_____

Analyst Name	Analyst Signature	Date
Supervisor Name	Supervisor Signature	Date

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Appendix G

Receipt of Soil Volatile Samples in Encores or Soil Jars

Volatile soil samples received in soil jars or encores must be extracted into sodium bisulfate and/or methanol vials within 48 hours from the time of collection. Samples received with little time remaining prior to expiration require immediate attention. Proceed as follows:

1) When these types of samples are received, check the sample containers against the COC. Following procedure, note any discrepancies on the COC.

2) Log the samples into Horizon.

3) Initiate the ALSI Encore Internal COC Logbook. Even if the samples cannot be logged into Horizon for any reason, continue with this step. In such a case, use the sample description in lieu of a Horizon sample number.

4) Transfer the samples to the GC/MS laboratory along with a copy of the COC.

   NOTE: Samples must be delivered to an actual person who acknowledges receipt of the samples by initialing the Encore Internal COC Logbook. The samples cannot be left on a counter or placed in the refrigerator without documented receipt. If an individual qualified to extract encores is not available, refer to the GC/MS phone list located in sample receiving and contact an individual to come in and perform the extractions.

5) Complete the Encore Internal COC Logbook. (See Appendix H)

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Appendix H

ALSI ENCORE INTERNAL COC LOGBOOK

Sample #	Date Sampled	Time Sampled	Analysis Method	Date Received in Lab	Time Received in Lab	Received within 48 hours (Y/N)	Relinquished By	Received By	Date Delivered to Analyst	Time Delivered to Analyst	Comments

Rev. 4/03

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SOP Change Summary

Section No.	Section	Reason for Change
Revision 7:		
5.9	Apparatus and Materials	Correction to current SOP
6.0	Reagents	Correction to current SOP
10.2.8	Procedure	A2LA Audit Response
10.6-10.7	Procedure	Horizon LIMS Implementation
Revision 8:		
10.2.4	Procedure	New Jersey DEP audit response
Revision 9:		
2	Summary of Method	DoD audit response 5/13/05
4	Safety	DoD audit response 5/13/05
5	Apparatus and Materials	DoD audit response 5/13/05
6	Reagents	DoD audit response 5/13/05
7	Instrument Calibrations	DoD audit response 5/13/05
8	Quality Control	DoD audit response 5/13/05
10	Procedure	DoD audit response 5/13/05
Appendix C	Sample Collection, Containers & Preservation For Organic Contaminants	DoD audit response 5/13/05
Appendix D	ALSI Chain of Custody	DoD audit response 5/13/05
Appendix E	DC-2 Data Package Inventory Checklist	DoD audit response 5/13/05

SOP Change Summary (continued)

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Section No.	Section	Reason for Change

Revision 10: 10/06/2006

Revised refrigeration temperatures to read "…above the freezing point of water up to 6ºC…" to reflect NELAC verbiage.

1.3	Scope and Application	Added use of project specific criteria
4.1	Safety	Added statement about maintaining MSDS
6.4.1, 6.4.2	Reagents	Revised volume of dispenser tops from 1 mL to 2 mL; revised number of squirts to accommodate new dispenser volume
6.4.3.3	Reagents	Revised volume added to TOC bottle
8.1	Quality Control	Added verbiage indicating that the SOP falls under the QA Plan umbrella
8.4, 8.5	Quality Control	Added initial DOC and statement about ongoing proficiency
10.10.4	Procedure	Removed recording of tests required in sample preservation logbook; added generation of logbook in a Microsoft Excel spreadsheet
11	Calculations	Added section
12	Reporting Results	Added section
16	Troubleshooting	Added section

Removed Appendix duplicating QA Plan Appendix B, Container, Preservation, Storage and Holding Times

C	Appendix	Updated COC to current form
E	Appendix	Added examples of training forms

SOP Change Summary (continued)

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Section No.	Section	Reason for Change
Revision 11: 02/05/07		
5.8.3	Apparatus and Materials	Added new walk-in refrigerator
6.1	Reagents	Added ALSI generated reagent water
6.3	Reagents	Replaced "well/tap" water with "reagent" water
6.4.10	Reagents	Added Ethylenediamine (EDA) Solution
10.2.1	Procedure	Added specific verbiage for microbial samples
10.11	Procedure	Added verbiage about sample holding times, microbial sample test times, soil samples and corrective actions for samples past holding time
10.13	Procedure	Added Wet Chem as lab for turbidity analysis
10.15.5, 10.15.7	Procedure	Added specific sample storage locations; deleted defunct refrigerators
B	Appendix	Added Fecal Coliform to "Analyze Immediately" column; Added Total Coliform to "24 Hour HT" column
F	Appendix	Added directions for the receipt of soil volatile samples in Encores or Soil Jars
G	Appendix	Added example of Encore Internal COC logbook page
Revision 12: 01/29/08		
2	Summary	Reformatted section
4.1	Safety	Updated MSDS availability
5.6, 5.7	Apparatus and Materials	Updated thermometer information
6	Reagents	Removed inapplicable reagents

SOP Change Summary (continued)

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Section No.	Section	Reason for Change
7.1, 7.2	Instrument Calibration	Removed sections
10.3.1	Procedure	Replaced DC-2 with DC-1
10.3.2	Procedure	Added section
10.3.5	Procedure	Updated procedure per DoD audit
10.4.1	Procedure	Removed “mercury”
10.10.2	Procedure	Removed recording lot# per DoD audit
10.10.6	Procedure	Updated procedure per DoD audit
Appendixes		Updated numbering
Appendix D		Replace DC-2 form with DC-1 form
Appendix E		Added section
Appendix F		Replace USACE with DoD per DoD audit

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SOP Concurrence Form
for the Distribution and Revision of Standard Operating Procedures

I have read, understood, and concurred with the Standard Operating Procedure (SOP) described above and will perform this procedure as it is written in the SOP.

Print Name	Signature	Date

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Document Title: Solid Phase Extraction of Water for the Analysis of Explosives by EPA Method 8330A (HPLC)

Document Control Number: _____

Organization Title: ANALYTICAL LABORATORY SERVICE, INC. (ALSI)
Address: 34 Dogwood Lane
Middletown, PA 17057

Phone: (717) 944-5541

Approved by:

_____ _____
Helen MacMinn, Date
Quality Assurance Manager

_____ _____
Justin Hall, Date
GC Department Supervisor

_____ _____
Evan Cooper, Ph.D. Date
Validator

Annual Review:

_____ _____
Reviewed By Date Reviewed

_____ _____
Approved By Date Approved

_____ _____
Reviewed By Date Reviewed

_____ _____
Approved By Date Approved

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Annual Review (continued):

Reviewed By	Date Reviewed
Approved By	Date Approved

Reviewed By	Date Reviewed
Approved By	Date Approved

Reviewed By	Date Reviewed
Approved By	Date Approved

Reviewed By	Date Reviewed
Approved By	Date Approved

Reviewed By	Date Reviewed
Approved By	Date Approved

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1 Scope and Application

1.1 This Standard Operating Procedure is adapted from U. S. EPA Test Methods for Evaluating Solid Waste Physical/Chemical Methods (SW846), Method 8330A, Revision 1, January 1998.

1.2 This document states the laboratory's policies and procedures established in order to meet requirements of all certification/accreditations currently held by the laboratory, including the most current NELAC Standards.

1.3 This extraction procedure is appropriate for those samples requiring analysis by EPA Method 8330A, Revision 1, January 1998. The analytes cited in Section 1 of SOP 1B-8330 are the analytes currently validated and acceptable for this procedure.

1.4 Individual project requirements may override criteria listed in this SOP.

2 Summary of Method

2.1 A measured volume of water, usually 1 liter, is passed through an SDB-RPS disk and eluted with acetonitrile.

3 Interferences

3.1 Phthalate esters contaminate many types of products commonly found in the laboratory. Plastics in particular must be avoided because phthalates are commonly used as plasticizers and are easily extracted from plastic materials.

3.2 Soap residue on glassware may cause degradation of certain compounds. All glassware shall be rinsed carefully with deionized water to avoid the problem.

3.3 Interferences co-extracted from the samples will vary considerably from source to source.

3.4 Light decomposes various target analytes, in particular, tetryl. Precautions shall be taken as to not allow excessive amounts of light to reach sample.

3.5 Heat causes some analytes, in particular, tetryl, to decompose rapidly. Samples shall not be exposed to temperatures above room temperature.

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4 Safety

4.1 The toxicity or carcinogenicity of each reagent used in this method has not been precisely defined; however, each chemical compound shall be treated as a potential health hazard. From this viewpoint, exposure to these chemicals must be reduced to the lowest possible level by whatever means available.

4.2 ALSI maintains material safety data sheets (MSDS) on all chemicals used in this procedure. ALSI recommends that all individuals performing this SOP familiarize themselves with the MSDS associated with the procedure prior to SOP performance. MSDS are available to all staff and are located in hard copy in the QA reference library and electronically on the ALSI server in the MSDS folder.

4.3 All solvents and reagents used in this procedure shall be handled in a fume hood wearing safety glasses, a fully buttoned lab coat, and chemical resistant gloves.

5 Apparatus and Materials

5.1 Vacuum pump – equipped with trap, sufficient capacity to maintain 30 inches of mercury.

5.2 Filtration apparatus – glass or Teflon-lined. Filtration surface shall accommodate 47-mm disks. An addition reservoir with a minimum capacity of 250 mL is recommended along with connecting clamps. Fritted glass support and 1.5 L vacuum trap.

5.3 Solid phase extraction disks – 47-mm SDB-RPS, a PTFE membrane with surface entrapped particles of sulfonated styrene divinyl benzene that have reversed phase modification, 3M Empore P/N 2241, or equivalent. Each lot of extraction disks shall be evaluated prior to use with actual samples. This is done by the extraction of a method blank, to verify that the disks do not elute any interfering compounds.

5.4 Collection tube – glass 25 x 250 mm tube.

5.5 Tweezers – Teflon-coated.

5.6 Pipets – glass 10-mL with 0.1 mL graduations.

5.7 Syringes – gastight, appropriate sized.

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5.8 VOA vials, 2- mL pre-cleaned glass.

5.9 Pasteur pipets – glass disposable.

5.10 Vials – amber 2-dram.

5.11 Graduated cylinder, Class A, TC, 1-L.

6 Reagents

NOTE: Unless otherwise noted in this section, all chemicals are stored at room temperature and labeled with an expiration date of five years from receipt. Manufacturer's labeled expiration dates, when less than five years, take precedent over all other expiration dates.

6.1 Reagent Water – A Filson Water Purification System is used which provides analyte-free >16.0 megaohm deionized water on demand.

6.2 Acetonitrile – HPLC grade, Burdick & Jackson P/N AH015-4, or equivalent.

6.3 Methanol – HPLC grade, Burdick & Jackson P/N AH230-4, or equivalent.

6.4 Surrogate Stock Solution – 1-chloro-3-nitrobenzene (1000 µg/mL) in acetonitrile, Ultra Scientific part #IST-630, or equivalent. Store at -10 to -20°C protected from light.

6.6 LCS/matrix spike stock solution – Cerilliant Method 8330 Stock Standard P/N ERE-021, or equivalent. This standard contains all 14 of the explosive compounds listed in EPA method 8330A, all at 200 µg/mL in acetonitrile. Store at -10 to -20°C protected from light.

6.7 Nitroglycerin LCS/matrix spike – Cerilliant Trinitroglycerin Standard P/N T-002, or equivalent. This standard contains nitroglycerin at 1000 µg/mL in acetonitrile. Store at -10 to -20°C protected from light. NOTE: nitroglycerin should only be spiked when specifically requested by a client. It is not a routine part of 8330A analysis.

6.8 Filter Aid – 3M Empore P/N FA400, or equivalent.

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7 Glassware Cleaning

7.1 Remove surface residuals immediately after use by rinsing with tap water or the last solvent used.

7.2 Soak the glassware in hot water and liquinox detergent to float most particulate material from glassware. Use a brush to scrub the glassware to aid in the removal of residual materials.

7.3 Hot water rinse the glassware.

7.4 If the glassware used was in contact with high level samples and/or there is an apparent residue remaining on the glassware after the first three steps, it will be necessary to soak the glassware in a strong oxidizing agent to destroy traces of residual compounds. The oxidizing agent currently used is Chem Solv 2157, manufactured by Mallinckrodt and distributed by Baxter Scientific (part #2157-INY, 1995). Chem Solv 2157 is a safer alternative to chromic acid solutions typically suggested for cleaning glassware. The manufacturer's instructions for the safe handling of Chem Solv 2157 shall be stored with each container and reviewed before its use. Glassware suspected or known to have been in contact with high level samples shall soak for 1 hour in the Chem Solv solution. Rinse with copious amounts of tap water and resubmit for normal cleaning procedure (Section 7.2).

7.5 Rinse the glassware thoroughly with deionized water to remove remaining materials and any metallic deposits.

7.6 Dry the glassware in an oven at 130 +/-30°C for a minimum of 30 minutes.

7.7 Allow the glassware to cool for a minimum of 30 minutes.

7.8 Wrap glassware openings with aluminum foil if stored for later use.

7.9 Flush all glassware immediately before use with the extraction solvent being used for the application.

7.10 Glassware cleaning filtration apparatus.

7.10.1 The filtration apparatus itself is the only nonconsumable used in the extraction process. With the reservoir removed, rinse the filtration surface

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with 3-5 mL of acetonitrite. Pull a vacuum on the surface until dry.

7.10.2 Attach the reservoir and rinse the walls down with approximately 15 mL of acetonitrite. Pull a vacuum on the unit until all surfaces are visibly dry.

7.10.3 Samples that leave a visible residue may require a cleaning and drying of the filtration apparatus as described in sections 7.1 – 7.9.

8 Quality Control

8.1 All policies and procedures in the most current revision of the ALSI QA Plan shall be followed when performing this procedure.

8.2 A method blank must be run with each batch of samples prepared. It is imperative that the blanks be subjected to exactly the same analytical procedures as those used in the actual samples. This includes the addition of the surrogate standards and other chemicals used in the extraction procedures.

8.3 A matrix spike and matrix spike duplicate or a matrix spike and duplicate must be extracted with each batch. If insufficient sample is available to perform a matrix spike or duplicate, a comment must be placed in the extraction log.

8.3.1 Samples selected for duplicate and matrix spike analysis shall be rotated among client samples so that various matrix problems may be noted and/or addressed. Poor performance in a duplicate or spike may indicate a problem with the sample composition and shall be reported to the client whose sample produced the poor recovery.

8.4 A laboratory control sample (LCS) must be extracted with every batch. The LCS is prepared similarly to a method blank but is spiked with the LCS spiking solution.

8.5 The size of any extraction batch cannot exceed 20 samples.

8.6 Initial Demonstration of Capability: This demonstration must be successfully performed by each analyst prior to being considered proficient to analyze samples by this method. Ongoing proficiency must be established annually as specified in the QA Plan, under Technical Training,

8.6.1 Four QC check samples will be prepared: Spike four 1000 mL samples of

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reagent water with 10.0 µL of the Spike Solution. Take the samples through all steps of the extraction as described in this SOP.

8.6.2 Analyze samples by HPLC as described in ALSI SOP 1B-8330.

8.6.3 An average recovery range of 70-130% recovery will be used as guidance to assess laboratory performance. See ALSI SOP 1B-8330 for calculation of percent recovery. A precision control limit of 30% RSD for all four check samples will be used as guidance to assess laboratory performance. When sufficient data is gathered, in house control limits will be used to assess laboratory performance.

8.6.4 If one or more analytes do not meet this criterion, identify and correct source of problem and report test for those analytes that initially failed.

8.7 MDL studies must be performed according to ALSI SOP 99-MDL or the reference method, whichever is more frequent.

9 Sample Collection, Preservation and Handling

9.1 Containers used to collect samples must be specially cleaned 1-Liter amber glass bottles. These sample bottles shall have screw caps with Teflon lining. A minimum of 1-Liter of sample is necessary, and three 1-Liter bottles for MS/MSD processing.

9.2 All samples shall be stored above the freezing point of water up to 6°C until extraction. No preservation is recommended.

9.3 Samples must be extracted within 7 days of collection.

9.4 Sample extracts must be analyzed within 40 days of extraction. All extracts shall be stored protected from light above the freezing point of water up to 6ºC.

9.5 See SOP 20-Field Services Sampling Plan for collection procedures.

10 Procedure

10.1 Examine the sample closely. A water sample may contain a significant amount of suspended solids or sediment. This extraction procedure is designed for water samples that are relatively free of sediment and suspended solids. If a sample

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contains a sediment layer larger than 0.5 cm, then the client must be notified that this sediment will not be part of the analysis. They should be given the option to have the sediment analyzed by the solids procedure, 09-8330S. For excessive sediment layers > 0.5 cm, the liquid layer must be carefully decanted into a separate clean bottle for analysis by this method. The original sample bottle with the sediment should be retained until the client is satisfied that analysis of the sediment is unnecessary.

10.2 Mark the water meniscus on the side of the sample bottle for later determination of sample volume. It may be necessary to decant sufficient sample in order to allow for the addition of 5 mL methanol as described later in this procedure. If that is the case, the bottle should be marked after decantation.

10.3 Add 1000 mL of reagent water to 2 (two), l-liter, glass bottles. Label one as the blank and the other as the LCS. The bottles must have sufficient headspace to allow for the addition of 5 mL of methanol.

10.4 Using a 10-mL graduated pipet, add 5 mL of methanol to all blanks, matrix spikes and samples. Cap all bottles and invert several times to mix.

10.5 Using a 25-µL syringe, add 5.0 µL of the surrogate stock solution to all samples, blanks and LCS's.

10.6 Using a 25-µL syringe, add 5.0 µL of the working spiking solution to all matrix spikes and the LCS.

10.7 If the analysis of nitroglycerin is specifically requested for a sample, then the associated matrix spikes and LCS must be spiked with nitroglycerin. IF NITROGLYCERIN IS NOT SPECIFICALLY REQUESTED DO NOT SPIKE WITH NITROGLYCERIN. Using a 25-µL syringe, add 5.0 µL of the nitroglycerin spiking solution to all matrix spikes and LCS.

10.8 Cap all bottles and invert several times to mix.

10.9 Ensure the filtration apparatus has been cleaned and dried as described in Section 7.

10.10 This SOP utilizes standard 47-mm diameter extraction disks. All solvent volumes used in washing and eluting disks are appropriate only with this size. This SOP is not applicable if other size disks are used.

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10.11 Assemble the filtration apparatus while also inserting a large 25 mm x 250 mm collection tube inside the flask so rinsing solvents will be collected directly into it through the filter support. Attach the flask to a vacuum hose from the trap which is connected to the pump.

10.12 Using clean tweezers, place an extraction disk onto the frit surface. Center the disk and make sure no wrinkles are present if flexible Teflon disks are used. Replace the reservoir carefully on top of apparatus so the sides are even with frit base and clamp into place.

10.13 If samples in the batch contain significant suspended solids, then the use of filter aid is recommended. In this event, carefully add approximately 40 g of filter aid to the surface of the extraction disk. Distribute the filter aid carefully so as to create a uniform layer of about 1.0 cm depth. When using filter aid, it is important to slowly add liquids down the disk reservoir so as to avoid disturbing the filter aid bed.

10.14 Precondition the disk by adding 10 mL of an acetonitrite using a 10-mL graduated pipet then applying low vacuum, draw about half of the solvent through the disk. Stop the vacuum to allow the disk to soak for about a minute, then start again to draw the remaining solvent through the disk turning up the vacuum to full so the disk is taken to what appears to be complete dryness. Turn vacuum back down to low then stop the pump.

10.15 Using a 10-mL graduated pipet, add 15 mL of acetonitrile to the disk, and pull it through the disk with vacuum, being careful to maintain a minimal liquid layer (1-2 mm) above the disk. The disk MUST NOT go to dryness from this point on until the disk is eluted post sample addition.

10.16 Add another 15 mL of acetonitrile to the disk, and pull it through with vacuum as in step 10.15 above.

10.17 Add 30 mL of reagent water to the disk.

10.18 Pull a slow vacuum until a minimal layer of water remains on the disk.

10.19 Remove the collection tube from the flask. Invert the sample bottle to mix and begin to pour the sample into the reservoir.

10.20 Adjust the vacuum to 8 inches of Hg. It should take about 6 minutes for clean

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samples to be pulled through the disk.

10.21 Once the entire sample has passed through the disk, dry the disk at 20 inches of Hg for 3 minutes.

10.22 Remove the filtered water sample from the flask.

10.23 Place a 20-mL VOA vial labeled with the COC# and LIMS ID under the elution tip.

10.24 Add exactly 5 mL of acetonitrile directly to the surface of the disk using a Class A graduated 10-mL pipet. It is critical that no more than 5 mL of acetonitrile be added to the disk. The final extract volume is targeted for 5 mL and any volume that results in an excess of 5 mL will result in raised reporting limits.

10.25 Carefully pull half of the solvent through the disk. Allow the disk to soak for 1 minute. Pull the remaining solvent through at 20 inches of Hg. Allow the disk to elute for 30 seconds at 20 inches of Hg.

10.26 Remove the 20-mL VOA vial containing the extract and cap immediately.

10.27 Pour the extract into an amber 2-dram vial. Label the vial with the COC # and the LIMS ID.

10.28 Check the volumes of all sample bottles by refilling with water to the mark and then pouring the contents into a 1-L graduated cylinder.

11 Calculations

11.1 Not applicable.

12 Reporting Results

12.1 Pre-extraction Entries (Batching).

12.1.1 In the “batching” function of the LIMS select the “appropriate” RULE under the EXTR Queue.

12.1.2 Select the desired samples for the extraction batch by placing a check beside the COC# number. Press the “build batch” button.

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12.1.3 Preview the "notes" section of the batch schedule to identify client specified QC. Determine which COC#s have additional sample available for the required sample matrix QCs' and add them to the batch using the "Add QC" button.

12.1.4 Verify all desired samples are in the batch and appropriate QCs' have been added. Save the batch. Record the HBN# in the extraction logbook.

12.2 Post Extraction Entries (Posting) and Data Review

12.2.1 Once extracts are vialed and initial sample volumes and extract final volumes have been recorded in the extraction logbook, the initial and final volumes must be posted in the LIMS.

12.2.2 In the "operations" function of the LIMS select one of the posting options.

12.2.3 Enter the technician's initials beginning the extraction and the date and time the extraction was initiated as recorded in the extraction logbook. Times must be recorded in hours and minutes. Seconds shall be recorded as "00".

12.2.4 Enter the appropriate initial and final volume in the LIMS. When entering data into Horizon LIMS, do not round off results; Horizon will automatically perform rounding appropriate to the method. Verify all entries are correct and "save" the entries.

12.2.5 Date and initial in the extraction logbook in the "approved" entry at the bottom of the page.

12.2.6 Review the labeling on all vials and deliver to the GC Department for storage at a temperature above the freezing point of water up to 6°C until analysis.

12.2.7 A second technician must verify all initials, dates, times, and volumes have been correctly transferred from the logbook to the LIMS. Date and initial in the extraction logbook in the "reviewed" entry at the bottom of the page.

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13 Waste Disposal

13.1 Refer to ALSI SOP 19-Waste Disposal.

14 Pollution Prevention

14.1 Pollution prevention encompasses any technique that reduces or eliminates the quantity or toxicity of waste at the point of generation. Numerous opportunities for pollution prevention exist in laboratory operations. Management shall consider pollution prevention a high priority. Extended storage of unused chemicals increases the risk of accidents. The laboratory shall consider smaller quantity purchases which will result in fewer unused chemicals being stored and reduce the potential for exposure by employees. ALSI tracks chemicals when received by recording their receipt in a traceable logbook. Each chemical is then labeled according to required procedures and stored in assigned locations for proper laboratory use.

15 Definitions

15.1 Refer to ALSI QA Plan under Laboratory Quality Control Checks for general definitions.

16 Troubleshooting

16.1 Refer to maintenance logs and instrument manuals for guidance in troubleshooting specific problems related to the instrumentation used in this method.

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Appendix A

Work continued from page:____

HPLC EXTRACTION

Work continued to page:____

EPA Method: _____ Surrogate ID: _____

ALSI SOP: _____ Surrogate Amount: _____

Extraction:	Date	Time	Tech	Sonication:	Time On	Time Off	Total Hours Sonicated	Tech

Line #	Sample ID	Sample Amount	QC Type	Spike ID	Spike Amount	Final Volume	Elution Time	Sample Specific Comments (Include weigh data for drying, if applicable.)
1.)								
2.)								
3.)								
4.)								
5.)								
6.)								
7.)								
8.)								
9.)								
10.)								
11.)								
12.)								
13.)								
14.)								
15.)								

Reagent Identification(s): _____

_____

Approved By:_____
Date Approved:_____

Page #:____

Revised 2/1/05

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SOP Change History Sheet

Section No.	Section	Reason for Change
Revision 2: 11/16/07		
Spelling, grammar, and formatting changes may have been made throughout SOP for clarity, correctness, and site conformity.		
Temperature ranges updated to read "above the freezing point of water to 6°C."		
1.3, 1.4	Scope and Application	Added sections
3.4, 3.5	Interferences	Added sections
4.2, 4.3	Safety	Added sections
5	Apparatus and Materials	Updates to materials, manufacturer and part numbers
6	Reagents	Added NOTE
6.4	Reagents	Removed section
6.5, 6.6	Reagents	Updated to current practice
7.6	Glassware Cleaning	Removed section
7.7, 7.8	Glassware Cleaning	Added sections
8.6, 8.7	Quality Control	Added sections
9.1, 9.4, 9.5	Sample Collection…	Added sections
10	Procedure	Numerous revisions made throughout section
12	Reporting Results	Updated section from AMS to Horizon LIMS
15	Definitions	Added section
16	Troubleshooting	Added section
Appendix A		Added section

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SOP Change History Sheet (continued)

Section No. ***Revision 3: 01/29/08***	**Section**	**Reason for Change**
5.3	Apparatus and Materials	Added verification verbiage per DoD audit

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SOP Concurrence Form
for the Distribution and Revision of Standard Operating Procedures

I have read, understood, and concurred with the Standard Operating Procedure (SOP) described above and will perform this procedure as it is written in the SOP.

Print Name	Signature	Date

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Document Title: Standard Operating Procedure for Chain of Custody Entry

Document Control Number: _____

Organization Title: ANALYTICAL LABORATORY SERVICE, INC. (ALSI)
Address: 34 Dogwood Lane
Middletown, PA 17057

Phone: (717) 944-5541

Approved by:

_____ _____
Helen MacMinn, Date
Quality Assurance Manager

_____ _____
Steve Smith, Date
Sample Receiving

_____ _____
Deborah J. Wood, Date
Validator

Annual Review:

_____ _____
Reviewed By Date Reviewed

_____ _____
Approved By Date Approved

_____ _____
Reviewed By Date Reviewed

_____ _____
Approved By Date Approved

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Annual Review (continued):

Reviewed By	Date Reviewed
Approved By	Date Approved

Reviewed By	Date Reviewed
Approved By	Date Approved

Reviewed By	Date Reviewed
Approved By	Date Approved

Reviewed By	Date Reviewed
Approved By	Date Approved

Reviewed By	Date Reviewed
Approved By	Date Approved

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1 Scope and Application

1.1 This standard operating procedure addresses the entry of chain-of-custodies for all customers of ALSI. This document shall serve as a guideline to entering the chain-of-custody when the sample(s) are received in the Sample Receiving Department.

1.2 This document states the laboratory's policies and procedures established in order to meet requirements of all certifications/accreditations currently held by the laboratory, including the most current NELAC standards.

1.3 Individual projects may override criteria listed in this SOP.

2 Summary of Method

2.1 Enter your user name and password to access the Horizon LIMS.

2.2 From the Samples Menu select Login, then select By Container.

2.3 Access the "sample login" section and enter all data pertaining to the individual sample such as date/time sampled and analyses required.

3 Interferences

3.1 Not Applicable.

4 Safety

4.1 Samples may contain compounds and preservatives that are significant health hazards. All possible steps should be taken to limit analyst contact with these samples. The minimum personal protective equipment requirements when handling samples are PVC gloves, safety glasses, and a fully-buttoned lab coat. This PPE should reduce the possibility of contact to a safe level, but the analyst should not limit themselves to these PPE requirements.

4.2 ALSI maintains material safety data sheets (MSDS) on all chemicals used in this procedure. MSDS are available in hard copy in the QA office and electronically on the ALSI network.

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5 Apparatus and Materials

5.1 Laboratory computer station having access to the current version of Horizon; Horizon 9.0 is in use at the time of SOP 19-COC, revision 4.

6 Reagents

6.1 Not Applicable

7 Instrument Calibration

7.1 Not Applicable

8 Quality Control

8.1 All policies and procedures in the most current revision of the ALSI QA Plan shall be followed when performing this procedure.

8.2 An Initial Demonstration of Capability shall be documented as follows:

8.2.1 Completion of the "New Employee Orientation: Sample Receiving Training Checklist: Sample Login." See Appendix C.

8.2.2 Corrective action for DOC failure:

8.2.2.1 Repeat training shall be performed until all forms are successfully completed.

8.2.2.2 It shall be at the discretion of supervisory staff and management to determine at what point repeat training is no longer applicable and reassignment or company termination is appropriate.

8.3 Ongoing proficiency on an annual basis, as specified in the QA Plan, Technical Training, does not apply to this procedure.

9 Sample Collection, Preservation, and Handling

9.1 Not Applicable

10 Procedure

10.1 Accessing Horizon

10.1.1 Double-click on the Horizon icon on the desktop menu. The Horizon login screen will appear.

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10.1.2 Enter your user name (first initial and last name) and password (password provided to the IT department.) The Horizon main menu will appear.

10.2 Creating Workorders

10.2.1 From the main menu select "Samples".

10.2.2 Select "Login".

10.2.2.1 Select "By Container"

10.2.3 From the Client field, click on the LOV (List Of Values) and select the client from the list.

10.2.4 Select the "Profile" field and click on the LOV (List of Values) icon.

10.2.5 Select the "Profile" field and click on the LOV (List of Values) icon.

10.2.6 The list shown will be only the profiles available for the client you have selected. Scroll down the list and pick the profile that best matches the COC you are logging in.

10.2.6.1 Profiles for DEP reportable drinking water samples will be identified by the 7 digit DEP identification number.

10.2.7 Selecting the profile will fill in all client information on the "Customer Login" screen. This information includes the client number and name, the type of deliverable, the report format, the sequence, the status, charges, the earliest due date, and the date created.

10.2.7.1 The type of deliverable can be changed if the COC requests a type different from the listed in the profile. Options under the LOV menu include: CM (commercial w/o deliverable), CT (commercial timeframe invoice), IL (invoicing at large), CQ (commercial QA/QC package), and SD (EPA sample deliverable group).

10.2.7.2 The report format can be changed if the COC requests a type different from that listed in the profile. Options under the LOV menu include: 40CFR (40 CFR report deliverable), SDWA (SDWA deliverable), Standard (standard

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deliverable), and UCMR (UCMR EDD deliverable).

10.2.8 Under "Work ID" field, type in a keyword(s) that will identify that project. These keywords can be identifiers such as "monthly DEP", weekly wastewater, etc. or they can be project or job numbers provided by a specific client. You can also press enter from this field and the computer will fill in the default workorder ID associated with the profile you have chosen. The workorder ID field must be blank for the default ID to work.

10.2.9 The PO field will be empty at this point. If a purchase order number is available enter it her. Unless the client has a PO that is used consistently, the PO in the "case" can be saved in the "Client Info". If the PO is stored in the client profile, the PO field will be filled in by the LIMS.

10.2.10 From the Collector field click on the LOV (List Of Values) Icon. A list will appear. Begin typing the last name of the collector, this will begin reducing the list of names making it easier to find the collector you are looking for.

10.3 Sample Login

10.3.1 From the Sample ID field, click on the LOV (List Of Values) Icon. If any valid ID's are stored in the client profile, they will appear in a list. If no valid ID's are available, the user can manually type in a Sample ID. Refrain from using abbreviations, all small cases or all upper case.

10.3.2 The "Phone", "Report to", "PO", "Location", "Description", "Rec Codes", "Chain", "Original", "Keywords", and "Paired" fields are empty fields.

10.3.3 Enter the date and time collected.

10.3.4 The "Matrix" field is filled in according to the profile, but can be changed if necessary. A list of matrix options can be seen by accessing the LOV menu for the "Matrix" field.

10.3.5 Enter the date and time received. The date and time received is the date and time the last signature on the COC was completed upon receipt by the sample receiving department.

10.3.6 The "Type" field and "Mgr" fields are filled in according to the profile.

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10.3.7 The "Turn" field is filled in according to the profile, but can be changed if necessary. A list of options can be seen by accessing the LOV menu for the "Turn" field. When selecting an option, always pick one expressed as "Workdays from Receipt".

10.3.8 The "Priority" field is filled in according to the profile, but can be changed if necessary. A list of options can be seen by accessing the LOV menu for the "Priority" field.

10.3.9 Click on the "Load Line" button from the top of the Horizon Screen. A list of available testing will be displayed associated with the client and profile chosen.

10.3.9.1 Line Item 1 for the profile will initially appear on the first line of the "Line Item" section. Click on the "Line Item"

10.3.9.2 All the line items available under that profile will appear. Line items can be a single test or a group of several different tests.

10.3.9.3 Select a line item that includes tests codes necessary for this sample. Click on "Set Line Item" Unchecking any tests will cause that test or tests not to load in the workorder.

10.3.9.4 You can continue to add testing from the list by "appending line items. Appending will add to what has already been loaded into the workorder. Setting A Line will cause everything loaded in the workorder to be replaced. Select the Line Item you wish to append then, click on "Append Line Item" to add these codes to the test codes already selected. Again unchecking any test will cause that test not to load.

10.3.9.5 Continue in this manner until all test codes needed are selected.

10.3.9.6 Once all test codes are loaded that are needed, click on OK on the Line Items window.

10.3.9.7 If a needed test code is not included as a line item, it can be entered manually. In the next unused Type field key in the type of container, or click on the LOV Icon to select from a list.

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10.3.9.8 Next key in the preservative or click on the LOV Icon and select the preservative from the list.

10.3.9.9 In the CC field key in "OK"

10.3.9.10 In the Count field key in the number of containers received.

10.3.9.11 Click in the ACODE 1 Field and then click on the LOV Icon and select the test code you are trying to add. You can continue to add additional testing to that bottle by going to the next ACODE to the Right. There are 16 available ACODES on a single line. You more is needed for a single bottle continue on the next line making sure The "Type" field remains blank. When the LIMS sees a blank type field, it automatically associates the testing for that line with the bottle listed above that line.

10.3.9.12 Once all test codes are entered, and all bottles are correct, click on "Save".

10.3.9.13 If auxiliary data is required for the sample, such as for DEP reportable samples, the auxiliary data field will appear.

10.3.9.14 Auxiliary data information will include: 1) Raw or Finished Water; Level of Compositing (Usually 0); Source (Surface (1), GUDI (2), or Groundwater (3); Start of Sampling Period; and End of Sampling Period.

10.3.9.15 Once the Auxiliary Data is entered, click "Save".

10.3.9.16 A "Lab ID" number will be generated, and unique bottle IDs will also be generated for each container, and the sample will be saved, and labels will print.

NOTE: If a second sample is included on the workorder, the LIMS will advance to the next sample. Proceed starting with Section 10.3.1. Information from the first sample will be carried over to the second and can be saved as is or changed. DO NOT changed the Work ID Field. If this field is altered in any way, the LIMS will begin a new workorder.

10.3.9.17 To begin a new workorder simply start from Section 10.2.3 and remember that you must changed the Work ID field to clear the

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WO number that the LIMS last assigned. You can also hold down the shift key while pressing F7 to clear the enter Container Login Screen the begin again from section 10.2.3. This is probably the "safest" way until you are comfortable with changing workorders.

10.4 Creating DEP Sample Identifier

10.4.1 From the Horizon main menu select the "Clients" icon.

10.4.2 Select "Setup/Edit"

10.4.3 Select the profile the DEP identified is to be added to.

10.4.4 Select "Valid ID" (Double check)

10.4.5 Add the new DEP identifier.

11 Calculations

11.1 Not Applicable

12 Reporting Results

12.1 Not Applicable

13 Waste Disposal

13.1 Refer to ALSI SOP 19-Waste Disposal

14 Pollution Prevention

14.1 Pollution prevention encompasses any technique that reduces or eliminates the quantity or toxicity of waste at the point of generation. Numerous opportunities for pollution prevention exist in laboratory operation. Management shall consider pollution prevention a high priority. Extended storage of unused chemicals increases the risk of accidents. The laboratory shall consider smaller quantity purchases which will result in fewer unused chemicals being stored and reduce the potential for exposure by employees. ALSI tracks chemicals when received by recording their receipt in a traceable logbook. Each chemical is then labeled according to required procedures and stored in assigned locations for proper laboratory use.

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15 Definitions

15.1 Refer to ALSI QA Plan under Laboratory Quality Control Checks for general definitions.

16 Troubleshooting

16.1 Refer to the maintenance logs and instrument manuals for guidance in troubleshooting specific problems related to the apparatus used in this method.

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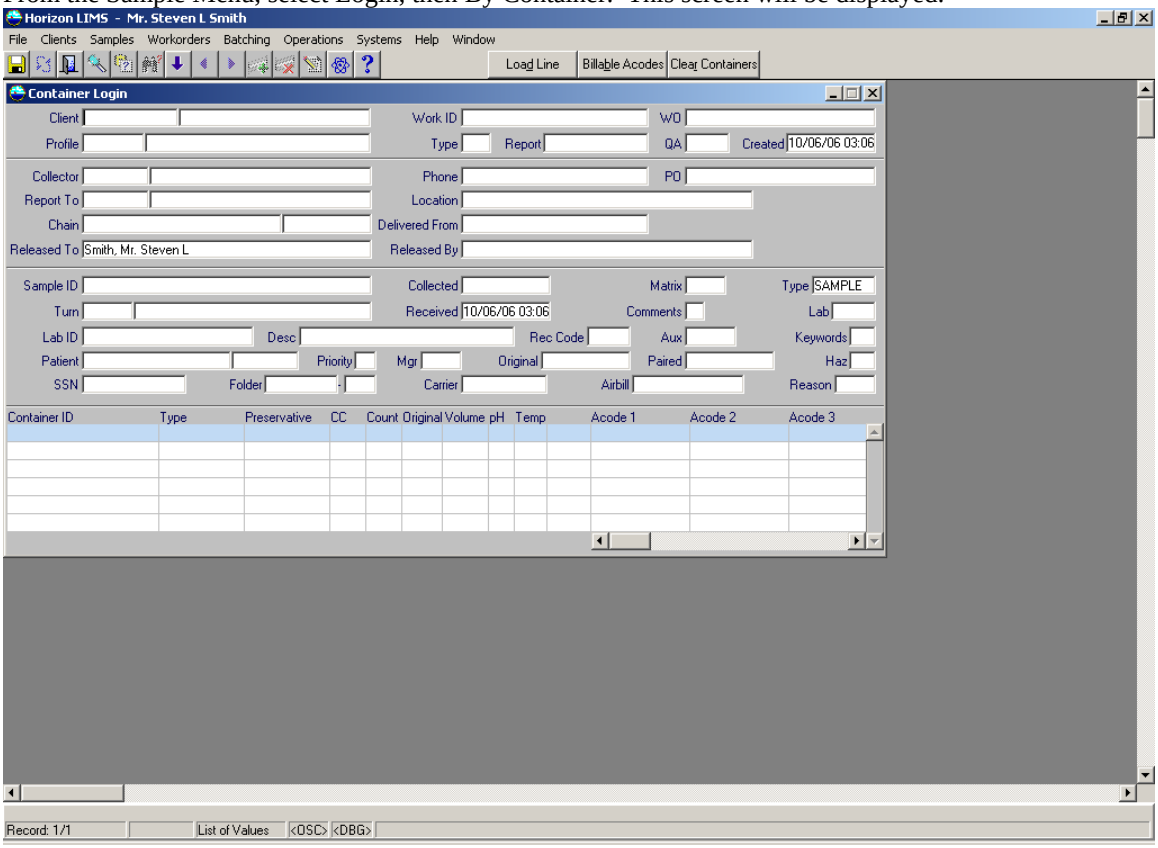
APPENDIX A

From the Sample Menu, select Login, then By Container. This screen will be displayed:



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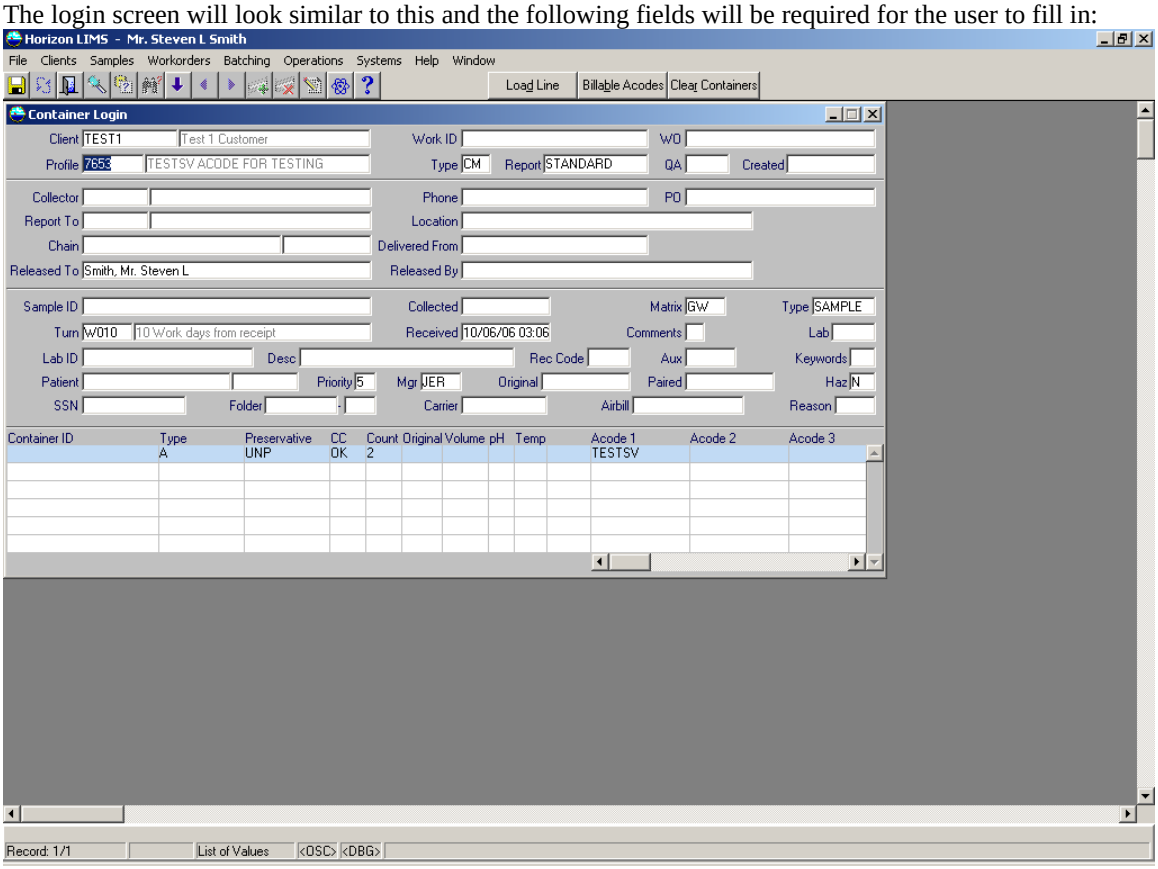
In the Client Field, Click on the List Of Values button. The client for the workorder will be displayed here. The login screen will look similar to this and the following fields will be required for the user to fill in:



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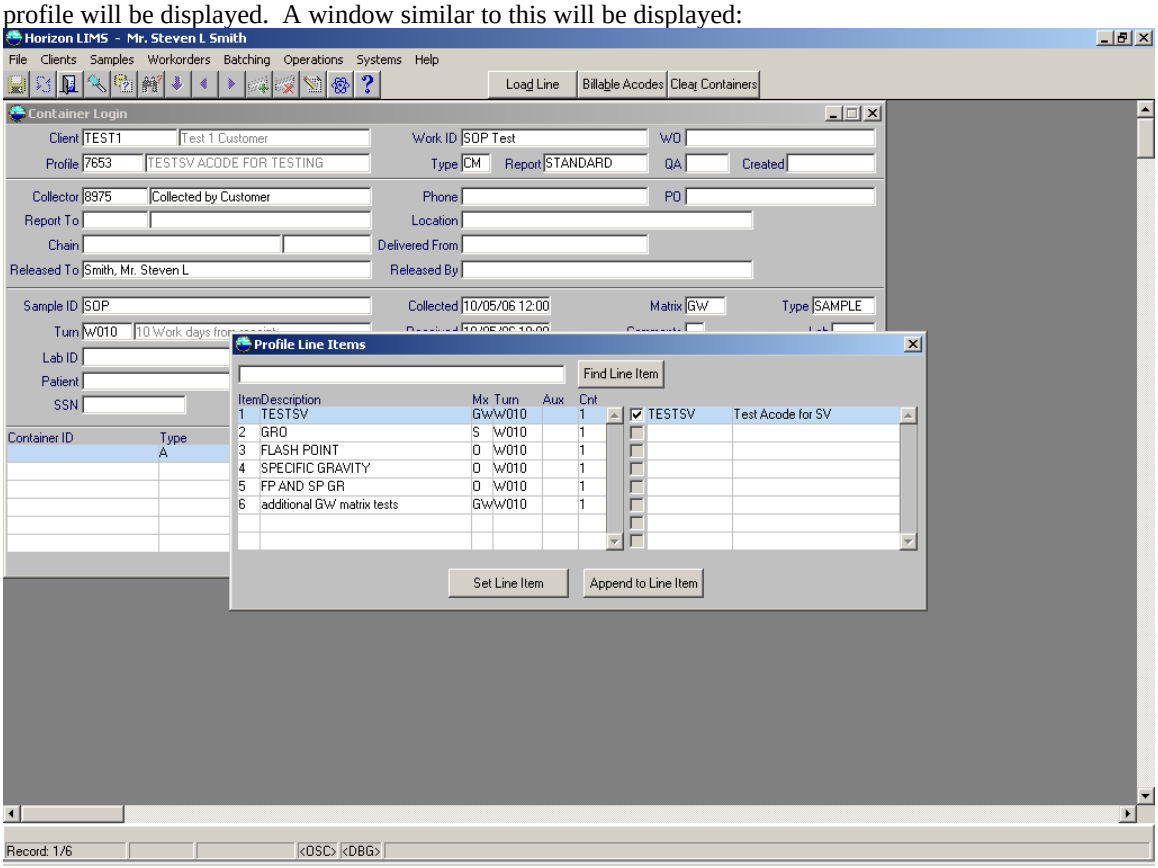
When the user is ready to add testing, simply click on the Load Line button. All available testing for the client and profile will be displayed. A window similar to this will be displayed:



From the Profile Line Items window, select the line item that best matches the COC being worked on. If a line item contains more testing then what is requested, simply uncheck what isn't to be added to the workorder. Click on the Set Line Item button. If additional line items are to be appended, simply click on the line item to be appended, uncheck any testing not needed to be added and click Append to Line Item.

NOTE: Clicking on the Set Line Item Button replaces everything.

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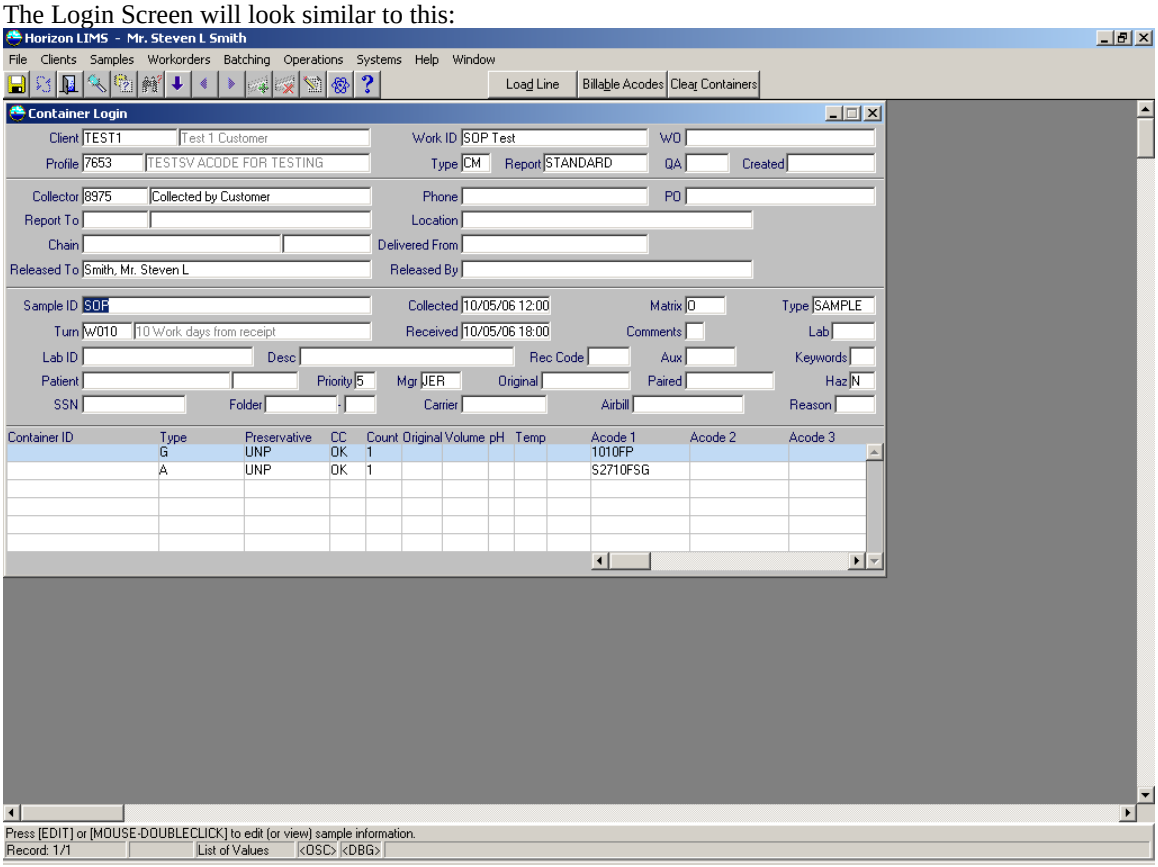
The Login Screen will look similar to this:



At this point the user can manually change a bottle or preservation for any bottle listed.
Once the user is satisfied to save and print labels, Click on the save button in the upper left corner of the login screen.

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APPENDIX B

New Employee Orientation

Sample Receiving Training Checklist

Procedure: Sample Log-in

SOP:_____

Revision:_____

	Analyst	Trainer
1) Analyst has read and understands SOP 19-COC and signed the concurrence form.	____	____
2) Analyst can access the Horizon LIMS.	____	____
3) Analyst can create a new workorder.	____	____
3) Analyst knows how to select a client profile.	____	____
4) Analyst knows how to change deliverable type and report format if necessary.	____	____
5) Analyst knows how to access the sample log-in screen.	____	____
6) Analyst knows how to select a sample collector.	____	____
7) Analyst knows how to select a sample ID, including an ID for a DEP reportable sample.	____	____
8) Analyst knows how to enter the date/time collected and received.	____	____
9) Analyst knows how to change the sample matrix if necessary.	____	____
10) Analyst knows how to modify the priority and turn-around fields if necessary.	____	____
12) Analyst knows how to add test codes using the "set line item" function.	____	____
13) Analyst knows how to append line items.	____	____

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Rev. 5/05

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	Analyst	Trainer
14) Analyst knows how to add test codes manually that are not included in line items.	____	____
15) Analyst knows how to enter auxiliary data.	____	____
16) Analyst knows how to create DEP sample identifiers.	____	____
17) Analyst demonstrated this ability on at least five separate projects/workorders, one of which is a DEP sample.	____	____

The workorders used for demonstration are:

_____
_____
_____
_____
_____

Analyst Name	Analyst Signature	Date

Supervisor Name	Supervisor Signature	Date

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SOP Change Summary

Section No.	Section	Reason for Change
Revision 4: 11/22/2006:		
1.2	Scope and Application	Added references to the most current NELAC standards
1.3	Scope and Application	Added use of project specific criteria
4.1	Safety	Added statement about maintaining MSDS
5.1	Apparatus and Materials	Revised reference to a specific Horizon version to read "current"
8.1	Quality Control	Added standard verbiage concerning ALSI QA Plan
8.2	Quality Control	Added DOC requirements
8.2.2	Quality Control	Added DOC failure corrective action
8.3	Quality Control	Added comment concerning ongoing proficiency
16	Troubleshooting	Added section
A	Appendix	Updated appendix
B	Appendix	Deleted screenshots; added training documentation

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SOP Concurrence Form
for the Distribution and Revision of Standard Operating Procedures

I have read, understood, and concurred with the Standard Operating Procedure (SOP) described above and will perform this procedure as it is written in the SOP.

Print Name	Signature	Date

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Document Title: Nitroaromatics and Nitroamines by HPLC with Ultraviolet Detection

Document Control Number: _____

Organization Title: ANALYTICAL LABORATORY SERVICE, INC. (ALSI)

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Approved by:

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GC Department Supervisor

_____ _____
Evan Cooper, Ph.D. Date
Validator

Annual Review:

_____ _____
Reviewed By Date Reviewed

_____ _____
Approved By Date Approved

_____ _____
Reviewed By Date Reviewed

_____ _____
Approved By Date Approved

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Annual Review (continued):

Reviewed By	Date Reviewed
Approved By	Date Approved

Reviewed By	Date Reviewed
Approved By	Date Approved

Reviewed By	Date Reviewed
Approved By	Date Approved

Reviewed By	Date Reviewed
Approved By	Date Approved

Reviewed By	Date Reviewed
Approved By	Date Approved

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1 Scope and Application

1.1 This standard operating procedure is adapted from EPA Method 8330B, Rev. 2, October 2006, SW 846, "Test Methods for Evaluating Solid Waste". Method Detection Limits (MDLs) are available on the ALSI network and are maintained and updated by QA Department. The detection limits for a specific sample may differ from those listed due to the nature of interferences in a particular sample matrix.

1.2 This method is used to determine nitroaromatics and nitramines in a variety of solid and liquid matrices. This method is applicable to nearly all types of samples regardless of water content, including ground water, aqueous sludges, caustic liquors, acid liquors, waste solvents, oily wastes, mousses, tars, fibrous wastes, polymeric emulsions, filter cakes, spent carbons, spent catalysts, soils and sediments. The following compound can be determined by this method:

ANALYTE	ABBREVIATION	CAS#
Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (Octogen)	HMX	2691-41-0
Hexahydro-1,3,5-trinitro-1,3,5-triazine (Hexogen)	RDX	121-82-4
1,3,5-Trinitrobenzene	1,3,5-TNB	99-35-4
1,3-Dinitrobenzene	1,3DNB	99-65-0
Methyl-2,4,6-trinitrophenylnitramine	Tetryl	479-75-8
Nitrobenzene	NB	98-95-3
2,4,6-Trinitrotoluene	2,4,6-TNT	118-96-7
4-Amino-2,6-dinitrotoluene	4-Am-DNT	1946-51-0
2-Amino-4,6-dinitrotoluene	2-Am-DNT	35572-78-2
2,4-Dinitrotoluene	2,4-DNT	121-14-2
2,6-Dinitrotoluene	2,6-DNT	606-20-2
2-Nitrotoluene	2-NT	88-72-2
3-Nitrotoluene	3-NT	99-08-1
4-Nitrotoluene	4-NT	99-99-0
Nitroglycerin	NG	55-63-0
Pentaerythritol tetranitrate	PETN	78-11-5
3,5-Dinitroaniline	3,5-DNA	618-87-1

1.3 This is a high performance liquid chromatography (HPLC) method applicable to the determination of the compounds listed above.

1.4 This method is restricted for use by or under the supervision of analysts experienced in the use of HPLC systems and who have demonstrated the ability to generate acceptable results using the procedure described in this document.

1.5 This document states the laboratory's policies and procedures established in order to meet the requirements of all certifications/accreditations currently held by the laboratory including the most recent NELAC standards.

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1.6 Individual project requirements may override criteria listed in this SOP.

2 Summary of Method

2.1 A measured volume/weight of sample is processed using one of the following procedures: a salting-out extraction, Solid-phase extraction, ultrasonic bath extraction, or a high level direct injection. An aliquot of the extract/sample is injected into a HPLC and the compounds are detected by the ultraviolet (UV) detector.

3 Interferences

3.1 Method interferences may be caused by contaminants in solvents, reagents, glassware and other sample processing hardware that lead to discrete artifacts and/or elevated baselines, causing misinterpretation of the chromatograms. All of these materials must be demonstrated to be free from interferences, under the conditions of the analysis by running method blanks.

3.2 2,4-DNT and 2,6-DNT elute at similar retention times (retention time difference of 0.2 minutes). A large concentration of one isomer may mask the response of the other isomer. If it is not apparent that both isomers are present (or are not detected), an isomeric mixture shall be reported.

3.3 Tetryl decomposes rapidly in methanol/water solutions, as well as with heat. All aqueous samples expected to contain tetryl shall be diluted with acetonitrile prior to filtration and acidified to pH <3. All samples expected to contain tetryl shall not be exposed to temperatures above room temperature.

3.4 Degradation products of tetryl appear as a shoulder on the 2,4,6-TNT peak. Peak heights rather than peak areas shall be used when tetryl is present in concentrations that are significant relative to the concentration of 2,4,6-TNT.

4 Safety

4.1 The toxicity or carcinogenicity of each reagent used in this method has not been precisely defined; however, each chemical compound shall be treated as a potential health hazard. From this viewpoint exposure to these chemicals must be reduced to the lowest possible level by whatever means available. The laboratory maintains a current awareness file of the OSHA regulations regarding the safe handling of the chemicals specified in this method.

4.2 ALSI maintains material safety data sheets (MSDS) on all chemicals used in this procedure. ALSI recommends that all individuals performing this SOP familiarize themselves with the MSDSs associated with the procedure prior to SOP performance. MSDS are available to all staff and are located in hard copy in the QA reference library and electronically on the ALSI server in

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the MSDS folder.

4.3 When handling any chemicals in this procedure, including sample extracts, it is recommended that gloves and safety glasses be used as personal protective equipment (PPE).

5 Apparatus and Materials

5.1 High Performance Liquid Chromatography (HPLC) apparatus

5.1.1 HPLC1 – Dionex Ultimate 3000 or equivalent.

5.2 HPLC Columns

5.2.1 Preferred columns, used when nitroglycerin is not analyzed:

5.2.1.1 PRIMARY: Dionex Acclaim Explosives E1, P/N 064305, used with a guard column, Dionex Acclaim Explosives E1, P/N 064303, or equivalent.

5.2.1.2 CONFIRMATION: Dionex Acclaim Explosives E2, P/N 064309, used with a guard column, Dionex Acclaim Explosives E2, P/N 064307, or equivalent.

5.2.2 Alternate Primary Column: Merck Purospher RP-18e column; 5 µm particle size; length 25 cm; i.d. 4.6 mm; Merck P/N 1.50169.0001 or Agilent P/N 79925PE-584, or equivalent

5.3 Data system: Data is acquired using PE Nelson Turbochrom. All data is imported to the Hewlett Packard Chemserver and processed using Target software

5.4 Autosampler: Dionex WPS-3000 Autosampler or equivalent.

5.5 Detectors: Ultraviolet detection: Dionex VWD-3400 Variable Wavelength UV/Vis Detector with multi-channel and multi-wavelength data collection, or equivalent.

5.6 Degasser: automated Teflon membrane vacuum degassing equipment, built-in with the Dionex Ultimate 3000 system, or equivalent.

5.7 Microsyringes: Hamilton gas tight, various sizes purchased from Supelco.

5.8 Analytical balance: capable of reading to 0.0001 g.

5.6 Membrane Filtration Apparatus using 0.2 µm, 47 mm, membrane filter; PALL Supor-200, P/N 60301, or equivalent.

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6 Reagents

NOTE: Unless otherwise noted in this section, all chemicals are stored at room temperature and labeled with an expiration date of five years from receipt. Manufacturer's labeled expiration dates, when less than five years, take precedent over all other expiration dates.

6.1 Acetonitrile: HPLC grade purchased from VWR Catalog #BJ015-4 or equivalent

6.2 Reagent Water – A Filson Water Purification System is used which provides analyte-free >16.0 megaohm deionized water on demand.

6.3 Methanol (MeOH): HPLC grade purchased from VWR Catalog #EM-MX0475-1, or equivalent.

6.4 Calcium chloride, $CaCl_2$ - Reagent grade, Fluka P/N 21098, or equivalent. Prepare an aqueous solution containing 5.0 g/L of calcium chloride. Label with an expiration date of 180 days.

6.5 1:1 Acetonitrile:$CaCl_2$ Solution: Mix 250 mL of Acetonitrile with 250 mL of $CaCl_2$ solution, expiration period of 6 months.

6.6 Surrogate Stock Solution – 1-chloro-3-nitrobenzene (1000 µg/mL) in acetonitrile, Ultra Scientific part #IST-630, or equivalent. Store at -10°C to -20°C protected from light.

6.7 Primary Stock Solution: Cerilliant Method 8330 Stock Standard P/N ERE-021, or equivalent. This standard contains all 14 of the explosive compounds listed in EPA method 8330A, all at 200 µg/mL in acetonitrile. Store at -10°C to -20°C protected from light.

6.7.1 Calibration Stock Solution (2000 µg/L): Mix 2.0 µL of Surrogate Stock and 10.0 µL of Primary Stock Solution, with 990 µL acetonitrile, prepare as needed for calibration.

6.8 Second Source Solution: Ultra Combined Stock Solution P/N NAIM-833E, or equivalent. This standard contains all 14 of the explosive compounds listed in EPA method 8330A, all at 1000 µg/mL in acetonitrile. Store at -10°C to -20°C protected from light.

6.8.1 Second Source Intermediate Stock Standard (20 µg/mL): Mix 20.0 µL of Surrogate Stock, 20.0 µL of Second Source Solution, with 960 µL acetonitrile. Store at -10°C to -20°C protected from light, label with an expiration date of 180 days.

6.8.1.1 Second Source Calibration Check Standard (100 µg/L): Fortify 1.00 mL of a 1:1 mixture of acetonitrile and $CaCl_2$ solution with 5.0 µL of Second Source Intermediate Stock Standard. Prepare daily as needed.

6.9 Additional Compounds: The compounds Nitroglycerin (NG), Pentaerythritol tetranitrate (PETN), and 3,5-Dinitroaniline (3,5-DNA), may also be analyzed by this method. The stock

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standards for these compounds are purchased as separate single component solutions:

6.9.1 NG Primary Stock Solution: Cerilliant Trinitroglycerin Standard P/N T-002, or equivalent. This standard contains NG at 1000 µg/mL in acetonitrile. Store from -10°C to -20°C protected from light.

6.9.2 NG Second Source Solution: Restek Nitroglycerin P/N 31498, or equivalent. This standard contains NG at 1000 µg/mL in methanol. Store at -10°C to -20°C protected from light.

6.9.3 PETN Primary Stock Solution: Cerilliant PETN Standard P/N P-037, or equivalent. This standard contains PETN at 1000 µg/mL in acetonitrile. Store from -10°C to -20°C protected from light.

6.9.4 PETN Second Source Solution: Restek PETN P/N 31600, or equivalent. This standard contains PETN at 1000 µg/mL in acetonitrile. Store at -10°C to -20°C protected from light.

6.9.5 3,5-DNA Primary Stock Solution: Restek 3,5-DNA P/N 31661, or equivalent. This standard contains 3,5-DNA at 1000 µg/mL in acetonitrile. Store at -10°C to -20°C protected from light.

6.9.6 3,5-DNA Second Source Solution: Restek 3,5-DNA P/N 31661, of a different manufacturer's lot from the Primary Standard (6.9.5), or equivalent. This standard contains 3,5-DNA at 1000 µg/mL in acetonitrile. Store at -10°C to -20°C protected from light.

6.9.7 Calibration Stock Solution with Additional Compounds: Adjust the Calibration Stock Solution (6.7.1) as necessary to incorporate 10.0 mg/mL of the additional compounds. As an example, a Calibration Stock Solution with the addition of Nitroglycerin would be prepared as follows: Mix 2.0 µL of Surrogate Stock, 10.0 µL of Primary Stock Solution, and 10.0 µL of Nitroglycerin Primary Stock Solution with 980 µL acetonitrile, prepare as needed for calibration.

6.9.8 Second Source Intermediate Stock Standard with Additional Compounds: Adjust the Second Source Intermediate Stock Standard (6.8.1) as needed to analyze for any or all of the additional compounds. As an example, a Second Source Intermediate Stock Standard (6.8.1) with addition of Nitroglycerin would be prepared as follows: Mix 20.0 µL of Surrogate Stock (6.6), 20.0 µL of Second Source Solution (6.8), and 20.0 µL of Nitroglycerin Second Source Stock Solution, with 940 µL acetonitrile. Store at -10°C to -20°C protected from light, label with an expiration date of 180 days.

6.10 Sand - Ottawa 20-30 mesh. Fisher Scientific, part # 523-50 (1999) or equivalent. Muffle

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furnace at 400ºC for four hours. Cool and store in a glass bottle at room temperature. Label with an expiration date of 180 days.

7 Instrument Calibration

7.1 An external standard procedure is used for the 8330 analysis. A valid calibration of all target compounds and the surrogate must be in place prior to sample analysis. The calibration must consist of at least five points for linear calibration models, and of at least six points for non-linear calibration models. The points are generated by varying the injection volume for the appropriate Calibration Stock Solution. The following table shows a typical set of injections:

Table 1

Injection Volume (µL) of Calibration Stock Solution (6.8.1 or 6.10.1)	Equivalent Concentration Based On 100 µL Sample Injection (µg/L)	Equivalent Concentration for Additional Compounds Based On 100 µL Sample Injection (mg/L)
1.0	20.0	0.100
2.5	50.0	0.250
5.0	100	0.500
12.5	250	1.25
25.0	500	2.50
50.0	1000	5.00
100	2000	10.0

7.2 With the Target Software, use the data to prepare a calibration using the external standard calibration technique. Two general calibration types are available on the target software.

7.2.1 Averaged Response Factor: This calibration model is acceptable if the averaged response factor over the calibration range is constant (20% RSD or less). If the RSD is greater than 20%, or if it does not represent the calibration data well, proceed to Section 7.2.2.

7.2.2 Prepare a calibration curve using a linear regression model. When using a linear regression calibration curve, do not include the origin or force the calibration through the origin. The linear regression calibration curve will be valid if the coefficient of determination (r^2) is 0.99 or greater.

7.2.3 If the criteria specified above in Section 7.2.1 or 7.2.2 are not met, sample analysis will not begin until corrective action is taken resulting in acceptable %RSD or coefficient of determination. The following are suggestions on types of corrective action that may be

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pursued:

7.2.3.1 If a specific calibration level is the cause of the unacceptable calibration, re-inject the standard.

7.2.3.2 A calibration level for an analyte may be removed if it does not represent the practical quantitation limit for the analyte and as long as the calibration consists of the minimum number of calibration levels specified in Section 7.1. Calibration points shall not be removed from the middle of the initial calibration without technical justification.

7.2.3.3 If the above steps do not correct the problem, prepare another calibration standard and repeat the calibration. If the new calibration is still unacceptable, instrument maintenance may be necessary.

7.3 The initial calibration must be verified by the analysis of a second source calibration check standard at the beginning of each 12-hour shift or every ten field samples, which ever is more frequent. If the response for each analyte is ±20% of the response obtained during the initial calibration then the initial calibration is considered still valid and the analyst may proceed with sample analysis. Should the standard injection not meet the ±20% criteria, the following step shall be taken:

7.3.1 Prepare a fresh second source calibration check standard, inject and analyze it. If it meets the ±20% criteria, then the initial calibration is considered valid and the analyst may proceed with sample analysis. Should this second standard injection not meet the ±20% criteria, the following step shall be taken:

7.3.2 If it is possible to identify a specific source that could inhibit a successful check standard injection, then correct and document this source, and re-inject the second source calibration check standard. If it meets the ±20% criteria, then the initial calibration is considered valid and the analyst may proceed with sample analysis. Should this second standard injection not meet the ±20% criteria, the following step shall be taken:

7.3.3 Recalibrate the instrument.

7.4 Verify the initial calibration following the analysis of a group of samples to ensure the instrument is still in control. The result shall be ±20% of the expected result. If this criterion is not met, re-inject a calibration verification standard. If the criterion is still not met, the following actions will be taken with the samples analyzed prior to the failing calibration verification standard.

7.4.1 If the bias is low, re-analyze the samples under a valid calibration.

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7.4.2 If the bias is high, and there were detections in a field sample, re-analyze that field sample.

7.4.3 If the bias was high and analytes were not detected in the field sample, data quality is not impacted. Do not re-analyze the samples. Report to the client without qualification.

8 Quality Control

8.1 All policies and procedures in the most current revision of the ALSI QA Plan shall be followed when performing this procedure.

8.2 Initial Demonstration of Capability. Each analyst must successfully perform this demonstration before being considered proficient to analyze samples by this method. Ongoing proficiency must be established annually as specified in the QA Plan, under Technical Training,

8.2.1 Four QC check samples will be prepared:

8.2.1.1 Soil: Spike four 2.0 g samples of reagent sand with 10.0 µL of the Primary Stock Solution, and 10.0 µL of the Surrogate Stock Solution, also add 10.0 µL of the Nitroglycerin Primary Stock Solution if that compound is also needed. Take the samples through all steps of the extraction as described in SOP 09-8330S.

8.2.1.2 Water: Spike four 1000 mL samples of reagent water with 5.0 µL of the Primary Stock Solution, and 5.0 µL of the Surrogate Stock Solution, also add 5.0 µL of the Nitroglycerin Primary Stock Solution if that compound is also needed. Take the samples through all steps of the extraction as described in SOP 09-8330W.

8.2.2 Analyze samples by HPLC as described in Section 10.

8.2.3 An average recovery range of 70-130% recovery will be used as guidance to assess laboratory performance. A precision control limit of 30% RSD for all four check samples will be used as guidance to assess laboratory performance. When sufficient data is gathered, in house control limits will be used to assess laboratory performance.

8.2.4 If one or more analytes do not meet these criteria, identify and correct source of problem and report test for those analytes that initially failed.

8.3 Laboratory Method Blank. A method blank is prepared and analyzed with each extraction batch of 20 samples or less.

8.3.1 Evaluate an instrument blank (acetonitrile) to determine if the contamination is post

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extraction related.

8.3.2 If Section 8.3.1 does not reveal a problem, evaluate all the samples in the extraction batch. If there are samples without detections of the analyte in question, data was not impacted and may be reported without qualification.

8.3.3 If samples do have detections of the analyte, and the detection of the analyte in the method blank is ≤ 10% of the detection in the field sample, data may be reported as acceptable.

8.3.4 If the samples have detections, and the detection in the method blank is greater than 10% of the detection in the sample, the following steps will be taken:

8.3.4.1 If additional sample is available and the sample is still within holding time, the sample will be re-extracted.

8.3.4.2 If additional sample is not available, or the sample is past its holding time, the appropriate customer service representative will be notified, and the data will be qualified to the end user.

8.3.5 DoD requirements: If the method blank concentration is greater than or equal to ½ the reporting limit AND is greater than $^{1}/_{10}$ the sample concentration, the source of contamination must be investigated and measures taken to minimize or eliminate the problem and affected samples reanalyzed. If reanalysis is not possible, data shall be reported with a qualifying statement.

8.4 Assessing Surrogate Recovery: The surrogate concentration in samples will be 5.0 µg/L based on a 1 liter initial volume, or in the case of solid samples 5.0 mg/kg. Until sufficient data has been acquired to calculate matrix and extraction specific control charts, surrogate recovery limits will be 65% to 135%. When sufficient data has been acquired (>20 data points), determine the average and standard deviation of the data points. Control limits will be the average of ± 3 standard deviations.

8.4.1 When surrogate recovery from a sample is outside the established control limits, and the method blank and laboratory control sample is in control, the following steps shall be taken:

8.4.1.1 Check calculations and volumes used for spiking.

8.4.1.2 In this situation, sample matrix may be the cause of the out of control recovery in the field sample. Examine the sample chromatogram for other indications of matrix affect. Re-extract the sample or qualify as suspect due to sample matrix.

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8.4.2 If surrogate recovery is out of control in the method blank and laboratory control sample, the following actions shall be taken:

8.4.2.1 Check calculations and volumes used for spiking.

8.4.2.2 Re-validate the surrogate spike solution used to spike the samples. If this indicates a problem, re-evaluate recoveries based on the actual concentration of the spike solution. Additionally, dispose of the spike solution.

8.4.2.3 Check instrument performance. If the instrument is not running correctly, make the appropriate adjustments, or perform the appropriate instrument maintenance. Re-calibration may be necessary before sample analysis can resume.

8.4.2.4 If the above do not indicate a problem, and re-analysis of the blank and / or laboratory control sample do not result in acceptable surrogate recovery the following actions will be taken:

8.4.2.4.1 If surrogate recoveries for the samples are in control, no further actions will be necessary.

8.4.2.4.2 If possible, re-extract all samples with out of control surrogate recoveries.

8.4.2.4.3 If re-extraction is not possible, contact the appropriate customer service person to notify client. Qualify the samples.

8.5 Assessing Laboratory Performance - One laboratory control sample (LCS) will be extracted and analyzed with each group of 20 field samples or one per extraction batch. The laboratory control sample is prepared according to the appropriate prep SOP 09-8330W for waters, 09-8330S for soils, and analyzed as described in Section 10.0. Until sufficient data is acquired to establish in house control limits, the recoveries must be within the ranges 70 to 130 %. However, for an LCS associated with a United States Department of Defense (DoD) sample, the current approved DoD QSM recovery limits will be acceptable (see Table 5 and Table 6, in the Appendix). If a recovery for an analyte is out of control, the following actions shall be taken:

8.5.1 Check calculations and volumes used for spiking.

8.5.2 Re-validate the spike solution used to make the LCS. If this indicates a problem, re-evaluate recoveries based on the actual concentration of the spike solution. Additionally, dispose of the spike solution.

8.5.3 If the above steps do not indicate a problem, the following actions shall be taken:

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8.5.3.1 If spike recovery for the matrix spike is acceptable, sample data is acceptable and reported to the end user without qualification.

8.5.3.2 If spike recovery for the matrix spike is also unacceptable, samples will be re-extracted if additional sample is available and if the sample is still within holding time.

8.5.3.3 If additional sample is not available, contact the appropriate customer service representative. Data will be reported to the end user as suspect.

8.6 Assessing Analyte Recovery (Matrix Spike & Matrix Spike Duplicate): The laboratory must add a known concentration to a minimum of 5% of the routine samples or one sample per batch, whichever is greater. The sample selected for spiking will be done randomly. The same sample will be spiked a second time for precision data. Alternatively, when a field sample is known to have significant levels of target analyte, the field sample will be extracted in duplicate rather than a matrix spike duplicate. Spiked samples will be fortified at the same level as the laboratory control sample. Samples selected for matrix spike and matrix spike duplicate analysis shall be rotated among client samples so that various matrix problems may be noted and/or addressed. Poor performance in a matrix spike or matrix spike duplicate may indicate a problem with sample composition and shall be reported to the client whose sample produced the poor recovery.

8.6.1 Until sufficient data is acquired to establish in house control limits, the recoveries must be within the ranges 70 - 130%, unless the project involved is for the Department of Defense (DoD). DoD matrix spike recoveries are evaluated under the DoD LCS Control Limits (Appendix A). If a recovery for an analyte is out of control, the following actions shall be taken:

8.6.1.1 If analyte recovery in a spiked field sample is outside laboratory control limits, and the same analyte is in control in the laboratory control sample, and the specific matrix interference is identified, sample results for that analyte in the unfortified matrix shall be reported with a qualifying statement.

8.6.1.2 If analyte recovery in a spiked field sample is outside laboratory control limits, and the same analyte is in control in the laboratory control sample, and the specific matrix interference is unknown, reanalyze the sample and matrix spike to determine matrix effect or analytical error.

8.6.2 Precision: Until sufficient data is acquired to generate precision control limits, 30% RPD will be the upper precision control limit when comparing results between the matrix spike and the matrix spike duplicate. The same precision criterion applies to results in a duplicate pair when a sample duplicate is extracted in place of a matrix spike duplicate.

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8.7 Retention Time Windows

8.7.1 Retention time windows are crucial to the identification of target compounds. Absolute retention times are used for compound identification in this method. Retention time studies will be conducted annually or after major instrument maintenance, including the changing of a column.

8.7.2 Three injections of the second source calibration check standard are made over the course of a 72 hour period.

8.7.3 Calculate the mean and standard deviation of the three absolute retention times for each component. The width of the retention time window for each analyte and the surrogate is defined as ± 3 times the standard deviation of the mean absolute retention time.

8.7.4 Establish the center of the retention time window for each analyte and the surrogate by using the absolute retention time for each analyte and the surrogate from the calibration verification standard at the beginning of each analytical batch.

8.8 MDL studies must be performed according to SOP 99-MDL or the reference method, whichever is more frequent.

9 Sample Collection, Preservation and Handling

9.1 Containers used to collect samples must be specially cleaned 1-liter amber glass bottles. The sample containers shall have screw caps with Teflon lined septa. Plastic containers or lids may not be used for the storage of samples due to the possibility of sample contamination from the phthalate esters and other hydrocarbons within the plastic. A minimum of one liter is necessary for this analysis.

9.2 The samples must be iced or refrigerated above the freezing point of water up to 6°C from the time of collection until extraction.

9.3 All aqueous samples must be extracted within 7 days.

9.4 Solid and concentrated waste samples must be extracted within 14 days.

9.5 Sample extracts must be analyzed within 40 days of extraction. Store extracts protected from light above the freezing point of water up to 6°C.

10 Procedure

10.1 Sample Preparation: Samples must be prepared by one of the following methods prior to HPLC analysis.

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Matrix	Methods
Water	3535A SPE, 8330A Salting out
Solid	8330A Soil sonication

10.2 To achieve maximum sensitivity with this method, the extract must be 5.0 mL.

10.3 HPLC Analysis

10.3.1 The HPLC operating conditions used for the initial calibration will be used for sample analysis.

10.3.2 HPLC conditions:

10.3.2.1 Injection Volume is 100 µL.

10.3.2.2 Mobile Phase/ Column Conditions:

- Preferred Primary Column (5.2.1.1) is used isocratically with 44.0% methanol in water, and column at 32.0º C.
- Alternate Primary Column for Nitroglycerin (5.2.2) is used with a gradient as shown in Table 2, and column at 30.0º C.
- Preferred Confirmation Column (5.2.1.2) is used isocratically with 48.0% methanol in water and column at 28.0º C.

Table 2
Primary Analysis Gradient Program

Time (min)	**Flow (mL/min)**	**%H_2O**	**%MeOH**	**Curve**
Initial	1.00	90	10	*
5.0	1.00	90	10	11 (hold)
30.0	1.00	20	80	6 (linear)
40.0	1.00	20	80	11 (hold)
45.0	1.00	90	10	6 (linear)

10.3.2.3 UV detection wavelength is dependent on the compounds analyzed. Some compounds perform best at certain wavelengths as shown in Table 3. The detector and data system are capable of simultaneously collecting only two wavelengths. As Table 3 shows, if nitroglycerin is not desired, then the best pair of wavelengths is 235 and 265 nm. If nitroglycerin is desired, then 218

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and 265 is preferred.

Table 3

UV Detection Wavelengths

UV Detection Wavelength	Primary Compounds for Wavelength	Secondary Compounds for Wavelength
218 nm	NG, PETN	HMX, RDX, 1,3,5-TNB, 1.3-DNB, Tetryl, NB, 2,4,6-TNT, 4-Am-2,6-DNT, 2-Am-4,6-DNT,
235 nm	HMX, RDX, 1,3,5-TNB, 1.3-DNB, Tetryl, 2,4,6-TNT, 4-Am-2,6-DNT, 2-Am-4,6-DNT, 2,6-DNT, 2,4-DNT, 3,5-DNA	NB
265 nm	NB, 2-NT, 4-NT, 3-NT, Surrogate	1,3-DNB, Tetryl, 2,4,6-TNT, 4-Am-2,6-DNT, 2-Am-4,6-DNT, 2,6-DNT, 2,4-DNT, 3,5-DNA

10.3.3 Qualitative Analysis: As previously discussed, the UV detector will be the primary detector used for identification and quantitation of target compounds. Primary analysis, using either of the primary columns, will be used for tentative identification and all quantitation of target compounds. Tentative identification of an analyte occurs when a peak from a sample extract fall within the retention time window of a compound of interest.

Confirmation Techniques:

10.3.4 Confirmation: All positive detections will be confirmed by analysis on a dissimilar column. The confirmation column will provide good qualitative confirmation if the analyte is found in the retention time windows on both the primary and the confirmation columns. Quantitation may be adversely impacted due to co-elution of analytes on the confirmation column. Verify the confirmation by comparing the result for an analyte for the primary column to the result for that analyte on the confirmation column, RPD should be less than or equal to 40%.

10.3.4.1 If RPD is less than or equal to 40%, then the primary result confirms, and the higher of the two values should be reported, unless chromatographic issues such as coelution preclude this. Any such issues must be documented in the data if the higher value is not reported.

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10.3.4.2 If RPD is greater than 40%, then the higher of the two values shall be reported with a comment (comment acts as the J-flag for DoD samples).

10.3.4.3 If a result from the primary column is not confirmed by the confirmation column, since the analyte peak detected on the primary column is not found in the retention window for that analyte on the confirmation column, then the result will not be reported, except for DoD samples, where the primary result will be reported with a qualifying comment (comment acts as the Q-flag for DoD samples.)

10.3.5 Quantitative Analysis: As described in Section 7, all compounds will have a valid calibration curve. All calculations will be performed with the Target software. Generally, the Target software will be capable of automatic integration for all analyte and the surrogate peaks. This is preferred. If it becomes necessary to perform manual integrations of the data, then these manual integrations will adhere to SOP 99-Integration, and they will be properly noted in the data.

10.3.6 Linear Range: If the peak area for any analyte exceeds the linear range of the system, either by exceeding the calibration range, or by exceeding the maximum detector response, then dilute the extract and reanalyze.

11 Calculations

11.1 LCS Recovery:

% Recovery = (Cm/Cn)x100

where: Cm = measured concentration of LCS

Cn = spiking concentration

11.2 Spike Recovery:

% Recovery = [(Cs-Cu)/Cn]x100

where: Cs = measured concentration of spiked sample aliquot

Cu = measured concentration of unspiked sample aliquot

Cn = spiking concentration

11.3 Precision (RPD):

% Recovery = [(Cs-Cu)/Cn]x100

where: Cs = measured concentration of spiked sample aliquot

Cu = measured concentration of unspiked sample aliquot

Cn = spiking concentration

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12 Reporting Results

12.1 All raw data used for reporting results must be dated and initialed by the qualified laboratory personnel performing first and second review.

12.2 Horizon LIMS results are reported to three significant figures but limited to the number of decimal places in the reporting limit for the individual compound or analyte.

12.3 When entering data into the Horizon LIMS do not round off results: Horizon will automatically round off to 3 significant figures after all internal calculations are completed.

12.4 Report the actual result in the Horizon LIMS. The reporting limit is at or above the lowest calibration standard.

13 Waste Disposal

13.1 Refer to ALSI SOP 19-Waste Disposal.

14 Pollution Prevention

14.1 Pollution prevention encompasses any technique that reduces or eliminates the quantity or toxicity of waste at the point of generation. Numerous opportunities for pollution prevention exist in laboratory operations. Management shall consider pollution prevention a high priority. Extended storage of unused chemicals increases the risk of accidents. The laboratory shall consider smaller quantity purchases which will result in fewer unused chemicals being stored and reduce the potential for exposure by employees. ALSI tracks chemicals when received by recording their receipt in a traceable logbook. Each chemical is then labeled according to required procedures and stored in assigned locations for proper laboratory use.

15 Definitions

15.1 Refer to ALSI QA Plan under Laboratory Quality Control Checks for general definitions.

16 Troubleshooting

16.1 Refer to maintenance logs and instrument manuals for guidance in troubleshooting specific problems related to the instrumentation used in this method.

16.2 The Chromeleon software that controls the instrument used for this procedure provides a fully searchable database of all instrument parameters, including peak areas, pump pressure, column temperature, and more. This database has trending capability. This routine recording of

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instrument parameters is an excellent reference for properly maintaining the instrument as well as an invaluable trouble-shooting tool.

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Appendix A

DoD QSM Control Limits

Based on QSM Revision 3, January 2006

TABLE 4

DoD QSM LCS Control Limits for 8330 Water Matrix[a]

Compound	Lower Control Limit (%)	Upper Control Limit (%)	Lower ME Limit (%)	Upper ME Limit (%)
HMX	80	115	75	120
RDX	50	160	35	180
1,3,5-TNB	65	140	50	150
1,3-DNB	45	160	30	175
Tetryl	20	175	10	200
2,4,6-TNT	50	145	35	160
NB	50	140	35	155
4-Am-DNT	55	155	40	170
2-Am-DNT	50	155	35	170
2,4-DNT	60	135	50	145
2,6-DNT	60	135	50	150
2-NT	45	135	30	150
3-NT	50	130	35	145
4-NT	50	130	35	145

TABLE 5

DoD QSM LCS Control Limits for 8330 Solid Matrix[a]

Compound	Lower Control Limit (%)	Upper Control Limit (%)	Lower ME Limit (%)	Upper ME Limit (%)
HMX	75	125	65	135
RDX	70	135	65	145
1,3,5-TNB	75	125	65	135
1,3-DNB	80	125	70	135
Tetryl	20	175	10	200
2,4,6-TNT	50	145	35	160
NB	50	140	35	155
4-Am-DNT	55	155	40	170
2-Am-DNT	50	155	35	170
2,4-DNT	60	135	50	145
2,6-DNT	60	135	50	150
2-NT	45	135	30	150
3-NT	50	130	35	145
4-NT	50	130	35	145

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UNCONTROLLED DOCUMENT

Appendix B Sample Logbook Page

Work continued from page:_____

HPLC-1 (Dionex) LOGBOOK

Work continued to page:_____

Sequence: ______ Batch: ______ Method: ______ Date: ______

Seq. No.	Sample ID	Inj. Dilution	Analyst	QC	Standard	Comments

Reagents:

Add'l. Comments:

Revision 4/07

Page #: _____

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SOP Change History Sheet

Section No.	Section	Reason for Change
Revision 3: 10/31/05		
10.3.4 – 10.3.5	Procedure	USACE audit response
Appendix A	Logbook Sample Page	USACE audit response
5.2	Apparatus and Materials	Removed reference to column guard; updated manufacturer information
6.5	Reagents	Added Isopropyl Alcohol to list
10.3.3	Procedure	Removed reference to guard column and expanded HPLC table
10.3.6	Procedure	Added gradient parameters table
Figure 1		Removed
Revision 4: 03/13/2006		
Revisions to spelling, grammar and format made throughout document.		
1.1	Scope and Application	Deleted MDL reference to HPLC; replaced MDL folder with MDL book
1.2	Scope and Application	Added Octogen and Hexogen references
1.6	Scope and Application	Added verbiage concerning project requirements
4.1	Safety	Added MSDS availability verbiage
5.1.1	Apparatus and Materials	Deleted “consistent flow” from HPLC1 description
6.3	Reagents	Revised reagent water to reflect definition and ALSI in-house production

SOP Change History Sheet (continued)

Section No.	Section	Reason for Change

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6.6	Reagents	Added vendor information
6.7.2, 6.8.1, 6.8.2	Reagents	Revised holding parameters
6.7.3, 6.8.3.1, 6.8.3.2	Reagents	Revised preparation volumes and holding parameters
6.10, 6.11	Reagents	Added sections for sand and spike solution
6.12	Reagents	Revised reference to table, deleted spike solution
7.2	Instrument Calibration	Added references to linear regression
7.2.3.2	Instrument Calibration	Added minimum calibration requirements
7.3	Instrument Calibration	Revised verification of second source calibration
7.4	Instrument Calibration	Added 7.4.1-7.4.3 for clarification
8.2	Quality Control	Added verbiage about ongoing proficiency; added sections describing 4 QC check samples preparation and precision control limits
8.3	Quality Control	Removed verbiage about method blank/MDL association
8.3.3, 8.3.4	Quality Control	Revised analyte detection percentage in the method blank
8.4	Quality Control	Deleted surrogate recovery assessment concentration basis
8.4.2.2, 8.5.2	Quality Control	Revised wording about spike solution degradation
8.5	Quality Control	Added/revised laboratory performance assessment

SOP Change History Sheet (continued)

Section No.	**Section**	**Reason for Change**
8.6	Quality Control	Added MS/MSD rotation

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8.6.1.1	Quality Control	Added reference to "spiked" field sample and identification of specific matrix interference
8.6.1.2	Quality Control	Added verbiage for corrective action
8.6.2	Quality Control	Revised RPD from "50" to "30" %
8.7	Quality Control	Added section on Retention Time Windows
8.8	Quality Control	Added section referencing MDL; Removed section concerning accessing an internal standard
9.1.1	Sample Collection…	Added "amber" to further describe container
10.3.2	Procedure	Revised section removing calibration verification reference and adding table references
10.3.5	Procedure	Deleted previous verbiage about unnecessary confirmation; added verbiage about positive detection confirmations
10.3.6.1	Procedure	Added Table 4 references
10.3.11	Procedure	Added section addressing automatic and manual integration
11.1	Reporting Results	Added section for reporting raw data results
16	Troubleshooting	Added section
A	Appendix	Deleted Table 1 and added Tables 5 & 6
B	Appendix	Added Sample Logbook page

SOP Change History Sheet (continued)

Section No.	**Section**	**Reason for Change**
Revision 5: 11/16/07		
Spelling, grammar, and formatting changes may have been made throughout SOP for clarity, correctness, and site conformity.		
1.2	Scope and Application	Added Nitroglycerin

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4.2, 4.3	Safety	Added section
5	Apparatus and Material	Update numerous manufacturer and part numbers
6	Reagents and	Added NOTE, numerous updates to manufacturer part numbers, and reagent formulations
7.1	Instrument Calibration	Added Table
8.3.5	Quality Control	Added section
8.4	Quality Control	Added soil criterion
8.6.1, 8.6.2	Quality Control	Removed equations
10	Procedure	Numerous revisions made throughout section
11	Calculations	Added calculations from Section 8
Appendix B		Update to current logbook page

Revision 6: 01/29/08

8.6.1	Quality Control	Added DoD verbiage per DoD audit
8.7.1	Quality Control	Updated procedure per DoD audit
10.3.6	Procedure	Updated procedure per DoD audit
16.2	Troubleshooting	Added section per DoD audit

SOP Change History Sheet (continued)

Section No.	**Section**	**Reason for Change**
Revision 7: 4/14/08		
1.1	Scope and Application	Updated reference method
1.2	Scope and Application	Updated analyte list
6.9	Reagents	Added new analytes

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6.10	Reagents	Removed section
7.3, 7.4	Instrument Calibration	Updated criteria from 15% to 20%
10.3.2.3	Procedure	Added analytes to Table 3

SOP Concurrence Form

for the Distribution and Revision of Standard Operating Procedures

I have read, understood, and concurred with the Standard Operating Procedure (SOP) described above and will perform this procedure as it is written in the SOP.

Print Name	Signature	Date
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____

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Document Title: Sample Preparation for the Determination of Mercury in Aqueous and Soil Samples

Document Control Number: _____

Organization Title: ANALYTICAL LABORATORY SERVICE, INC. (ALSI)

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Annual Review:

_____ _____
Reviewed By Date Reviewed

_____ _____
Approved By Date Approved

_____ _____
Reviewed By Date Reviewed

_____ _____
Approved By Date Approved

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Annual Review (continued):

Reviewed By	Date Reviewed
Approved By	Date Approved

Reviewed By	Date Reviewed
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1 Scope and Application

1.1 This procedure is adapted from EPA Method 245.1, Revision 3, 1994, Methods for Chemical Analysis of Water and Wastes; SW-846 Method 7470A, Revision 1, September 1994; SW-846 Method 7471B, Revision 2, January 1998.

1.2 This document states the laboratory's policies and procedures established in order to meet requirements of all certifications/accreditations currently held by the laboratory, including the most current NELAC standards.

1.3 This method is used to digest groundwater, surface, and saline waters, domestic and industrial wastes, soils, sediments, bottom deposits and sludge type materials in the determination of mercury.

1.4 In addition to inorganic forms of mercury, organic mercurials may also be present. These organo-mercury compounds will not respond to the cold vapor atomic absorption technique unless they are first broken down and converted to mercuric ions. Potassium permanganate oxidizes many of these compounds, but recent studies have shown that a number of organic mercurials including phenyl mercuric acetate and methyl mercuric chloride are only partially oxidized by this reagent. Potassium persulfate has been found to give approximately 100% recovery when used as the oxidant with these compounds. Therefore, a persulfate oxidation step following the addition of the permanganate has been included to ensure that organo-mercury compounds, if present, will be oxidized to the mercuric ion before measurement. A heat step is required for methyl mercuric chloride when present in or spiked into a natural system.

1.5 Method Detection Limits (MDLs) are available on the ALSI network and are maintained and updated by the QA Department. The detection limits for a specific sample may differ from those listed due to the nature of interferences in a particular sample matrix.

1.6 Individual project requirements may override criteria listed in this SOP.

2 Summary of Method

2.1 Samples analyzed for mercury must be digested to ensure mercury is in the elemental state for analysis. Aqueous samples are digested in potassium permanganate-potassium persulfate solutions and oxidized for 2 hours at 95°C. Solid samples are digested with potassium permanganate solution and autoclaved for 15 minutes.

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3 Interferences

3.1 Possible interference from sulfide is eliminated by the addition of potassium permanganate. Concentrations as high as 20 mg/L of sulfide as sodium sulfide do not interfere with the recovery of added inorganic mercury from distilled water.

3.2 Copper is known to interfere, however spiked mercury samples have recovered with concentrations of copper as high as 10 mg/L.

3.3 Samples high in chlorides will also interfere since free chlorine released during oxidation will absorb light at the 253.7nm wavelength. These samples may require additional potassium permanganate (as much as 25 mL) and additional hydroxylamine hydrochloride (25 mL). Inorganic and organic mercury spikes have been recovered from seawater using this technique.

3.4 Certain volatile organic materials that absorb at this wavelength may cause interference. Positive samples shall be reanalyzed without the addition of stannous chloride to rule out this interference.

4 Safety

4.1 Since this procedure requires the use of many reagents including acids and oxidizers. Extreme caution shall be used for the reason that the toxicity and carcinogenicity of each reagent used in this procedure has not been fully established. Each chemical shall be regarded as a potential health hazard and exposure to these compounds shall be minimized by good laboratory practices.

4.2 ALSI maintains Material Safety Data Sheets (MSDSs) on all chemicals used in this procedure. ALSI recommends that all individuals performing this SOP familiarize themselves with the MSDSs associated with the procedure prior to SOP performance. MSDSs are available to all staff and are located in hard copy in the QA reference library and electronically on the ALSI server in the MSDS folder.

4.3 The minimum personal protective equipment requirement for this method is safety glasses, a fully buttoned lab coat and chemical resistant gloves. The acidification of samples containing reactive material may result in release of toxic gases, such as cyanides or sulfides. A fume hood shall be used during the acidification of samples. This PPE should reduce the possibility of contact to a safe level, but the analyst should not limit themselves to these PPE minimums.

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4.4 Mercury compounds are highly toxic if swallowed, inhaled or absorbed through the skin. Analyses should be conducted in a laboratory exhaust hood. The analyst should use chemical resistant gloves when handling concentrated mercury standards.

5 Apparatus and Materials

5.1 40-mL VOA vials, with Teflon/Silicone Septum, Pre-cleaned Protocol B, Industrial Glassware #2795FL-PC, or equivalent.

5.2 Assorted Class A variable volume dispensing pipettes, calibrated according to ALSI SOP 19-AP.-

5.2.1 (20-200 µL volume)Finnpipette Digital Pipettors, Thermo Labsystems, VWR catalog #53515-020 or equivalent

5.2.2 (200-1000 µL volume) Finnpipette Digital Pipettors, Thermo Labsystems,

VWR catalog #53515-044 or equivalent

5.2.3 (2-10 mL volume) Finnpipette Digital Pipettors, Thermo Labsystems, VWR catalog #53515-050 or equivalent

5.3 Disposable pipette tips for Finnpipette Digital Pipettors-

5.3.1 (Unifit Tips, 1-200 µL) VWR catalog #53503-094 or equivalent

5.3.2 (Finntip 1000, 100-1000 µL) VWR catalog #53515-876 or equivalent

5.3.3 (Finntip 10 mL, 2-10 mL) VWR catalog #53516-178 or equivalent

5.4 Disposable Transfer Pipettes- VWR catalog #14670-103 or equivalent

5.5 Class A volumetric flasks-

5.5.1 (25 mL) VWR catalog #29620-109 or equivalent

5.5.2 (100 mL) VWR catalog #29620-142 or equivalent

5.5.3 (200 mL) VWR catalog #29620-164 or equivalent

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5.5.4 (500 mL) VWR catalog #29620-200 or equivalent

5.5.5 (1000 mL) VWR catalog #29620-222 or equivalent

5.6 Amber glass jar- (1 L) VWR catalog #IR141-0950 or equivalent

5.7 Dispensers for acids, calibrated according to ALSI SOP 19-AP

5.7.1 (1-5 mL) Brinkmann Instruments Bottletop Dispenser, VWR catalog #17553-524, or equivalent

5.7.2 (0.1-2.5 mL) Brinkmann Instruments Bottletop Dispenser, VWR catalog #7553-522, or equivalent

5.8 Water Bath, Precision Model 186, capable of maintaining water depth of 2-3 inches and a temperature of 94-96°C for 2 hours, or equivalent.

5.9 Balance capable of weighing to nearest 0.1 g (Mettler PM 4800 or equivalent). Note: The analytical balance must be calibrated each day. Prior to use, the analyst must verify a record of calibration in the Balance Calibration Logbook. The procedure for balance calibration may be found in ALSI SOP 09-PM2000.

5.10 Certified thermometer for water bath, calibrated annually against a NIST thermometer per ALSI SOP 09-TCAL. Reference ALSI SOP 99-Temp for further information.

5.11 Wide Mouth Square Bottles, Nalgene HDPE, Fisher Scientific catalog #02-923-75, or equivalent

5.12 PTFE Boiling Stones, Fisher Scientific catalog #09-191-20, or equivalent

5.13 Wooden Tongue Depressors, VWR catalog #62505-007, or equivalent

5.14 Autoclave-Sterilmatic, Market Forge, Serial No. 179100, or equivalent

6 Reagents

NOTE: Unless otherwise noted in this section all chemicals are stored at room temperature and labeled with an expiration date of five years from receipt. Manufacturer's labeled expiration dates take precedent over all other expiration dates. All reagents and standard solutions in this section must be labeled and logged into appropriate laboratory logbooks. In addition, the logbook numbers must be labeled on the reagent or standard solution and on all appropriate preparation worksheets. Reagent

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bottles must also include the analyst's initials, preparation date, and expiration date.

6.1 Reagent water - A Filson Water Purification System is used which provides analyte-free, >16.0 megohm-cm deionized water on demand. This water is used for preparation of all reagents, calibration standards, and as dilution water.

6.2 Concentrated Sulfuric Acid (H_2SO_4) - J.T.Baker ACS Reagent Trace Metal Grade with mercury content < 1 µg/L, VWR catalog # JT9673-33 or equivalent. Label as expiring one year from date opened and record on the bottle.

6.3 Concentrated Nitric Acid (HNO_3) - J.T. Baker ACS Reagent Trace Metal Grade with low mercury content < 1 µg/L, VWR catalog # JT9598-34 or equivalent. Label as expiring one year from date opened and record on the bottle. Note: If a high reagent blank is obtained, the acid must be checked for mercury impurities.

6.4 Potassium permanganate ($KMnO_4$) - J.T. Baker ACS Reagent, VWR catalog # JT3227-5 or equivalent.

6.4.1 Potassium permanganate solution (5% $KMnO_4$) - dissolve 50 g of potassium permanganate ($KMnO_4$) in 1000 mL reagent water. Store for up to 3 months in a properly labeled 1-L amber glass bottle.

6.5 Potassium persulfate ($K_2S_2O_8$) - J.T. Baker ACS Reagent, VWR catalog # JT3239-05 or equivalent.

6.5.2 Potassium persulfate solution (5% $K_2S_2O_8$) - dissolve 50 grams of potassium persulfate ($K_2S_2O_8$) in 1000 mL of reagent water. Store for up to 3 months in a properly labeled 1-L amber glass bottle.

6.6 Mercury Calibration Standard (25 ppb).

6.6.1 Mercury Stock Standard (1000 ppm) - QCD Analysts, catalog # SKU980W12, or equivalent. This standard must be discarded according to the manufacturer's label.

6.6.2 Intermediate Mercury Standard (1 ppm) - Place 0.100 mL of (1000 ppm) Mercury Stock Standard (Section 6.6.1) and 0.300 mL of concentrated HNO_3 into a 100-mL Class A volumetric flask half full with reagent water. Dilute to volume and mix well. Record the preparation of this standard in the Inorganic Prep Logbook. Store at room temperature for 14 days.

6.6.3 Working Mercury Standard (25 ppb) - Place 2.5 mL of (1ppm)

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Intermediate Mercury Standard (Section 6.6.2) and 0.300 mL of concentrated HNO_3 in a 100-mL Class A volumetric flask. Dilute to volume and mix well. Prepare fresh daily.

6.7 Mercury QC or Second Source (25 ppb).

6.7.1 Mercury QC Stock Standard (1000 ppm) - High Purity Standards, catalog #100033-1, or equivalent. The Mercury QC or Second Source Standard must be prepared from a stock solution obtained from a supplier which is different than the supplier used for the stock solution in 6.6.1, above. This standard must be discarded according to the manufacturer's label.

6.7.2 Intermediate QC Mercury Standard (1 ppm) - Place 0.100 mL of (1000 ppm) Mercury QC Stock Standard (Section 6.7.1) and 0.300 mL of concentrated HNO_3 into a 100-mL Class A volumetric flask. Dilute to volume and mix well. Store at room temperature for up to 14 days.

6.7.3 Working QC Mercury Standard (25 ppb) - Place 2.5 mL of (1 ppm) Intermediate QC Mercury Standard (Section 6.7.2) and 0.300 mL of concentrated HNO_3 in a 100-mL Class A volumetric flask. Dilute to volume and mix well. Prepare fresh daily.

6.8 Mercury Matrix Spike Solution for both aqueous and solid samples is obtained from the 1 ppm Intermediate Mercury Standard (6.6.2). See Section 10.5 for instructions on spike preparation.

7 Glassware Cleaning

7.1 Glassware washing procedures can be found in ALSI SOP 19-GLWH.

8 Quality Control

8.1 All policies and procedures in the most current revision of the ALSI QA Plan shall be followed when performing this procedure.

8.2 Blanks, Standards, ICV, CCV and LCS solutions and MS and MSD samples are digested with every batch of soil samples, up to 20 samples per batch.

Quality Control Requirements

Specific project requirements may override the following:

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Parameter	Concentration	Frequency	Control Limits	Corrective Action
Method Blank	-	1 per batch of 20 samples or less.	Refer to SOP 03-Hg.	Refer to SOP 03-Hg.
ICV Second Source	H_2O/Soil 4 µg/L H_2O (Low) 0.100 µg/L	1 per analytical run.	Refer to SOP 03-Hg.	Refer to SOP 03-Hg.
CCV Same Source	H_2O/Soil 4 µg/L H_2O (Low) 0.100 µg/L	A sufficient volume of CCV sample must be digested to allow for the analysis of a CCV every 10 samples during the analytical run. A minimum of 2 aliquots is recommended.	Refer to SOP 03-Hg.	Refer to SOP 03-Hg.
LCS	Waters: 2 µg/L Soils: 200 µg/kg H_2O (Low) 0.100 µg/L	1 per batch of 20 samples or less.	Refer to SOP 03-Hg.	Refer to SOP 03-Hg.
Matrix Spike**	Waters – 5 µg/L Soils 500 µg/kg H_2O (Low) 0.200 µg/L	1 per 10 samples with at least 1 per batch.	Refer to SOP 03-Hg.	Refer to SOP 03-Hg.
Matrix Spike Duplicate or sample duplicate**	--	1 per 10 samples with at least 1 per batch.	Refer to SOP 03-Hg.	Refer to SOP 03-Hg.
ICB/CCB (Reagent Blanks)	--	A sufficient volume of ICB/CCB must be digested to allow for the analysis of an ICB/CCB every 10 samples during the analytical run. A minimum of 3 aliquots is recommended.	Refer to SOP 03-Hg.	Refer to SOP 03-Hg.

** Samples selected for matrix spike and matrix spike duplicate analysis shall be rotated among client samples so that various matrix problems may be noted and/or addressed. Poor performance in a duplicate or spike may indicate a problem with the sample composition and shall be reported to the client whose sample produced the poor recovery.

8.3 A demonstration of capability (DOC) shall be performed by each analyst performing this procedure before any client samples are analyzed.

8.3.1 The DOC is determined by the analysis of four different Laboratory Control Samples (LCSs).

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8.3.2 The percent recovery of the four LCSs must be within ±15% of the true value, and the percent RPD must be ≤10%. If demonstration of capability fails, reanalyze.

8.3.3 The analyst must repeat this step (8.3) until precision and accuracy criteria are met.

8.4 Ongoing proficiency must be established annually as specified in the QA Plan, Technical Training.

8.5 MDL studies must be performed according to SOP 99-MDL or the reference methods, whichever is more frequent.

9 Sample Collection, Preservation and Handling

9.1 Aqueous samples collected in glass or plastic are preserved by acidification with (1+1) nitric acid to a pH of <2 at the time of collection or as soon as possible after collection upon receipt in the laboratory. Following acidification in the lab, the sample shall be mixed, held for 24 hours and then verified to be pH<2. A minimum of 75 mL is required.

9.2 Samples requiring dissolved mercury shall be filtered through a 0.45-µm filter BEFORE the preservation acid is added. A minimum of 75 mL of sample is needed.

9.3 Soils and solids are refrigerated above the freezing point of water up to 6°C. A minimum of 1.50 g of sample is needed.

9.4 Leachates prepared by the Toxicity Characteristic Leaching Procedures (TCLP) are preserved with nitric acid and then refrigerated until analysis. A minimum of 75 mL of sample is needed.

9.5 Samples must be digested and analyzed for mercury within 28 days of the sampling date or leachate preparation date.

9.6 Samples must be analyzed within 24 hours of de-colorization.

10 Procedure

10.1 Water and liquid sample preparation.

10.1.1 Using a balance, weigh 25g ± 0.1g of the well mixed sample (or an aliquot diluted with reagent water to 25g ± 0.1g) into a labeled 40-mL glass VOA

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vial.

10.1.2 Add 1.25 mL of concentrated H_2SO_4 and mix well.

10.1.3 Add 0.625 mL of concentrated HNO_3 and mix well.

10.1.4 Add 2 mL of 5% $K_2S_2O_8$ solution using a Finnpipette Digital Pipettor and mix well.

10.1.5 Add approximately 3.8 mL of 5% $KMnO_4$ solution using a Finnpipette Digital Pipettor and mix well. Wait 15 minutes to determine if purple color persists. If color does not remain purple, use less of the sample and bring to a volume of 25 mL. Add the 5% $KMnO_4$ and wait 15 minutes. Record sample amount in logbook.

10.1.6 Cap loosely and place in a hot water bath for 2 hours at 95°C (± 1°C).

10.1.7 Remove from water bath and cool to room temperature and deliver to metals lab for analysis.

10.1.8 Complete logbook page and verify the completion of testing by entering the batch into the Laboratory Information Management System (LIMS). For batching instructions refer to Section 12.1.

NOTE: Samples that require Low-Level analysis are prepared with the same spikes as above; Extra Low-Level samples are extracted the same as above but require the Low-Level QC and ICV/CCV to be prepared alongside.

10.2 Water calibration standards and Laboratory Control Sample (LCS) solution preparation.

10.2.1 To prepare the calibration blanks and standards, transfer 0, 0.2, 1.0, 2.0, 4.0 and 10.0 mL aliquots of the 25 ppb Hg Working Standard to labeled 40-mL VOA vials using the Finnpipette Digital Pipettors. Dilute the standards with reagent water to a total volume of 25 mL. Prepare the blanks (25 mL reagent water) in triplicate so that they can also be used as initial and continuing calibration blanks (ICB/CCB). Follow steps 10.1.2 through 10.1.8 from above to finish preparing the standards.

10.2.2 LCS - To prepare the LCS solution, transfer a 2.0 mL aliquot of the 25 ppb Hg Working Standard (Section 6.6.3) to labeled 40-mL VOA vials using a Finnpipette Digital Pipettor. Add reagent water using the Finnpipette Digital Pipettor to a total volume of 25 mL. Follow steps

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10.1.2 through 10.1.8 from above to finish preparing the LCS.

10.2.3 Low Level - To prepare the calibration blanks and standards for a lower detection limit curve, transfer 0, 0.050, 0.075, 0.100, 0.200, and 0.500 mL aliquots of the 25 ppb Hg Working Standard to labeled 40-mL VOA vials using a Finnpipette Digital Pipettor. Dilute the standards with reagent water to a total volume of 25 mL. Prepare the blanks in triplicate so that they can also be used as initial and continuing calibration blanks (ICB/CCB). Follow steps 10.1.2 through 10.1.8 from above to finish preparing the standards.

10.2.4 Low Level LCS- To prepare the LCS solution for the low detection limit, transfer a 0.100 mL aliquot of the 25 ppb Hg Working Standard to a labeled 40-mL VOA vial using a Finnpipette Digital Pipettor. Add reagent water using the Finnpipette Digital Pipettor to a total volume of 25 mL. Follow steps 10.1.2 through 10.1.8 from above to finish preparing the LCS.

10.3 Water Initial/Continuing Calibration Verification Standard (ICV/CCV) preparation.

10.3.1 ICV: Transfer a 4.0 mL aliquot of the 25 ppb Hg QC or second source standard to labeled 40-mL VOA vials using a Finnpipette Digital Pipettor. Add reagent water using the Finnpipette Digital Pipettor to a total volume of 25 mL. Follow steps 10.1.2 through 10.1.8 from above to finish preparing the ICV.

10.3.2 CCV: Transfer 4 mL of 25 ppb Hg Working Standard to a labeled 40-mL VOA vial using a Finnpipette Digital Pipettor. Add reagent water using the Finnpipette Digital Pipettor to a total volume of 25 mL. Follow steps 10.1.2 through 10.1.8 from above to finish preparing the CCV's.

10.3.3 Low Level ICV - For the low detection limit curve transfer a 0.100 mL aliquot of the 25 ppb Hg QC or Second Source standard to a labeled 40-mL VOA vial using a Finnpipette Digital Pipettor for the ICV. Follow steps 10.1.2 through 10.1.8 from above to finish preparing the ICV.

10.3.4 Low Level CCV – For the low detection limit curve transfer a 0.100 aliquot in duplicate of 25 ppb Hg Working Standard to a labeled 40-mL VOA vial using a Finnpipette Digital Pipettor. Add reagent water using the Finnpipette Digital Pipettor to a total volume of 25 mL. Follow steps 10.1.2 through 10.1.8 from above to finish preparing the CCV's.

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10.4 Method Blank preparation

10.4.1 Prepare a method blank with each batch of samples by transferring 25 mL of reagent water to labeled 40-mL VOA vial. Follow steps 10.1.2 through 10.1.8 to prepare the method blank.

10.5 Water matrix spike preparation

10.5.1 For samples that are to be spiked, pipette 25 mL of sample and 0.125 mL of a 1.0 ppm Hg standard spiking solution using a Finnpipette Digital Pipettor into two labeled 40-mL VOA vials. Spikes are prepared in duplicate. Follow step 10.1.2 through 10.1.8 from above to digest the spikes as samples.

10.5.2 Low Level - For samples that are to be spiked at the low detection limit, measure 25 mL of sample and add 0.200 mL of the 25 ppb Hg calibration standard using a Finnpipette Digital Pipettor into each of two labeled 40-mL VOA vials. Spike samples are prepared in duplicate. Follow step 10.1.2 through 10.1.8 from above to digest the spikes as samples.

10.6 Soil sample preparation.

10.6.1 Carefully inspect all apparatus that will come into contact with the sample to ensure cleanliness and reduce the introduction of contaminants.

10.6.2 The following procedure will be used to obtain a representative sample. Please refer to SOP 19-Subsampling for more information.

10.6.2.1 Remove approximately 50 grams of sample from the container using a wooden tongue depressor and place in a polypropylene weigh boat.

10.6.2.2 Mix sample with wooden tongue depressor. Break any clumped soil. Mix the soil to homogenize any particles that may seem unique in color, particle size, or apparent texture.

10.6.2.3 Transfer approximately 0.50 g - 0.60 g of homogenized sample to a labeled 100-mL wide mouth square bottle. Replace unused portion of homogenized sample from weight boat back into the sample container.

10.6.2.4 If the sample is a sludge it is required that it is shake well and 2.00 g of sample is used for the digestion.

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10.6.2.5 Record weight of sample transferred to wide mouth square bottle into appropriate logbook.

10.6.3 To each wide mouth square bottle, add 50 mL of reagent water using a Class A volumetric flask.

10.6.4 To each wide mouth square bottle, add approximately 5 mL of concentrated sulfuric acid (H_2SO_4) and mix well.

10.6.5 To each wide mouth square bottle, add 2 mL of concentrated nitric acid (HNO_3) and mix well.

10.6.6 Add approximately 15 mL of 5% potassium permanganate ($KMnO_4$) using a Finnpipette Digital Pipettor. NOTE: Due to the nature of soils, the addition of more $KMnO_4$ is used to assure the oxidation of the samples has been completed. It has been noted in the past that without ample amounts of $KMnO_4$ being added, the sample can lose its purple color resulting in an incomplete digestion. There is a possibility of interferences from sulfide.

10.6.7 Cap wide mouth square bottle loosely and place on an autoclave tray.

10.6.8 Autoclave at 121°C for 15 minutes with exhaust setting of slow (liquids).

10.6.9 Cool, then add 28 mL of reagent water to each sample using a Finnpipette Digital Pipettor. This will bring each sample to a final volume of 100 mL. Place cap back on the bottle.

10.6.10 Deliver samples to metals lab for analysis.

10.6.11 Complete log book and verify the completion of testing by entering the batch into the LIMS. Refer to section 12.2.

10.7 Soil standards and LCS preparation.

10.7.1 To prepare the calibration standards, transfer 0, 0.5, 1.0, 2.0, 4.0 and 10.0 mL aliquots of the 25 ppb Hg Working Standard to labeled 40 mL VOA vial using a Finnpipette Digital Pipettors. Dilute the standards with reagent water to a total volume of 15 mL. Prepare the blanks (15 mL reagent water) in triplicate so that they can also be used as initial and continuing calibration blanks (ICB/CCB).

10.7.1.1 Add 1.25 mL of concentrated H_2SO_4 and mix well. Add

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0.625 mL of concentrated HNO_3 and mix well. Add 3.8 mL of 5% $KMnO_4$ and mix well. Follow Section 10.6.7 through 10.6.11, but add 4.45 mL of reagent water instead of 28 mL to bring the sample to volume.

10.7.2 Soil LCS - To prepare the LCS, weigh 0.5 g of PTFE boiling stones in a labeled 100-mL wide mouth square bottle. Next, transfer 0.200 mL aliquot of the 1.0 ppm Intermediate Hg Standard to the same 100-mL wide mouth square bottle using a Finnpipette Digital Pipettor. Dilute the LCS with reagent water adding a volume of 50 mL. Follow steps 10.6.4 through 10.6.10 from above to finish preparing the LCS.

10.8 Soil ICV/CCV preparation.

10.8.1 Soil ICV - Transfer 4.0 mL aliquot of the 25 ppb QC or Second Source Solution to labeled 40-mL VOA vial using a Finnpipette Digital Pipettor. Dilute the ICV with reagent water to a total volume of 15 mL. Follow 10.7.1.1 from above to finish preparing the ICV.

10.8.2 Soil CCV - Transfer duplicate portions of 4 mL aliquot of 25 ppb Hg Working Standard to each of two labeled 40-mL VOA vial using a Finnpipette Digital Pipettor. Dilute the CCV's with reagent water to a total volume of 15 mL using a Class A volumetric flask. Follow 10.7.1.1 from above to finish preparing the CCV's.

10.9 Method Blank preparation

10.9.1 Prepare a method blank with each batch of samples by weighing 0.5 g of PTFE boiling stones in a labeled 100-mL wide mouth square bottle. Dilute with 50 mL of reagent water using a Class A volumetric flask. Follow steps 10.6.4 through 10.6.10 to prepare the method blank.

10.10 Soil matrix spike preparation - 500 µg/kg

10.10.1 MS/MSD - For samples that are to be spiked, weigh out 0.5 g of sample in duplicate aliquots for spiking and transfer to each of two labeled 100-mL wide mouth square bottles . To each bottle, add 0.5 mL of 1.0 ppm Intermediate Hg Standard using a Finnpipette Digital Pipettor. Add 50 mL of reagent water to the spiked samples. Follow steps 10.6.4 through 10.6.10 from above to finish preparing the MS/MSD.

11 Calculations

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11.1 Not applicable

12 Reporting Results

12.1 BATCHING –Instructions for pre-digestion sample entries in LIMS

12.1.1 Select the BATCHING menu in the LIMS, then select NEW BATCH and enter MDIG to obtain the samples requiring Mercury Digestion.

12.1.2 Select one of the following test codes 245.1 PREP; 245.1D PREP; 7470 PREP; 7470D PREP; HGS PREP.

12.1.3 Select up to 20 samples to make the batch, select BUILD BATCH, at this point a Method Blank, LCS and MS/MSD will be generated. Upon SAVING the batch, the LIMS system will generate the numbers that are to be assigned to all QC.

12.2 POSTING – Instructions for post-digestion sample entries in LIMS

12.2.1 Upon the completion of digestion, select the OPERATION menu in the LIMS. Select POSTING – BY BATCH.

12.2.2 Enter the Batch Number and test code.

12.2.3 Enter the date and time that digestion was completed and make any necessary volume changes.

12.2.4 Save the Batch. Samples are now available for analysis in the META portion of the LIMS.

12.2.5 When entering data into Horizon LIMS do not round off results; Horizon will automatically perform rounding appropriate to the method.

12.2.6 A second review of the digestion Log is performed by a peer before the analysis of the samples

13 Waste Disposal

13.1 Refer to ALSI SOP 19-Waste Disposal.

14 Pollution Prevention

14.1 Pollution prevention encompasses any technique that reduces or eliminates the quantity or toxicity of waste at the point of generation. Numerous opportunities

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for pollution prevention exist in laboratory operations. Management shall consider pollution prevention a high priority. Extended storage of unused chemicals increases the risk of accidents. The laboratory shall consider smaller quantity purchases which will result in fewer unused chemicals being stored and reduce the potential for exposure by employees. ALSI tracks chemicals when received by recording their receipt in a traceable logbook. Each chemical is then labeled according to required procedures and stored in assigned locations for proper laboratory use.

15 Definitions

15.1 Refer to ALSI QA Plan under Laboratory Quality Control Checks for general definitions.

15.2 Method Specific Definitions include:

15.2.1 Initial Calibration Verification (ICV) is prepared by the analyst by combining compatible elements from a standard source different than that of the Calibration Standard and at concentrations within the linear working range of the instrument. The commercial provider of the stock solution for the ICV must not be the same as the provider of the calibration standards unless only one commercial provider can be identified for that solution.

15.2.2 Continuing Calibration Verification (CCV) is prepared in the same acid matrix using the same standards used for the calibration at a concentration near the mid-point of the calibration curve.

16 Troubleshooting

16.1 Refer to maintenance logs and instrument manuals for guidance for troubleshooting specific problems related to the apparatus used in this method.

Appendix A

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MERCURY SAMPLE PREPARATION

Method: _____ Hot Water Bath/Autoclave ID#: _____
WLSI SOP: _____ Initial Temp. Of Bath: _____ Time: _____
Date: _____ Final Temp. Of Bath: _____ Time: _____
Time: _____ Thermometer ID#: _____
Technician: _____ Batch #: _____

Line#	Sample #	Sample Amount X=25ml or as noted	Additional KMnO4 (ml)	Final Volume X=25ml	Spike Amount (ml)	Spiking Std Used	Prep Type	Pipette ID #
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								
11								
12								
13								
14								
15								
16								
17								
18								
19								
20								
21								
22								
23								
24								
25								
26								
27								
28								

Reagents and working standards	Calibration and check standards
Working Std:_____ml of _____ into_____ml	*S0(ICB,CCB):# of S0's made:_____ Pipette ID#_____
Working QC:_____ml of _____ into_____ml	*S0.2:_____ml of Working Std into_____ml
5% $KMnO_4$:_____ Pipette ID#_____	*S1.0:_____ml of Working Std into_____ml
5% $K_2S_2O_8$:_____	*S2.0:_____ml of Working Std into_____ml
c. H_2SO_4:_____	*S4.0:_____ml of Working Std into_____ml
c. HNO_3:_____	*S10.:_____ml of Working Std into_____ml
	*ICV:_____ml of Working QC into_____ml
	*CCV:_____ml of Working Std into_____ml
	# of CCV's made_____

*All standards are prepared daily prior to analysis of samples in the same matrix as the samples to be analyzed

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SOP Change History Sheet

Section No.	Section	Reason for Change
1.2	Scope and Application	Correction to current SOP
6	Reagents	Correction to current SOP
9.1 –9.2	Procedure	Correction to current SOP
11	Reporting Results	Update for Horizon LIMS
14	Added Definitions section.	NELAC requirement
5	Apparatus and Materials	A2LA Audit 4/26/05
8	Procedure	SOP update 04/26/05
10	Quality Control	SOP update 4/26/05
Appendix A	Mercury Sample Preparation Logbook	Added
5.8 -5.9	Apparatus and Materials	DoD audit response 5/11/05
8.6.2	Procedure	DoD audit response 5/11/05
14.2.1	Definitions	DoD audit response 5/11/05
1	Scope and Application	DoD audit response
5	Apparatus and Materials	DoD audit response
10	Procedure	DoD audit response DEP audit response
Revision 3: 02/22/2006		
1.2	Scope and Application	Method updates added
1.6	Scope and Application	Project requirements added
4	Safety	Major revisions throughout section
5	Apparatus and Materials	Major revisions/additions throughout section

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SOP Change History Sheet (continued)

Section No.	Section	Reason for Change
6	Reagents	Major revisions/additions throughout section, including reagent water details and holding parameters
7	Glassware Cleaning	Added section
8.2	Quality Control	Major revisions throughout table, with special attention to be given to changes in frequency and concentrations
8.4	Quality Control	DOC ongoing proficiency detailed
8.5	Quality Control	MDL Study parameters addressed
9.1	Sample Collection…	Container information revised, aqueous sample collection detailed
9.3	Sample Collection…	Refrigeration parameters revised as per NELAC
9.4	Sample Collection…	Revised “sample collection” to read “Leachates prepared”
9.5	Sample Collection… requirement	Added leachate preparation date
10.1.1	Procedure	Added aliquot verbiage
10.1.2/10.1.3	Procedure	Revised order of H_2SO_4 & HNO_3 addition
10.1.8	Procedure	Added batching reference
10.2-10.10	Procedure	Numerous revisions and addition of details
10.6.2.3	Procedure	Revised to include sample mass range
10.6.9	Procedure	Revised water volume
10.7.1	Procedure	Revised water volumes, deleted preparation section references

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SOP Change History Sheet (continued)

Section No.	Section	Reason for Change
10.7.1.1	Procedure	Added section
10.8.1	Procedure	Revised water volumes
11	Calculations	Section included
12	Reporting Results	Section clarifications made plus second review requirement added
16	Troubleshooting	Section included

Revision 4: 10/24/07

Spelling, grammar, and formatting changes made throughout SOP for clarity, correctness, and site conformity.

1.5	Scope and Application	Update to MDL availability
4.2	Safety	Update to MSDS availability
4.4	Safety	Added section
6	Reagents	Added NOTE
9.1	Sample Collection, Preservation…	Update pH verification hold time
9.6	Sample Collection, Preservation…	Added section
10.1.5	Procedure	Update reagent amount
10.1.8	Procedure	Added NOTE
10.6.2	Procedure	Add reference to SOP 19-Subsampling
10.6.2.4	Procedure	Added section
10.7	Procedure	Update reagent and standard amounts
10.10	Procedure	Update spike concentration
12.2.5	Reporting Results	Added section

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SOP Concurrence Form
for the Distribution and Revision of Standard Operating Procedures

I have read, understood, and concurred with the Standard Operating Procedure (SOP) described above and will perform this procedure as it is written in the SOP.

Print Name	Signature	Date

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UNCONTROLLED DOCUMENT

Document Title: Method 6020 – Determination of Trace Elements in Water and Waste by Inductively Coupled Plasma – Mass Spectrometry

Document Control Number: _____

Organization Title: ANALYTICAL LABORATORY SERVICES, INC. (ALSI)

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1 Scope and Application

1.1 This document states the laboratory's policies and procedures established in order to meet requirements of all certifications/accreditations currently held by the laboratory, including the most current NELAC standards.

1.2 This Inductively coupled plasma-mass spectrometry (ICP-MS) is applicable to the determination of sub-µg/L concentrations of a large number of elements in water samples and in waste extracts or digests. When dissolved constituents are required, samples must be filtered and acid-preserved prior to analysis. No digestion is required prior to analysis for dissolved elements in water samples. Acid digestion prior to filtration and analysis is required for groundwater, aqueous samples, industrial wastes, soils, sludges, sediments, and other solid wastes for which total (acid-leachable) elements are required. This method is adapted from SW-846 Method 6020A, Revision I, January, 1998.

1.3 Method detection limits (MDLS) and linear working ranges will be dependent on the sample matrix, instrumentation and selected operating conditions. These will be up-dated on an annual basis as required in this method. Method detection limits can be found in the current metals department method detection limit book. The detection limits for a specific sample may differ from those listed due to the nature of interferences in a particular sample matrix.

1.4 ICP-MS has been applied to the determination of over 60 elements in various matrices. Analytes for which EPA has demonstrated the acceptability of Method 6020 in a multi-laboratory study on solid wastes are listed in Table 1. Instrument detection limits, sensitivities, and linear ranges will vary with the matrices, instrumentation, and operating conditions. In relatively simple matrices, detection limits will generally be below 0.02 µg/L.

1.5 If Method 6020 is used to determine any analyte not listed in Table 1, it is the responsibility of the analyst to demonstrate the accuracy and precision of the Method in the waste to be analyzed. The analyst is always required to monitor potential sources of interferences and take appropriate action to ensure data of known quality (see Section 4.0).

1.6 Use of this method is restricted to spectroscopists who are knowledgeable in the recognition and in the correction of spectral, chemical, and physical interferences in ICP-MS

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1.7 Users of the method must document and have on file the required initial demonstration performance data described in Section 8.5 prior to using this method.

1.8 An appropriate internal standard is required for each analyte determined by ICP-MS. Recommended internal standards are ^{6}Li, ^{45}Sc, ^{89}Y, ^{103}Rh, ^{115}In, ^{159}Tb, ^{165}Ho, and ^{209}Bi. The lithium internal standard shall have an enriched abundance of ^{6}Li, so that interference from lithium native to the sample is minimized. Other elements may need to be used as internal standards when samples contain significant amounts of the recommended internal standards.

1.9 Individual project requirements may override criteria listed in this SOP.

2 Summary of Method

2.1 Prior to analysis, samples which require total ("acid-leachable") values must be digested using appropriate sample preparation methods (such as Methods 3005 - 3051).

2.2 Method 6020 describes the multi-elemental determination of analytes by ICP-MS. The method measures ions produced by a radio-frequency inductively coupled plasma. Analyte species originating in a liquid are nebulized and the resulting aerosol transported by argon gas into the plasma torch. The ions produced are entrained in the plasma gas and introduced, by means of an interface, into a mass spectrometer. The ions produced in the plasma are sorted according to their mass-to-charge ratios and quantified with a channel electron multiplier. Interferences must be assessed and valid corrections applied or the data flagged to indicate problems. Interference correction must include compensation for background ions contributed by the plasma gas, reagents, and constituents of the sample matrix.

3 Interferences

3.1 Isobaric elemental interferences in ICP-MS are caused by isotopes of different elements forming atomic ions with the same nominal mass-to-charge ratio (m/z).

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A data system must be used to correct for these interferences. This involves determining the signal for another isotope of the interfering element and subtracting the appropriate signal from the analyte isotope signal. Since commercial ICP-MS instruments nominally provide unit resolution at 10% of the peak height, very high ion currents at adjacent masses can also contribute to ion signals at the mass of interest. Although this type of interference is uncommon, it is not easily corrected, and samples exhibiting a significant problem of this type could require resolution improvement, matrix separation, or analysis using another verified and documented isotope, or use of another method.

3.2 Isobaric molecular and doubly-charged ion interferences in ICP-MS are caused by ions consisting of more than one atom or charge, respectively. Most isobaric interferences that could affect ICP-MS determinations have been identified in the literature. Examples include $ArCl^+$ ions on the ^{75}As signal and MoO^+ ions on the cadmium isotopes. While the approach used to correct for molecular isobaric interferences is demonstrated below using the natural isotope abundances from the literature, the most precise coefficients for an instrument can be determined from the ratio of the net isotope signals observed for a standard solution at a concentration providing suitable (<1 percent) counting statistics. Because the ^{35}Cl natural abundance of 75.77 percent is 3.13 times the ^{37}Cl abundance of 24.23 percent, the chloride correction for arsenic can be calculated (approximately) as follows (where the $^{38}Ar^{37}Cl^+$ contribution at m/z 75 is a negligible 0.06 percent of the $^{40}Ar^{35}Cl^+$ signal):

corrected arsenic signal (using natural isotopes abundances for coefficient approximations) =

(m/z 75 signal) - (3.13) (m/z 77 signal) + (2.73) (m/z 82 signal),
(where the final term adjusts for any selenium contribution at 77 m/z),

NOTE: Arsenic values can be biased high by this type of equation when the net signal at m/z 82 is caused by ions other than $^{82}Se^+$, (e.g., $^{81}BrH^+$ from bromine wastes [6]).

Similarly,

corrected cadmium signal (using natural isotopes abundances for coefficient approximations) =

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(m/z 114 signal) - (0.027)(m/z 118 signal) - (1.63)(m/z 108 signal),
(where last 2 terms adjust for any tin or MoO^+ contributions at m/z 114).

NOTE: Cadmium values will be biased low by this type of equation when $^{92}ZrO^+$ ions contribute at m/z 108, but use of m/z 111 for Cd is even subject to direct ($^{94}ZrOH^+$) and indirect ($^{90}ZrO^+$) additive interferences when Zr is present.

NOTE: As for the arsenic equation above, the coefficients in the Cd equation are **ONLY** illustrative. The most appropriate coefficients for an instrument can be determined from the ratio of the net isotope signals observed for a standard solution at a concentration providing suitable (<1 percent) counting precision.

The accuracy of these types of equations is based upon the constancy of the OBSERVED isotopic ratios for the interfering species. Corrections that presume a constant fraction of a molecular ion relative to the "parent" ion have not been found to be reliable, e.g., oxide levels can vary. If a correction for an oxide ion is based upon the ratio of parent-to-oxide ion intensities, the correction must be adjusted for the degree of oxide formation by the use of an appropriate oxide internal standard previously demonstrated to form a similar level of oxide as the interferant. This type of correction has been reported for oxide-ion corrections using ThO^+/Th^+ for the determination of rare earth elements. The use of aerosol desolvation and/or mixed plasmas have been shown to greatly reduce molecular interferences. These techniques can be used provided that method detection limits, accuracy, and precision requirements for analysis of the samples can be met.

3.3 Physical interferences are associated with the sample nebulization and transport processes as well as with ion-transmission efficiencies. Nebulization and transport processes can be affected if a matrix component causes a change in surface tension or viscosity. Changes in matrix composition can cause significant signal suppression or enhancement. Dissolved solids can deposit on the nebulizer tip of a pneumatic nebulizer and on the interface skimmers (reducing the orifice size and the instrument performance). Total solid levels below 0.2% (2,000 mg/L) have been currently recommended to minimize solid deposition. An internal standard can be used to correct for physical interferences, if it is carefully matched to the analyte so that the two elements are similarly affected by matrix changes. When the intensity level of an internal standard is less than 30 percent or greater than 120 percent of the intensity of the first standard used during calibration, the sample must be reanalyzed after a fivefold (1+4) or greater dilution has been performed.

3.4 Memory interferences can occur when there are large concentration differences between samples or standards which are analyzed sequentially. Sample deposition on the sampler and skimmer cones, spray chamber design, and the type

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of nebulizer affect the extent of the memory interferences which are observed. The rinse period between samples must be long enough to eliminate significant memory interference.

4 Safety

4.1 ALSI maintains material safety data sheets (MSDSs) on all chemicals used in this procedure. MSDSs are available to all staff and are located in the QA office.

4.2 The toxicity or carcinogenicity of reagents used in this method have not been fully established. Each chemical shall be regarded as a potential health hazard and exposure to these compounds shall be as low as reasonably achievable. The laboratory maintains a current awareness file of OSHA regulations regarding the safe handling of the chemicals specified in this method. Specifically, concentrated nitric and hydrochloric acids present various hazards and are moderately toxic and extremely irritating to skin and mucus membranes. Use these reagents in a fume hood whenever possible and if eye or skin contact occurs, flush with large volumes of water. Always wear safety glasses or a shield for eye protection, protective clothing and observe proper mixing when working with these reagents.

4.3 The acidification of samples containing reactive materials may result in the release of toxic gases, such as cyanides or sulfides.

4.4 Analytical plasma sources emit radiofrequency radiation in addition to intense UV radiation. Suitable precautions shall be taken to protect personnel from such hazards. The inductively coupled plasma shall only be viewed with proper eye protection from UV emissions.

5 Apparatus and Materials

5.1 Inductively coupled plasma-mass spectrometer: Perkin Elmer Elan 6000 and Perkin Elmer Elan DRCe are currently in use.

5.1.1 Both systems are capable of providing resolution better than or equal to 1.0 amu at 10% peak height The instruments are capable of scanning the mass range of 5-250 amu and the data systems allow corrections for isobaric interferences and the applying of the internal standard technique

Note: If an electron multiplier detector is being used, precaution shall be taken, where necessary, to prevent exposure to high ion flux. Otherwise changes in instrument response or damage to the multiplier may result.

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5.1.2 Argon gas supply: high-purity grade (99.99%) When analyses are conducted frequently, liquid argon is more economical and requires less frequent replacement of tanks than compressed argon in conventional cylinders. Argon is supplied by GTS.

5.1.3 Radio-Frequency generator compliant with FCC regulations.

5.1.4 A mass-flow controller on the nebulizer gas supply is required. A water cooled spray chamber may reduce some types of interferences. (e.g. polyatomic oxide species.

5.2 Analytical balance, with the capacity to measure to .1 mg for use in weighing solids.(Mettler PM2000 or equivalent).

5.2.1. An assortment of auto-pipettes capable of delivering volumes ranging from 20 ul to 10 mL with an assortment of high quality disposable pipet tips. These pipettes are calibrated using SOP 19-AP (Standard Operating Procedure for Calibration Checks for Auto-pipetters / dispensers)

5.2.2 Finnpipette 2 mL-10 mL (VWR Cat #53515-050 or equivalent).

5.2.3 Finnpipette 100-1000 µL (VWR Cat #53515-044 or equivalent).

5.2.3 Finnpipette 1000 µL (VWR Cat #53511-566 or equivalent).

5.2.5 Eppendorf pipet 10-100 µL (VWR Cat #53511-577 or equivalent).

5.2.6 Finnpipette tips 2 mL-10 mL are VWR Catalog #53516-178 or equivalent,

5.2.7 Tips for the Finnpipette 200-1000 µL and the Eppendorf 1000 µL are VWR Catalog #53508-876 or equivalent.

5.2.8 Tips for the Eppendorf 10-100 µL are VWR Catalog #53503-094 or equivalent.

5.2.9 Narrow mouth storage bottles, FEP (fluorinated ethylene propylene) with ETFE (ethylene tetraflourethylene) screw closures, 125 mL to 250 mL capacities. (Greenwood Products Catalog # DB08A)

5.3 ICP-MS tubing:

5.3.1 Black/ Black sample tubing SCP Science catalog # 020-030-07 or equivalent.

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5.3.2 Black/White waste tubing. SCP Science catalog #020-030-021 or equivalent.

5.4 Autosampler Supplies

5.4.1. 17 x 100 polypropylene sample tubes. VWR catalog #60818-618 or equivalent.

5.4.2 17 x 100 dual position tube caps. VWR catalog #60819-091 or equivalent.

5.5 Labware – For determination of trace levels of elements, contamination and loss are of prime consideration. Potential contamination sources include improperly cleaned laboratory apparatus and general contamination within the laboratory environment from dust, etc. A clean laboratory work area designated for trace element sample handling must be used. Sample containers can introduce positive and negative errors in the determination of trace elements (1) by contributing contaminants through surface adsorption or leaching and (2) by depleting element concentrations through adsorption processes. All reusable labware (glass, quartz, polyethylene, PTFE, FEP, etc.) shall be sufficiently clean for the task objectives. All glassware shall be cleaned in accordance with ALSI's glassware procedure.

NOTE: Chromic acid must not be used for cleaning glassware.

6 Reagents

6.1 Reagents may contain elemental impurities that might affect the integrity of analytical data. Owing to the high sensitivity of ICP-MS, high-purity reagents shall be used whenever possible. All acids used for this method must be of ultra high-purity grade. Nitric acid is preferred for ICP-MS in order to minimize polyatomic ion interferences. Several polyatomic ion interferences result when hydrochloric acid is used, however, it shall be noted that hydrochloric acid is required to maintain stability in solutions containing antimony and silver. When hydrochloric acid is used, corrections for the chloride polyatomic ion interferences must be applied to all data.

6.1.1 Nitric acid, concentrated EM Science Ultra Pure Acid, Cat. #EM-NX0608-6 or equivalent. Store at room temperature until the manufacturer's expiration date.

6.1.2 Nitric acid (1+1) - Add 500 mL conc. nitric acid to 400 mL of reagent water and dilute to I L. Store at room temperature for a maximum of 6 months.

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6.1.3 Nitric acid (1+9) - Add 100 mL conc. nitric acid to 400 mL of reagent grade water and dilute to I L. Store at room temperature for a maximum of 6 months.

6.1.4 Hydrochloric acid, concentrated EM Science Ultra Pure Acid, Cat. #EM-HX0608-6 or equivalent. Store at room temperature until the manufacturers expiration date.

6.1.5 Hydrochloric acid (1+1) - Add 500 mL conc. hydrochloric acid to 400 mL of reagent grade water and dilute to 1 L. Store at room temperature for a maximum of 6 months.

6.1.6 Hydrochloric acid (1+4) - Add 200 mL conc. hydrochloric acid to 400 mL of reagent grade water and dilute to I L. Store at room temperature for a maximum of 6 months.

6.2 Reagent water - Reagent water is water in which an interferant is not observed at the analyte of interest. For this purpose, ALSI uses a Filson Water Purification system which provides analyte free, greater than 18.0 megohm-cm DI water on demand. This water is used for preparation of all reagents and standard.

6.3 Standard Stock Solutions - Stock standards may be purchased from a reputable commercial source or prepared from ultra high-purity grade chemicals or metals (99.99 - 99.999% pure). Stock standard solutions are purchased commercially and are NIST traceable certified solutions. When received in the lab each standard is assigned a unique log number and is recorded in the Standard Preparation Logbook (Appendix B), along with the manufacturer, date of receipt, expiration date, and the analyst's initials. These stock solutions may be stored at room temperature until the manufacturer's expiration date.

6.3.1 CPI stock solution (P/N 4400-130597) in 1%HNO3 +Trace HF or an equivalent NIST certified standard. This standard contains the following elements (all elements are at a concentration of 10 µg/mL). Al, Sb, As, Be, Cd, Cr, Co, Cu, Pb, Mn, Mo, Ni, Se, Tl, V, and Zn.

6.3.2 CPI stock solution (P/N 4400-130775) in 1% HNO3 or an equivalent NIST certified standard. This standard contains the following elements (all elements are at a concentration of 10 µg/mL). Ba, B, Ca, Fe, Mg, Ag, and Sr.

6.3.3 The second source standard (ICV or QCS) is purchased commercially from QCD Analysts (P/N QCS26QK) or equivalent. The stock solution is in a 5% HNO3 matrix. The standard contains the following elements (all

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elements are at a concentration of 100 mg/L). Al, Sb, As, Ba, Be, B, Cd, Ca, Cr, Co, Cu, Fe, Pb, Mg, Mn, Mo, Ni, K, Se, Si, Ag, Na, Tl, Ti, V, and Zn.

6.3.4 The Interference Check Solutions are purchased commercially and contain known concentrations of interfering elements. These solutions will show the magnitude of interferences and provide adequate tests of any corrections. There are two solutions: A and AB. The final concentrations found in A and AB are listed below. These are purchased from QCD Analysts, catalog #20MICSAK and #6020ALICD or equivalent.

6.3.4.1 Working Solution A – Prepare by adding 10 mL of Stock Standard A to a 100 mL volumetric flask. Add 10 mL of HNO3 (or that which matches the samples) and take up to volume. Store at room temperature. Prepare fresh daily. This solution contains the following analytes:

ELEMENT	CONCENTRATION
Cl	1800 ppm
Ca	300 ppm
Fe and Na	250 ppm
C	200 ppm
Al, Mg, P, K, and S	100 ppm
Mo and Ti	2 ppm

6.3.4.2 Working Solution AB – Prepare by adding 10 mL of Stock Standard A and 1 mL of Stock Standard AB to a 100 mL volumetric flask. Add 10 mL of HNO3 (or that which matches the samples)and take up to volume. Store at room temperature. Prepare fresh daily. This solution contains the following analytes:

ELEMENT	CONCENTRATION
Cl	1800 ppm
Ca	300 ppm
Fe and Na	250 ppm
ELEMENT	**CONCENTRATION**
C	200 ppm
Al, Mg, P, K and S	100 ppm
Mo and Ti	2 ppm
Cr, Co, Cu, Mn, Ni, and V	200 ppb
As, Cd, Se, and Zn	100 ppb
Ag	50 ppb

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NOTE: The ICS solutions in Table 2 are intended to evaluate corrections for known interferences on only the analytes in Table 1. If Method 6020 is used to determine an element not listed in Table 1, it is the responsibility of the analyst to modify the ICS solutions, or prepare an alternative ICS solution, to allow adequate verification of correction of interferences on the unlisted element.

6.4 Working Standard Solutions: Prepare these standards in an acid matrix that is similar to the samples being analyzed. This is dependent on the type of digestion performed on the samples. The acid concentration shall be adjusted to match the samples being analyzed. After preparation, each standard is assigned a log number and is recorded in the standard preparation logbook along with the stock solution used, the concentration of the stock solution, the volume used, the final volume, the matrix, the date prepared, the date it will expire, and the initials of the preparer. These standards must be prepared fresh on a daily basis.

6.4.1 Calibration Blank: To a 100 mL volumetric flask, add 10 mL of HNO3 (or that which matches the samples) and bring up to volume using reagent water.

6.4.2 Standard 1 or Reporting Limit Standard (RLS): For elements whose reporting limit is 1 ppb (Be, Cd, Ag, Tl, and V) make a 1 ppm intermediate standard by taking 0.1 mL of each 1000 ppm stock standard and adding it to a 100 mL class A volumetric flask. For elements whose reporting limit is 2 ppb (Sb, Cr, Pb, and Mo) make a 2 ppm intermediate standard by taking 0.2 mL of each 1000 ppm stock standard and adding it to a 100 mL volumetric flask. Take 1 mL of each intermediate standard and add to a 1000 mL volumetric flask containing 100 mL of HNO3 (or that which matches the samples) and 500 mL reagent water. Bring up to volume with reagent water.

6.4.2.1 Silver Stock Solution (1000 ppm) in 4% HNO3. SCP Cat. # 140-051-472 or equivalent NIST certified standard.

6.4.2.2 Beryllium Stock Solution (1000 ppm) in 4% HNO3. SCP Cat. # 140-051-042 or equivalent NIST certified standard.

6.4.2.3 Cadmium Stock Solution (1000 ppm) in 4% HNO3. SCP Cat. # 140-051-482 or equivalent NIST certified standard.

6.4.2.4 Thallium Stock Solution (1000 ppm) in 4 % HNO3. SCP Cat. # 140-051-812 or equivalent NIST certified standard.

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6.4.2.5 Vanadium Stock Solution (1000 ppm) in 4% HNO3. SCP Cat. # 140-051-232 or equivalent NIST certified standard.

6.4.2.6 Antimony Stock Solution (1000 ppm) in 4% HNO3. SCP Cat. # 140-051-512 or equivalent NIST certified standard.

6.4.2.7 Chromium Stock Solution (1000 ppm) in 4% HNO3. SCP Cat. # 140-051-242 or equivalent NIST certified standard.

6.4.2.8 Lead Stock Solution (1000 ppm) in 4% HNO3. SCP Cat. #140-051-822 or equivalent NIST certified standard.

6.4.2.9 Molybdenum Stock Solution (1000 ppm) in H2O. SCP Cat. #140-050-422 or equivalent NIST certified standard.

6.4.3 Standard 2: To a 100 mL volumetric flask, add 10 mL of HNO3 (or that which matches the samples) in reagent water, add 50 µL of CPI stock solutions 4400-130597 and 4400-130775. Bring up to volume with reagent water. All elements in this standard will be at a concentration of 5 ppb.

6.4.4 Standard 3: To a 100 mL volumetric flask, add 10 mL. of HNO3 (or that which matches the samples) in reagent water, add 0.2 mL of CPI stock solutions 4400-130597 and 4400-130775. Bring up to volume with reagent water. All elements in this standard will be at a concentration of 20 ppb.

6.4.5 Standard 4: To a 100 mL volumetric flask, add 10 mL of HNO3 (or that which matches the samples) in reagent water, add 2.0 mL of CPI stock solutions 4400-130597 and 4400-130775. Bring up to volume with reagent water. All elements in this standard will be at a concentration of 200 ppb.

6.4.6 Continuing Calibration Check Solution (CCV): Concentrations of the CCV must be mid-range of the calibration.. Therefore, a 100 ppb CCV is prepared.. To a 100 mL Class A volumetric flask, add 10 mL of HNO3 (or that which matches the samples) in reagent water and add 1 mL of stock solutions 4400-130597 and 4400-130775. Bring up to volume with reagent water. All concentration will be at a concentration of 100 ppb.

6.4.7 Initial Calibration Check Solution (ICV): To a 100 mL Class A volumetric flask, add 10 mL of HNO3 (or that which matches the samples) in reagent water, add 0.1 mL of QC26 solution (QCD Analysts,

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Cat. #QCS26QZ). Bring up to volume with reagent water. All analytes are at a concentration of 100 ppb.

6.5 Internal Standards Stock Solution: To a 100 mL volumetric flask, add 3 mL of HNO3 and the following amounts of each internal standard. Bring up to volume with reagent water.

Product	Element	Stock Conc.	mL to add	Final Conc.
High Purity #100024-1	Indium	1000 ppm	2 mL	20 ppm
High Purity #100067-1	Yttrium	1000 ppm	2 mL	20 ppm
High Purity #100023-1	Holmium	1000 ppm	2 mL	20 ppm
High Purity #100057-1	Terbium	1000 ppm	2 mL	20 ppm
High Purity #100048-1	Scandium	1000 ppm	2 mL	20 ppm
QCD # 8703006	Lithium	100 ppm	20 mL	20 ppm
High Purity #100020-1	Germanium	1000 ppm	10 mL	100 ppm
SCP Science # 140-052-451	Rhodium	1000 ppm	2 mL	20 ppm

This solution must be added to all blanks, calibration standards, and samples. 0.05 mL of the internal standard stock solution shall be added to every 5 mL of blank, standard, or sample. This stock solution is stored at room temperature and is stable for a period of 3 months.

6.6 Blanks. Three types of blanks are required for the analysis. The calibration blank is used in establishing the calibration curve. The preparation blank is used to monitor for possible contamination resulting from the sample preparation procedure. The rinse blank is used to flush the system between all samples and standards.

6.6.1 The calibration blank consists of the same concentrations of the same acids used to prepare the final dilution of the calibrating solutions of the analytes (often 1% HNO3 (v/v) in reagent water) along with the selected concentrations of internal standard element for each of the analytes.

6.6.2 The preparation (or reagent) blank must be carried through the complete preparation procedure and contain the same volumes of reagents as the sample solutions.

6.6.3 The rinse blank consists of 6 percent HNO_3 (v/v) in reagent water. Prepare a sufficient quantity to flush the system between standards and samples.

6.7 Stock tuning solution. This solution is used for instrument tuning prior to analysis and to verify that the instrument has reached thermal stability. The solution is prepared by mixing 1.0 mL of the stock solutions in a 100 mL volumetric flask.

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The 6000 ICP/MS uses a solution containing Pb, Ba, Mg, Ce, U, In, Rh. The ICP/MS uses a solution containing Mg, Cu, Rh, Cd, In, Ba, Ce, Pb, U.

6.8 Working Tuning Solution: Add 0.1 mL of the 10 ppm Tuning solution to a 100 mL volumetric flask. Add 3 mL of HNO_3.(or that which matches the samples) Bring up to volume with reagent water. This will give a solution of 10 ppb. Use the 10 ppb solution as the working tuning solution and do not add internal standards to this solution.

6.9 Stock Mass Calibration Standard: Prepare this solution by adding 3 mL of HNO3 to a 100 mL Class A volumetric flask. Add 1 mL of the following elements to the flask: Cerium (High Purity # 100010-1), Rhodium (SCP Science #140-052-451), Lead (SCP Science # 140-051-822), Barium (SCP Science # 140-051-562), Magnesium (SCP Science # 140-051-122), and Uranium (SCP Science #140-051-921) or equivalent NIST approved standards. Bring up to volume with reagent water. This results in a 10ppm solution of these elements. Use this stock solution to prepare the actual tuning solution.

6.10 Working Mass Calibration Solution. Take a 500 mL Class A volumetric flask and Add 50 mL of HNO3 (or that which matches the samples) and 0.5 mL of the stock solution. Take up to volume with reagent water. Do not add internal standard to this solution. This results in a 10 ppb solution of the six elements above.

6.11 Laboratory Fortified Blank (LFB or LCS_): To a 100 mL aliquot of reagent water
add 1 mL aliquots from the QCD(#Q-AL-1 and #Q-AL-2 or equivalent) custom blend multi-element solutions. The final concentration is 100 ug/L for each element. The LFB must be carried through the same preparation method as the samples. Including sample digestion, when applicable. Add internal standards after preparation is complete.

6.12 Undigested Matrix Spike: To a 100 mL aliquot of sample, add 1mL aliquots from the QCD(#Q-AL-1 and Q-AL-2) custom blend multi-element solution. The final concentration is 100 ug/L for each element . Add internal standards after preparation is completed.

7 Instrument Calibration

7.1 The argon pressure shall be set between 50 and 52 psi. The plasma shall be set at 1000 watts for aqueous solutions and 1200 watts for solids. All other instrument settings are optimized daily and may change on a regular basis. Refer to the instrument operating manuals for more information on instrument settings.

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7.2 Allow at least 30 minutes for the instrument to equilibrate before analyzing any samples.

7.3 Instrument stability must be demonstrated by analyzing the tuning solution a minimum of five times. The resulting relative standard deviation for all analytes must be less than 2%.

7.4 Mass calibration and resolution checks must also be conducted in the mass regions of interest using the working mass calibration solution. Adjust the mass calibration if analytes differ from their unit mass by more than 0.05 amu. Adjust the spectrometer resolution if the peak width for all analytes is not within 0.75 ± 0.10 amu.

7.4.1 For the Perkin Elmer 6000, magnesium intensities shall be greater than 20000, rhodium intensities shall be greater than 150000, and lead intensities shall be greater than 100000. Background shall be less than 30 and the double charged ions and oxides shall be less than or equal to 0.030.

7.4.2 For the Perkin Elmer DRCe, magnesium intensities shall be greater than 50000, indium intensities shall be greater than 250000, and uranium intensities shall be greater than 200000. Background shall be less than 2 and the double charged ions and oxides shall be less than or equal to 0.030.

7.5 Internal standards must be used in all analyses to correct for instrument drift and physical interferences. A list of acceptable internal standards is provided in Table 2. Internal standards must be present in all samples, standards, and blanks at identical levels. This may be achieved by adding 0.05 mL of the Internal Standard Stock Solution (Section 6.5) to 5 mL of sample, standard, or blank.

7.6 The instrument must be calibrated using the internal standard technique described in Section 7.5 on a daily basis. The instrument must be calibrated for the analytes to be determined using the calibration blank and standards described in Sections 6.4.1 through 6.4.5. A minimum of three replicate integrations is required for data acquisition. Use the average of the integrations for instrument calibration and data reporting. The correlation coefficient for each analyte curve must be 0.995 or greater.

7.7 The rinse blank (Section 6.6.3) shall be used to flush the system between samples, standards, and blanks. Sufficient rinse time must be allowed to remove traces of the previous sample. Currently the rinse time is set at 60 seconds. Solutions shall be aspirated for 60 seconds prior to the acquisition of data to allow equilibrium to be established.

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7.8 Samples that have concentrations exceeding the linear range for an analyte must be diluted and reanalyzed or measured using an alternate line.

8 Quality Control

8.1 All policies and procedures in the most current version of the ALSI QA Plan shall be followed when performing this procedure.

8.2 Instrument Detection Limits (IDLs) in µg/L can be estimated by calculating the average of the standard deviations of the three runs on three non-consecutive days from the analysis of a reagent blank solution with seven consecutive measurements per day. Each measurement must be performed as though it were a separate analytical sample (i.e., each measurement must be followed by a rinse and/or any other procedure normally performed between the analysis of separate samples). IDLs must be determined at least every three months.

NOTE: Only isobaric elemental, molecular, and doubly charged interference corrections which use the observed isotopic-response ratios or parent-to-oxide ratios (provided an oxide internal standard is used as described in Section 3.2) for each instrument system are acceptable corrections for use in Method 6020.

8.3 Linear calibration ranges - Linear calibration ranges are primarily detector limited. The upper limit of the linear calibration range shall be established for each analyte by determining the signal responses from a minimum of three different concentration standards, one of which is close to the upper limit of the linear range. Care shall be taken to avoid potential damage to the detector during this process. The linear calibration range, which may be used for the analysis of samples, shall be judged by the analyst from the resulting data. The upper LDR limit shall be an observed signal no more than 10% below the level extrapolated from lower standards. Determined sample analyte concentrations that are greater than 90% of the determined upper LDR limit must be diluted and reanalyzed. The LDRs shall be verified every 6 months or whenever, in the judgment of the analyst, a change in analytical performance caused by either a change in instrument hardware or operating conditions would dictate they be re-determined.

8.4 Method detection limits (MDL) shall be established for all analytes, using the procedure outlined in *ALSI SOP 99-MDL*. MDLs shall be determined annually, when a new operator begins work or whenever, in the judgment of the analyst, a change in analytical performance caused by either a change in instrument hardware or operating conditions would dictate they be re-determined. Reporting limits (PQL) are determined by multiplying the MDL by 3-5 times plus any safety factor that may be deemed necessary.

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8.5 Demonstration of Capability (DOC): DOC's must be performed prior to independent analysis using this method and established annually as specified in the QA Plan, Technical Training. To perform DOC's, four consecutive Laboratory Control Samples (LCS) with a matrix matching that of the calibration standards are analyzed. The recoveries obtained must be within 80-120 % of the known values for each of the associated elements, and the consecutive reads must have an RSD less than 20%. If the DOC's are outside these acceptance limits, a new calibration curve must be established, and the LCS's reanalyzed. This process is repeated until the DOC's are completed successfully. For recertification the successful analysis of a blind performance sample (PT) may be used for the yearly DOC.

8.6 Quality Control Requirements

(Specific Project Requirements may override these requirements)

Parameter	Concentration	Frequency	Control Limits	Corrective Action
Calibration Blank	--	Beginning of run, after every 10 samples, and at the end of the run.	< 3 x IDL **For DoD** < 1/2 RDL	Reanalyze the blank, prepare new blank and analyze, perform maintenance on instrument , recalibrate, reanalyze any samples since the last acceptable blank. If reanalysis is not possible, report with a qualifying comment.
Method Blank (LRB)	--	One per batch of no more than 20 samples. Analyze with associated sample batch.	<reporting limit or <10% of sample concentration **For DoD** < 1/2 RDL	Reanalyze the blank. If still not acceptable, associated samples must be redigested and reanalyzed. If reanalysis is not possible, report with a qualifying comment.
Laboratory Fortified Blank (LFB or LCS)	All analytes 100ppb	One per batch of no more than 20 samples. Analyze with associated sample batch.	80-120% (**DoD samples** require 80-120% recovery with the exception of Ag, Mo, and Se. The recoveries for these metals are 75-120%)	Reanalyze the LFB. If still outside of acceptable range, samples must be redigested and reanalyzed. If reanalysis is not possible, report with a qualifying comment.
Parameter	**Concentration**	**Frequency**	**Control Limits**	**Corrective Action**
Quality Control Sample (QCS or ICV) Second Source Standard	All analytes are at 100 ppb	Immediately after calibration.	Mean concentration from 3 replicates must be within 90-110%	Reanalyze the ICV. If the standard is still not acceptable, perform instrument maintenance, and prepare a new calibration.
Continuing Calibration Check Standard (CCV) Same Source	CCV conc. 100 ppb	Beginning of run, after every 10 samples, and at the end of the run.	90-110%	Reanalyze the CCV. If the standard is still not acceptable, perform instrument maintenance, and prepare a new calibration. Reanalyze any samples since the last acceptable CCV. If reanalysis is not possible, report with a qualifying comment.
Reporting Limit Standard (RLS)	Standard # 1 Section 6.4.2	Used in Calibration Curve	+30% Part of the Calibration Curve	This standard does not have to be analyzed if it is part of the calibration curve.
* Matrix Spike (MS)	All analytes are at 100 ppb	One every 20 samples with at least one per batch.	75-125 % Recovery calculations are not required if the conc. of the analyte is greater than	If calibration verification standards are acceptable, reanalyze spike once. If the spike still fails or if reanalysis is not possible, report the results with a qualifying comment.

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			4 times the spiking level. (**DoD samples** 80-120% recovery. Exceptions for Ag, Mo, and Se. recoveries are 75-120%)	If the LCS is acceptable and the specific matrix interference is known, report with a qualifying statement. If the interference in unknown reanalyze the sample and matrix spike to determine matrix effect or analytical error.
*Duplicate or matrix spike duplicate (MSD)	--	One every 20 samples with at least one per batch.	RPD ≤ 20%	Reanalyze the duplicate. If the RPD is still >20% or if reanalysis is not possible, report the results with a qualifying comment.
**Post-Digestion Spike	All analytes are at 100 ppb	Samples that have unacceptable matrix spike recoveries.	75-125%	Dilute the sample and reanalyze to compensate for the matrix effect. Results must agree to within 10% of the original determination.
Internal Standard Response	__	Added to all samples and QCs	> 30% of the response in the initial calibration standard.	Flush the instrument with rinse blank and monitor the response in the calibration blank. If acceptable, Dilute sample by factor of 4, and reanalyze. If after flushing the calibration blank response is unacceptable, terminate the analysis and determine cause of drift. May be due to partially blocked sampling cone or change in tuning condition of instrument.
Interference Check Standard	Listed in Section 6.3.4	At the beginning and end of each run and every 8 hours thereafter	ICSA: Absolute value for all non-spiked analytes < RL (unless they are verified trace impurities) ICSAB: 80-120% of expected value.	Rerun the check standard, if still unacceptable, recalibrate. Samples shall not be analyzed until acceptable.
Dilution Test	Sample must be at least 100x greater than the reagent blank	Every 20 samples	Within 10% of the original result	Interference must be suspected. Rerun. If still not acceptable, dilute again.

* Samples selected for duplicate and matrix spike analysis shall be rotated among client samples so that various matrix problems may be noted and/or addressed. Poor performance in a duplicate or spike analysis may indicate a problem with the sample composition and shall be reported to the client whose sample produced the poor recovery.

** Post Digestion Spike is performed when dilution test fails or when both the matrix spike and matrix spike duplicate fail for an analyte. The recovery for the post digestion spike must be within 75-125%. If the post digestion spike fails dilute sample and spike until the recovery is within the acceptance limits.

9 Sample Collection, Preservation and Handling

9.1 Sample Collection.

9.1.1 Samples must be collected in plastic or glass containers. For aqueous samples, the minimum sample amount is 150 mL. For soil samples, the minimum amount is 3.00 g.

9.2 Sample Preservation

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9.2.1 Preserve aqueous samples using HNO_3 to a pH<2. Sample preservation shall be performed immediately upon sample collection. If this is not possible, then samples shall be preserved ASAP when received by the laboratory.

9.2.1.1 Following acidification in the laboratory, samples must be held 16 hours and then verified to be pH<2. If for some reason, the sample pH is verified to be greater than 2, more acid must be added and the sample held for an additional 16 hours until verified to be pH<2.

9.2.2 Soil samples must be preserved above the freezing point of water up to 6°C until analysis.

9.3 Sample Handling

9.3.1 All samples must be analyzed within 180 days of collection. All samples not analyzed within this time frame must be discarded and resampled for analysis, unless permission is given by the client to run the sample past its hold time. If this occurs, it must be clearly noted on the laboratory report. Digested samples can be stored at room temperature until they are analyzed. Digestates must be stored separately from standard solutions.

9.3.2 For samples requiring digestion, refer to the Sample Preparation SOPs for procedures.

10 Procedure

10.1 Aqueous Sample Preparation – Dissolved Analytes

10.1.1 For the determination of dissolved analytes in ground and surface waters, pipet an aliquot (> 20 mL) of the filtered, acid preserved sample into a 50-mL polypropylene centrifuge tube. Add an appropriate volume of (1+1) nitric acid to adjust the acid concentration of the aliquot to approximate a 1% (v/v) nitric acid solution (e.g., add 0.4 mL (1+1) HNO, to a 20 mL aliquot of sample). If the direct addition procedure is being used, add internal standards, cap the tube and mix. The sample is now ready for analysis. Allowance for sample dilution shall be made in the calculations.

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NOTE: If a precipitate is formed during acidification, transport, or storage, the sample aliquot must be treated using the procedure prior to analysis.

10.2 Sample Analysis

10.2.1 For every new or unusual matrix, it is highly recommended that the sample be screened for elements at high concentration. This may help prevent potential damage to the detector during sample analysis and identify elements that are higher than their linear range. This will also screen the sample for background levels of all elements being used as internal standards in order to prevent bias in the calculation of the analytical data.

10.2.2 Initiate the instrument operating configuration. Tune and calibrate the instrument for the analytes of interest.

10.2.3 Setup the run procedures for quantitative analysis. For all sample analyses, a minimum of three replicate integrations is required for data acquisition. Use the average of the integrations for data reporting.

10.2.4 All masses that might affect data quality must be monitored during the analytical run. This information shall be used to correct the data for identified interference.

10.2.5 During the analysis of samples, the laboratory must comply with the required quality control described in this SOP. Only for the determination of dissolved analytes or the "direct analysis" of drinking water with turbidity of < I NTU is the sample digestion step of the LRB, LFB, and LFM not required.

10.2.6 The rinse blank shall be used to flush the system between samples. Allow sufficient time to remove traces of the previous sample or a minimum of one minute Samples shall be aspirated for 60 sec prior to the collection of data.

10.2.7 Samples having concentrations higher than the established linear dynamic range shall be diluted into range and reanalyzed. First analyze the samples for the trace elements. Then dilute and analyze the sample for the high concentration elements. Alternatively, the dynamic range may be adjusted by selecting an alternative isotope of lower natural abundance, provided quality control data for that isotope have been established. The dynamic range must not be adjusted by altering instrument conditions to an uncharacterized state. (**DoD** samples will be diluted to within the

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calibration range or high-level check standard will be analyzed as part of the analysis. The acceptance limits will agree within +10 of expected value.)

10.3 Initial Set-up and Analysis for the Perkin Elmer ELAN 6000 ICP-MS and Perkin Elmer Elan DRCe

10.3.1 Perform the daily and as needed maintenance.

10.3.1.1 Check waste containers, empty if needed.

10.3.1.2 Clean the skimmer and sampler cones.

10.3.1.3 Change the sample tubing daily.

10.3.1.4 Change the waste tubing at least weekly, more frequently if needed.

10.3.2 Turn on the computer. Click on "start" at the bottom left hand corner of the screen. Move the mouse to "Programs". Move the mouse to the right and hold it on Elan 6000 (common). Move the mouse to the right and click on :Elan:. This will allow you to enter the ICPMS software.

10.3.3 The method that was used last will be on the screen. Click on the method box and click on sampling. Initialize the autosampler by clicking on "Probe". Then, click on "Go to Rinse". Start the pump by clicking on the device icon. Click on connect and the direction arrow that points to the right. Change the speed of the pump by typing the speed wanted in the box with the "rpm" next to it.

10.3.4 To light the plasma, click on the instrument window and click on "Start" under the word plasma. Allow the instrument to warm up for at least one-half hour.

10.3.5 Click on the File icon and then click on the Daily Performance method. Be sure the Daily Performance check meets the criteria listed in Section 7.12.2. Click on the File Icon and then click on the Tuning method. Click on the Tune Mass Spec box. All measured peak widths must be between 0.625 and 0.675 amu. The measured peak must be within + 0.05 amu of the actual mass value. Once these two measurements have passed the instrument is ready to analyze samples.

10.3.6 Click on the Method icon and then move the mouse to File. Under "File" click on "Open", click on the method that is going to be used.

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10.3.7 Click on the Sample icon and then move the mouse to File. Under "File" click on "Open", click on the sample program that is going to be used.

10.3.8 Click on the Data Set icon and move the mouse to File. Click on "New". Use that day's date for naming the Data Set. If a second Data Set is used on the same day, add an A at the end of the date.

10.3.9 Click on the sample page that was opened. Samples are analyzed using this page. Click on the "Batch" box in the upper right hand corner. The calibration and beginning QC are programmed into the software. If not, follow the example on Table 5.

11 Calculations

11.1 Elemental equations recommended for sample data calculations are listed in Table 3.

11.2 Data values shall be corrected for instrument drift or sample matrix induced interferences by the application of internal standardization. Corrections for characterized spectral interferences shall be applied to the data. Chloride interference corrections shall be made on all samples, regardless of the addition of hydrochloric acid, as the chloride ion is a common constituent of environmental samples.

11.3 If an element has more than one monitored isotope, examination of the concentration calculated for each isotope, or the isotope ratios, will provide useful information for the analyst in detecting a possible spectral interference. Consideration shall therefore be given to both primary and secondary isotopes in the evaluation of the element concentration. In some cases, secondary isotopes may be less sensitive or more prone to interferences than the primary recommended isotopes, therefore differences between the results do not necessarily indicate a problem with data calculated for the primary isotopes. See table 1 for the preferred isotopes to be reported.

11.4 The QC data obtained during the analyses provide an indication of the quality of the sample data and shall be entered into the LIMS.

11.5 Assessing Analyte Recovery and Data Quality

11.5.1 **LCS Recovery**:

$$\% \text{ Recovery} = (C_m / C_n) \times 100$$

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where C_m = measured concentration of LCS
C_n = spiking concentration

11.5.2 **Spike Recovery:**

$$\% \text{ Recovery} = [(C_s - C_u) / C_n)] \times 100$$

where C_s = measured concentration of spiked sample aliquot
C_u = measured concentration of unspiked sample aliquot
C_n = spiking concentration.

11.5.3 **Precision (RPD):**

$$\% \text{ RPD} = \frac{|R_1 - R_2|}{\frac{1}{2}(R_1 + R_2)} \times 100$$

where: R_1= Matrix Spike Recovery
R_2= Matrix Spike Duplicate Recovery

12 Reporting Results

12.1 When entering results in the LIMS, enter the sample result from the instrument and the dilution factor separately. The LIMS will multiply the dilution factor.

12.2 All results available on the raw data shall be entered into the LIMS. When entering data into Horizon LIMS do not round off results. Horizon will automatically perform rounding appropriate to the method. Horizon LIMS results are reported to three significant figures but limited to the number of decimal places in the reporting limit for the individual compound or analyte. This will allow the laboratory to provide "J" values to the client when they are requested. When "J" values are not requested.

12.3 Spikes, matrix spike duplicates, and the internal QC samples all need to be reported in the LIMS.

12.4 Report the actual result even if it is less than the reporting limit. Any sample with a result less than the reporting limit is reported as a ND (non-detectable by the Horizon LIMS); LIMS will automatically report the appropriate detection limit.

12.5 All raw data used for reporting results must be dated and initialed by the qualified laboratory personnel performing the first and second review.

13 Waste Disposal

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13.1 Refer to ALSI SOP 19-Waste Disposal.

14 Pollution Prevention

14.1 Pollution prevention encompasses any technique that reduces or eliminates the quantity or toxicity of waste at the point of generation. Numerous opportunities for pollution prevention exist in laboratory operations. Management shall consider pollution prevention a high priority. Extended storage of unused chemicals increases the risk of accidents. The laboratory shall consider smaller quantity purchases which will result in fewer unused chemicals being stored and reduce the potential for exposure by employees. ALSI tracks chemicals when received by recording their receipt in a traceable logbook. Each chemical is then labeled according to required procedures and stored in assigned locations for proper laboratory use.

15 Definitions

15.1 Optimum concentration range: A range below which scale expansion must be used and above which curve correction shall be considered. This concentration range will vary with the sensitivity of the instrument and the operating conditions employed.

15.2 Sensitivity: The slope of the analytical curve. The functional relationship between emission intensity and concentration.

15.3 Method detection limit: The minimum concentration of a substance that can be measured and reported with 99% confidence that the analyte concentration is greater than zero. The MDL is determined from analysis of a sample in a given matrix containing the analyte.

15.4 Total recoverable metals: The concentration of metals in an unfiltered sample following treatment with hot dilute mineral acid.

15.5 Dissolved metals: The concentration of metals determined in a sample after the sample is filtered through 0.45-um filter.

15.6 Suspended metals: The concentration of metals determined in the portion of a sample that is retained by a 0.45-um filter.

15.7 Total metals: The concentration of metals determined in a sample following digestion by Methods 3010, 3015, 3020, 3050, 3051, or 3052.

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15.8 Instrument detection limit (IDL): The concentration equivalent to a signal due to the analyte which is equal to three times the standard deviation of a series of 7 replicate measurements of a reagent blank's signal at the same wavelength or mass.

15.9 Interference check sample: A solution containing both interfering and analyte elements of known concentration that can be used to verify background and inter-element correction factors.

15.10 Initial Calibration Verification Standard (ICV): A certified or independently prepared solution used to verify the accuracy of the initial calibration.

15.11 Continuing calibration verification (CCV): Used to assure calibration accuracy during each run. It must be run for each analyte. It shall be analyzed at the beginning of the run, after every ten samples, and after the last analytical sample. The concentration of this standard shall be at or near the mid-range level of the calibration curve.

15.12 Calibration standards: A series of known standard solutions used by the analyst for calibration of the instrument.

15.13 Linear dynamic range: The concentration range over which the analytical curve remains linear.

15.14 Method blank: A volume of reagent water processed through each sample preparation procedure.

15.15 Calibration blank: A volume of reagent water acidified with the same amounts of acids as were the standards and samples.

15.16 Laboratory control standard (LCS): A volume of reagent water spiked with known concentrations of analytes and carried through the preparation and analysis procedure as a sample. It is used to monitor loss/recovery values.

15.17 Method of standard addition (MSA): This technique involves the use of the unknown.

15.18 Sample holding time: The storage time allowed between sample collection and sample analysis when the designated preservation and storage techniques are employed.

15.19 Check standard: A solution containing a known concentration of analyte derived from externally prepared test samples. The check standard is obtained from a source external to the laboratory and is used to check laboratory performance.

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15.20 Refer to ALSI QA Plan under Quality Control Checks for general definitions.

16 Troubleshooting

16.1 Refer to maintenance logs and instrument manuals for guidance in troubleshooting specific problems related to instrumentation used in this method.

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Appendix A

Logbook Example

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ICP-MS PE ELAN 6000
Analytical Worksheet

Data Set:						Cal-St0 log #:		
Date:						Cal–St1 log #:		
Analyst:						Cal-St2 log #:		
Matrix:						Cal-St3 log #:		
Parameter:						Cal-St4 log #:		
Cal:						QC26 log #		
						Cal Blank (ccb) #:		
						Rinse #:		
						Tuning Solution #:		
Sample ID	Seq.	AS Pos.	Sample ID	Seq.	AS Pos.	Sample ID	Seq.	AS Pos.
Oxides								
Sensitivity								
Mass Cal Mg								
Mass Cal Rh								
Mass Cal Pb								
Calibration Blank								
Cal-St0								
Cal-St1								
Cal-St2								
Cal-St3								
Cal-St4								

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Appendix B

Metals Standard Preparation Logbook

Standard	Standard	Standard	Stock Standard			Final	Final	Prep	Exp.	Pipette		
log#	Name	Conc.	Log #	Conc.	Vol. Used	Volume	Matrix	Date	Date	ID #	Comments	Tech

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Table 1

List of Recommended Masses

Element of Interest	Isotope
Aluminum	27
Antimony	121,(123)
Arsenic	75
Barium	135,(137)
Beryllium	9
Boron	10,(11)
Cadmium	106, 108, (111), 114
Calcium	44
Chromium	(52), 53
Cobalt	59
Copper	(63), 65
Iron	54, (56), 57
Lead	(206), (207), (208)
Magnesium	24, 25, (26)
Manganese	55
Molybdenum	95, 97, (98)
Nickel	(60),62
Selenium	77, (82)
Silver	(107), 109
Strontium	(87)
Thallium	203, (205)
Thorium	(232)
Uranium	(238)
Vanadium	51
Zinc	(66), 67, 68
Krypton	83
Ruthenium	99
Palladium	105
Tin	118

Note: Isotopes recommended for analytical determination are bracketed.

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Table 2

List of Acceptable Internal Standards

Internal Standard	Mass
Lithium	6
Scandium	45
Yttrium	89
Rhodium	103
Indium	115
Terbium	159
Holmium	165
Lutetium	175
Bismuth	209

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Table 3

Elemental Equations

Element	Equation
Vanadium 51	-3.127 * ClO 53 + 0.3534 * Cr 52
Chromium 50	-0.9691 * Ti 49 - .002406 * V 51
Iron 54	-0.02823 * Cr 52
Zinc 66(2)	-0.00093 * Ba ++ 138 + 0.0014 Ga 71
Zinc 66(3)	-0.00093 * Ba ++ 138 + 0.0014 Ga 71 - 145.6 SO2 68
Zinc 67	-0.0335 * Ba ++ 138 + 0.05236 * Ga 71
Zinc 68	-0.11 * Ba ++ 138 + 0.1657 * Ga 71
Arsenic 75(1)	-3.127 * Se 77 + 2.529 * Se 82
Arsenic 75(2)	-3.127 * Se 77 + 0.9894 * Se 78
Selenium 82(1)	-1.001 * Kr 83
Selenium 82(2)	-1.001 * Kr 83 - 0.027 * Br 79
Selenium 78(1)	-0.0303 * Kr 83
Selenium 78(2)	-0.187 * Ar2 76 - 0.0303 * Kr 83
Selenium 78(3)	-0.187 * Ar2 76
Strontium 87	-0.386 * Rb 85
Molybdenum 98(1)	-0.1095 * Ru 101
Molybdenum 98(2)	-0.146 * Ru 99
Silver 107(2)	-0.2186 * ZrO 106
Silver 109(2)	-0.0005688 * ZrO 106
Cadmium 114	-0.02747 * Sn 118 - 1.629 * MoO 108
Cadmium 111	-1.073 * MoO 108 + 0.764 * Pd 106
Antimony 123	-0.1245 * Te 125
Indium 115	-0.01457 * Sn 118
Lead 206(Bi)	+1.00 * Pb 207 + 1.00 * Pb 208
Lead 206(Ho)	+1.00 * Pb 207 + 1.00 * Pb 208

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Table 4
Reporting Limit Standard Concentrations

Analyte	Mass	PQL (ppb)
Aluminum	27	80.0
Antimony	121	2.0
Antimony	123	2.0
Arsenic	75	5.0
Barium	135	5.0
Barium	137	5.0
Beryllium	9	1.0
Cadmium	111	1.0
Cadmium	114	1.0
Calcium	44	50.0
Chromium	50	2.0
Chromium	52	2.0
Cobalt	59	1.0
Copper	63	5.0
Copper	65	5.0
Iron	54	30.0
Iron	57	30.0
Lead	206	2.0
Manganese	55	1.0
Molybdenum	95	2.0
Molybdenum	97	2.0

Analyte	Mass	PQL (ppb)
Molybdenum	98	2.0
Nickel	60	5.0
Nickel	62	5.0
Selenium	77	5.0
Selenium	78	5.0
Selenium	82	5.0
Silver	107	1.0
Silver	109	1.0
Strontium	87	2.0
Thallium	203	1.0
Thallium	205	1.0
Vanadium	51	1.0
Zinc	67	5.0
Zinc	68	5.0
Zinc	66	5.0
Magnesium	24	40.0
Boron	10	40.0
Boron	11	40.0
Mercury	200	0.2
Mercury	202	0.2

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Table 5
Sample/Batch Report

User Name: jdavies
Computer Name: MS50
Sample File: D:\elandata\Sample\Letterkenny Ag.sam
Report Date/Time: Friday, July 27, 2001 13:30:57

A/S Loc.	Batch ID	Sample ID	Description	Sample Type	Init. Quant.	Prep. Vol.	Aliquot Vol.	Diluted Vol.	Solids Ratio
7		ICV	Initial Calib. Std.						
3		ICB	Initial Calib. Blank						
8		CCV	Continuing Calib. Std.						
10		A	Interference						
11		AB	Interference						
3		CCB	Continuing Calib Blk.						

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SOP CHANGE HISTORY SHEET

Section No.	Section	Reason For Change
1.6	Scope and Application	SOP Update 5/23/05
6.1.1	Apparatus and Materials	SOP Update 5/23/05
6.2.1	Apparatus and Materials	A2LA Audit 5/23/05
7.1.1	Reagents and Standards	SOP Update 5/23/05
7.1.4	Reagents and Standards	SOP Update 5/23/05
7.3	Reagents and Standards	SOP Update 5/23/05
7.3.3.1	Reagents and Standards	SOP Update 5/23/05
7.4.2	Reagents and Standards	SOP Update 5/23/05
7.4.3	Reagents and Standards	SOP Update 5/23/05
7.4.4	Reagents and Standards	SOP Update 5/23/05
7.4.5	Reagents and Standards	SOP Update 5/23/05
7.6	Reagents and Standards	SOP Update 5/23/05
7.6.1	Reagents and Standards	SOP Update 5/23/05
7.7.1	Reagents and Standards	SOP Update 5/23/05
8.3	Quality Control	SOP Update 5/23/05
8.5.3	Quality Control	Added Section 5/23/05
8.5.4	Quality Control	Added Section 5/23/05

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SOP CHANGE HISTORY SHEET (continued)

Section No.	Section	Reason For Change
QC Table	Quality Control (Calibration Blank)	SOP Update 5/23/05
QC Table	Quality Control (CCV)	SOP Update 5/23/05
9.6	Calibration and Standardization	SOP Update 5/23/05
9.8	Calibration and Standardization	SOP Update 5/23/05
9.9	Calibration and Standardization	SOP Update 5/23/05
9.14	Calibration and Standardization	SOP Update 5/23/05
10.1.1	Sample Collection, Preservation and Handling	SOP Update 5/23/05
10.3.1	Sample Collection, Preservation and Handling	SOP Update 5/23/05
12.7	Calculations and Reporting Results	SOP Update 5/23/05
12.8	Calculations and Reporting Results	SOP Update 5/23/05

Revision 3: 04/03/2006

1.8	Scope and Applications	Project requirements verbiage added
4.1	Safety	Availability to MSDSs added
5.1.1-5.6	Apparatus and Materials	Added and updated apparatus and materials
6	Apparatus and Materials	Added storage parameters
6.2	Reagents and Standards	Revised DI water megohm-cm
6.3.2, 6.3.3.	Reagents and Standards	Removed mercury reference
6.3.4.1	Reagents and Standards	Revised HNO3 volume

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SOP CHANGE HISTORY SHEET (continued)

Section No.	Section	Reason For Change
6.3.4.2	Reagents and Standards	Revised HNO3 volume and Mo & Ti concentration, moved note from 6.6.3 to 6.3.4.2
6.4.2	Reagents and Standards	Revised preparation process; added RLS reference and standard stability
6.4.6	Reagents and Standards	Major revisions throughout section
6.5	Reagents and Standards	Removed references to #10006-1 & 100021-2, revised preparation volumes
6.7-6.12	Reagents and Standards	Major additions and revisions throughout
7	Instrument Calibration	Major revisions throughout section
8	Quality Control	Major revisions throughout section
10.2.6	Procedure	Removed mercury reference, revised aspiration time
10.2.7	Procedure	DoD audit response
10.3	Procedure	Added instrument names
11.1	Calculations	Deleted sample data reporting from this section
11.2	Calculations	Deleted data value reporting from this section
11.5	Calculations	Added detailing on assessing analyte recovery and data quality
12.2	Reporting Results	Deleted verbiage about which data values to report and sample dilution factor reporting limits
12.2, 12.4	Reporting Results	Added directions for Horizon LIMS entries

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SOP CHANGE HISTORY SHEET (continued)

Section No.	Section	Reason For Change
12.5	Reporting Results	Added raw data requirements
15.20	Definitions	Added reference to QA Plan
16.1	Troubleshooting	Added section

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SOP Concurrence Form
for the Distribution and Revision of Standard Operating Procedures

I have read, understood, and concurred with the Standard Operating Procedure (SOP) described above and will perform this procedure as it is written in the SOP.

Print Name	Signature	Date

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SW846 6010	Water	Control Limits		Precision
Parameter	Sample Type	LCL	UCL	RPD
Barium, Dissolved	LCS	80	120	-
Barium, Total	LCS	80	120	-
Beryllium, Dissolved	LCS	80	120	-
Beryllium, Total	LCS	80	120	-
Cadmium, Dissolved	LCS	80	120	-
Cadmium, Total	LCS	80	120	-
Calcium, Dissolved	LCS	80	120	-
Calcium, Total	LCS	80	120	-
Chromium, Dissolved	LCS	80	120	-
Chromium, Total	LCS	80	120	-
Cobalt, Dissolved	LCS	80	120	-
Cobalt, Total	LCS	80	120	-
Copper, Dissolved	LCS	80	120	-
Copper, Total	LCS	80	120	-
Iron, Dissolved	LCS	80	120	-
Iron, Total	LCS	80	120	-
Lead, Dissolved	LCS	80	120	-
Lead, Total	LCS	80	120	-
Lithium, Dissolved	LCS	80	120	
Lithium, Total	LCS	80	120	-
Magnesium, Dissolved	LCS	80	120	-
Magnesium, Total	LCS	80	120	-
Manganese, Dissolved	LCS	80	120	-
Manganese, Total	LCS	80	120	-
Mercury, Dissolved	LCS	80	120	-
Mercury, Total	LCS	80	120	-
Nickel, Dissolved	LCS	80	120	-
Nickel, Total	LCS	80	120	-
Potassium, Dissolved	LCS	80	120	-
Potassium, Total	LCS	80	120	-
Silver, Dissolved	LCS	80	120	-
Silver, Total	LCS	80	120	-
Sodium, Dissolved	LCS	80	120	-
Sodium, Total	LCS	80	120	-
Strontium, Dissolved	LCS	80	120	-
Strontium, Total	LCS	80	120	-
Tin, Dissolved	LCS	80	120	-
Tin, Total	LCS	80	120	-
Vanadium, Dissolved	LCS	80	120	-
Vanadium, Total	LCS	80	120	-
Zinc, Dissolved	LCS	80	120	-
Zinc, Total	LCS	80	120	-
Barium, Dissolved	MS	75	125	-
Barium, Total	MS	75	125	-
Beryllium, Dissolved	MS	75	125	-
Beryllium, Total	MS	75	125	-
Cadmium, Dissolved	MS	75	125	-
Cadmium, Total	MS	75	125	-
Calcium, Dissolved	MS	75	125	-
Calcium, Total	MS	75	125	-

Chromium, Dissolved	MS	75	125	-
Chromium, Total	MS	75	125	-
Cobalt, Dissolved	MS	75	125	-
Cobalt, Total	MS	75	125	-
Copper, Dissolved	MS	75	125	-
Copper, Total	MS	75	125	-
Iron, Dissolved	MS	75	125	-
Iron, Total	MS	75	125	-
Lead, Dissolved	MS	75	125	-
Lead, Total	MS	75	125	-
Lithium, Dissolved	MS	75	125	-
Lithium, Total	MS	75	125	-
Magnesium, Dissolved	MS	75	125	-
Magnesium, Total	MS	75	125	-
Manganese, Dissolved	MS	75	125	-
Manganese, Total	MS	75	125	-
Mercury, Dissolved	MS	75	125	-
Mercury, Total	MS	75	125	-
Nickel, Dissolved	MS	75	125	-
Nickel, Total	MS	75	125	-
Potassium, Dissolved	MS	75	125	-
Potassium, Total	MS	75	125	-
Silver, Dissolved	MS	75	125	-
Silver, Total	MS	75	125	-
Sodium, Dissolved	MS	75	125	-
Sodium, Total	MS	75	125	-
Strontium, Dissolved	MS	75	125	-
Strontium, Total	MS	75	125	-
Tin, Dissolved	MS	75	125	-
Tin, Total	MS	75	125	-
Vanadium, Dissolved	MS	75	125	-
Vanadium, Total	MS	75	125	-
Zinc, Dissolved	MS	75	125	-
Zinc, Total	MS	75	125	-
Barium, Dissolved	DUP/MSD	-	-	20
Barium, Total	DUP/MSD	-	-	20
Beryllium, Dissolved	DUP/MSD	-	-	20
Beryllium, Total	DUP/MSD	-	-	20
Cadmium, Dissolved	DUP/MSD	-	-	20
Cadmium, Total	DUP/MSD	-	-	20
Calcium, Dissolved	DUP/MSD	-	-	20
Calcium, Total	DUP/MSD	-	-	20
Chromium, Dissolved	DUP/MSD	-	-	20
Chromium, Total	DUP/MSD	-	-	20
Cobalt, Dissolved	DUP/MSD	-	-	20
Cobalt, Total	DUP/MSD	-	-	20
Copper, Dissolved	DUP/MSD	-	-	20
Copper, Total	DUP/MSD	-	-	20
Iron, Dissolved	DUP/MSD	-	-	20
Iron, Total	DUP/MSD	-	-	20
Lead, Dissolved	DUP/MSD	-	-	20
Lead, Total	DUP/MSD	-	-	20

Lithium, Dissolved	DUP/MSD	-	-	20
Lithium, Total	DUP/MSD	-	-	20
Magnesium, Dissolved	DUP/MSD	-	-	20
Magnesium, Total	DUP/MSD	-	-	20
Manganese, Dissolved	DUP/MSD	-	-	20
Manganese, Total	DUP/MSD	-	-	20
Mercury, Dissolved	DUP/MSD	-	-	20
Mercury, Total	DUP/MSD	-	-	20
Nickel, Dissolved	DUP/MSD	-	-	20
Nickel, Total	DUP/MSD	-	-	20
Potassium, Dissolved	DUP/MSD	-	-	20
Potassium, Total	DUP/MSD	-	-	20
Silver, Dissolved	DUP/MSD	-	-	20
Silver, Total	DUP/MSD	-	-	20
Sodium, Dissolved	DUP/MSD	-	-	20
Sodium, Total	DUP/MSD	-	-	20
Strontium, Dissolved	DUP/MSD	-	-	20
Strontium, Total	DUP/MSD	-	-	20
Tin, Dissolved	DUP/MSD	-	-	20
Tin, Total	DUP/MSD	-	-	20
Vanadium, Dissolved	DUP/MSD	-	-	20
Vanadium, Total	DUP/MSD	-	-	20
Zinc, Dissolved	DUP/MSD	-	-	20
Zinc, Total	DUP/MSD	-	-	20

SW846 6010	Soil	Control Limits		Precision
Parameter	Sample Type	LCL	UCL	RPD
Barium, Dissolved	LCS	80	120	-
Barium, Total	LCS	80	120	-
Beryllium, Dissolved	LCS	80	120	-
Beryllium, Total	LCS	80	120	-
Cadmium, Dissolved	LCS	80	120	-
Cadmium, Total	LCS	80	120	-
Calcium, Dissolved	LCS	80	120	-
Calcium, Total	LCS	80	120	-
Chromium, Dissolved	LCS	80	120	-
Chromium, Total	LCS	80	120	-
Cobalt, Dissolved	LCS	80	120	-
Cobalt, Total	LCS	80	120	-
Copper, Dissolved	LCS	80	120	-
Copper, Total	LCS	80	120	-
Iron, Dissolved	LCS	80	120	-
Iron, Total	LCS	80	120	-
Lead, Dissolved	LCS	80	120	-
Lead, Total	LCS	80	120	-
Lithium, Dissolved	LCS	80	120	
Lithium, Total	LCS	80	120	-
Magnesium, Dissolved	LCS	80	120	-
Magnesium, Total	LCS	80	120	-
Manganese, Dissolved	LCS	80	120	-
Manganese, Total	LCS	80	120	-
Mercury, Dissolved	LCS	80	120	-
Mercury, Total	LCS	80	120	-
Nickel, Dissolved	LCS	80	120	-
Nickel, Total	LCS	80	120	-
Potassium, Dissolved	LCS	80	120	-
Potassium, Total	LCS	80	120	-
Silver, Dissolved	LCS	80	120	-
Silver, Total	LCS	80	120	-
Sodium, Dissolved	LCS	80	120	-
Sodium, Total	LCS	80	120	-
Strontium, Dissolved	LCS	80	120	-
Strontium, Total	LCS	80	120	-
Tin, Dissolved	LCS	80	120	-
Tin, Total	LCS	80	120	-
Vanadium, Dissolved	LCS	80	120	-
Vanadium, Total	LCS	80	120	-
Zinc, Dissolved	LCS	80	120	-
Zinc, Total	LCS	80	120	-
Barium, Dissolved	MS	75	125	-
Barium, Total	MS	75	125	-
Beryllium, Dissolved	MS	75	125	-
Beryllium, Total	MS	75	125	-
Cadmium, Dissolved	MS	75	125	-
Cadmium, Total	MS	75	125	-
Calcium, Dissolved	MS	75	125	-
Calcium, Total	MS	75	125	-

Chromium, Dissolved	MS	75	125	-
Chromium, Total	MS	75	125	-
Cobalt, Dissolved	MS	75	125	-
Cobalt, Total	MS	75	125	-
Copper, Dissolved	MS	75	125	-
Copper, Total	MS	75	125	-
Iron, Dissolved	MS	75	125	-
Iron, Total	MS	75	125	-
Lead, Dissolved	MS	75	125	-
Lead, Total	MS	75	125	-
Lithium, Dissolved	MS	75	125	
Lithium, Total	MS	75	125	-
Magnesium, Dissolved	MS	75	125	-
Magnesium, Total	MS	75	125	-
Manganese, Dissolved	MS	75	125	-
Manganese, Total	MS	75	125	-
Mercury, Dissolved	MS	75	125	-
Mercury, Total	MS	75	125	-
Nickel, Dissolved	MS	75	125	-
Nickel, Total	MS	75	125	-
Potassium, Dissolved	MS	75	125	-
Potassium, Total	MS	75	125	-
Silver, Dissolved	MS	75	125	-
Silver, Total	MS	75	125	-
Sodium, Dissolved	MS	75	125	-
Sodium, Total	MS	75	125	-
Strontium, Dissolved	MS	75	125	-
Strontium, Total	MS	75	125	-
Tin, Dissolved	MS	75	125	-
Tin, Total	MS	75	125	-
Vanadium, Dissolved	MS	75	125	-
Vanadium, Total	MS	75	125	-
Zinc, Dissolved	MS	75	125	-
Zinc, Total	MS	75	125	-
Barium, Dissolved	DUP/MSD	-	-	20
Barium, Total	DUP/MSD	-	-	20
Beryllium, Dissolved	DUP/MSD	-	-	20
Beryllium, Total	DUP/MSD	-	-	20
Cadmium, Dissolved	DUP/MSD	-	-	20
Cadmium, Total	DUP/MSD	-	-	20
Calcium, Dissolved	DUP/MSD	-	-	20
Calcium, Total	DUP/MSD	-	-	20
Chromium, Dissolved	DUP/MSD	-	-	20
Chromium, Total	DUP/MSD	-	-	20
Cobalt, Dissolved	DUP/MSD	-	-	20
Cobalt, Total	DUP/MSD	-	-	20
Copper, Dissolved	DUP/MSD	-	-	20
Copper, Total	DUP/MSD	-	-	20
Iron, Dissolved	DUP/MSD	-	-	20
Iron, Total	DUP/MSD	-	-	20
Lead, Dissolved	DUP/MSD	-	-	20
Lead, Total	DUP/MSD	-	-	20

Lithium, Dissolved	DUP/MSD	-	-	20
Lithium, Total	DUP/MSD	-	-	20
Magnesium, Dissolved	DUP/MSD	-	-	20
Magnesium, Total	DUP/MSD	-	-	20
Manganese, Dissolved	DUP/MSD	-	-	20
Manganese, Total	DUP/MSD	-	-	20
Mercury, Dissolved	DUP/MSD	-	-	20
Mercury, Total	DUP/MSD	-	-	20
Nickel, Dissolved	DUP/MSD	-	-	20
Nickel, Total	DUP/MSD	-	-	20
Potassium, Dissolved	DUP/MSD	-	-	20
Potassium, Total	DUP/MSD	-	-	20
Silver, Dissolved	DUP/MSD	-	-	20
Silver, Total	DUP/MSD	-	-	20
Sodium, Dissolved	DUP/MSD	-	-	20
Sodium, Total	DUP/MSD	-	-	20
Strontium, Dissolved	DUP/MSD	-	-	20
Strontium, Total	DUP/MSD	-	-	20
Tin, Dissolved	DUP/MSD	-	-	20
Tin, Total	DUP/MSD	-	-	20
Vanadium, Dissolved	DUP/MSD	-	-	20
Vanadium, Total	DUP/MSD	-	-	20
Zinc, Dissolved	DUP/MSD	-	-	20
Zinc, Total	DUP/MSD	-	-	20

SW846 6020	Water	Control Limits		Warning Limits		Precision
Parameter	Sample Type	LCL	UCL	LWL	UWL	RPD
Aluminum, Dissolved	LCS	80	120	-	-	-
Aluminum, Total	LCS	80	120	-	-	-
Antimony, Dissolved	LCS	80	120	-	-	-
Antimony, Total	LCS	80	120	-	-	-
Arsenic, Dissolved	LCS	80	120	-	-	-
Arsenic, Total	LCS	80	120	-	-	-
Selenium, Dissolved	LCS	80	120	-	-	-
Selenium, Total	LCS	80	120	-	-	-
Thallium, Dissolved	LCS	80	120	-	-	-
Thallium, Total	LCS	80	120	-	-	-
Aluminum, Dissolved	MS	80	120	-	-	-
Aluminum, Total	MS	75	125	-	-	-
Antimony, Dissolved	MS	75	125	-	-	-
Antimony, Total	MS	75	125	-	-	-
Arsenic, Dissolved	MS	75	125	-	-	-
Arsenic, Total	MS	75	125	-	-	-
Selenium, Dissolved	MS	75	125	-	-	-
Selenium, Total	MS	75	125	-	-	-
Thallium, Dissolved	MS	75	125	-	-	-
Thallium, Total	MS	75	125	-	-	-
Aluminum, Dissolved	DUP/MSD	-	-	-	-	20
Aluminum, Total	DUP/MSD	-	-	-	-	20
Antimony, Dissolved	DUP/MSD	-	-	-	-	20
Antimony, Total	DUP/MSD	-	-	-	-	20
Arsenic, Dissolved	DUP/MSD	-	-	-	-	20
Arsenic, Total	DUP/MSD	-	-	-	-	20
Selenium, Dissolved	DUP/MSD	-	-	-	-	20
Selenium, Total	DUP/MSD	-	-	-	-	20
Thallium, Dissolved	DUP/MSD	-	-	-	-	20
Thallium, Total	DUP/MSD	-	-	-	-	20

SW846 6020	Soil	Control Limits		Warning Limits		Precision
Parameter	Sample Type	LCL	UCL	LWL	UWL	RPD
Aluminum, Dissolved	LCS	80	120	-	-	-
Aluminum, Total	LCS	80	120	-	-	-
Antimony, Dissolved	LCS	80	120	-	-	-
Antimony, Total	LCS	80	120	-	-	-
Arsenic, Dissolved	LCS	80	120	-	-	-
Arsenic, Total	LCS	80	120	-	-	-
Selenium, Dissolved	LCS	80	120	-	-	-
Selenium, Total	LCS	80	120	-	-	-
Thallium, Dissolved	LCS	80	120	-	-	-
Thallium, Total	LCS	80	120	-	-	-
Aluminum, Dissolved	MS	80	120	-	-	-
Aluminum, Total	MS	75	125	-	-	-
Antimony, Dissolved	MS	75	125	-	-	-
Antimony, Total	MS	75	125	-	-	-
Arsenic, Dissolved	MS	75	125	-	-	-
Arsenic, Total	MS	75	125	-	-	-
Selenium, Dissolved	MS	75	125	-	-	-
Selenium, Total	MS	75	125	-	-	-
Thallium, Dissolved	MS	75	125	-	-	-
Thallium, Total	MS	75	125	-	-	-
Aluminum, Dissolved	DUP/MSD	-	-	-	-	20
Aluminum, Total	DUP/MSD	-	-	-	-	20
Antimony, Dissolved	DUP/MSD	-	-	-	-	20
Antimony, Total	DUP/MSD	-	-	-	-	20
Arsenic, Dissolved	DUP/MSD	-	-	-	-	20
Arsenic, Total	DUP/MSD	-	-	-	-	20
Selenium, Dissolved	DUP/MSD	-	-	-	-	20
Selenium, Total	DUP/MSD	-	-	-	-	20
Thallium, Dissolved	DUP/MSD	-	-	-	-	20
Thallium, Total	DUP/MSD	-	-	-	-	20

SW846 8260B	Water	Control Limits		Precision
Parameter	**Sample Type**	**LCL**	**UCL**	**RPD**
Benzene	LCS	80	124	-
Carbon Disulfide	LCS	57	131	-
Chloroform	LCS	78	122	-
Ethyl Ether	LCS	71	131	-
Methylene Chloride	LCS	76	121	-
Toluene	LCS	80	125	-
Benzene	DUP/MSD	-	-	0-26
Carbon Disulfide	DUP/MSD	-	-	0-28
Chloroform	DUP/MSD	-	-	0-16
Ethyl Ether	DUP/MSD	-	-	0-19
Methylene Chloride	DUP/MSD	-	-	0-17
Toluene	DUP/MSD	-	-	0-20
1,2-Dichloroethane-d4	SURR	70	120	-
Toluene-d8	SURR	85	120	-
Dibromofluoromethane	SURR	85	115	-
4-Bromofluorobenzene	SURR	75	120	-

SW846 5035/8260B	Solid	Control Limits		Precision	
Parameter	**Sample Type**	**LCL**	**UCL**	**RPD**	
Benzene	LCS/MS	75	132	-	
Carbon Disulfide	LCS/MS	47	144	-	
Chloroform	LCS/MS	73	126	-	
Ethyl Ether	LCS/MS	66	137	-	
Methylene Chloride	LCS/MS	68	133	-	
Toluene	LCS/MS	73	129	-	
Benzene	DUP/MSD	-	-	40	
Carbon Disulfide	DUP/MSD	-	-	40	
Chloroform	DUP/MSD	-	-	40	
Ethyl Ether	DUP/MSD	-	-	40	
Methylene Chloride	DUP/MSD	-	-	40	
Toluene	DUP/MSD	-	-	40	
1,2-Dichloroethane-d4	SURR	56	124	-	
Dibromofluoromethane	SURR	62	123	-	
4-Bromofluorobenzene	SURR	51	128	-	
Toluene-d8	SURR	59	131	-	

SW846 8330B	Water/Soil	Control Limits		Precision
Parameter	Sample Type	LCL	UCL	RPD
1,3,5-Trinitrobenzene	LCS/MS	70	130	-
1,3-Dinitrobenzene	LCS/MS	70	130	-
2,4,6-Trinitrotoluene	LCS/MS	70	130	-
2,4-Dinitrotoluene	LCS/MS	70	130	-
2,6-Dinitrotoluene	LCS/MS	70	130	-
2-Amino-4,6-Dinitrotoluene	LCS/MS	70	130	-
2-Nitrotoluene	LCS/MS	70	130	-
3,5-Dinitroaniline	LCS/MS	70	130	
3-Nitrotoluene	LCS/MS	70	130	-
4-Amino-2,6-dinitrotoluene	LCS/MS	70	130	-
4-Nitrotoluene	LCS/MS	70	130	-
HMX	LCS/MS	70	130	-
Nitrobenzene	LCS/MS	70	130	-
Nitrocellulose	LCS/MS	70	130	-
Nitroglycerin	LCS/MS	70	130	-
Nitroguanidine	LCS/MS	70	130	-
PETN	LCS/MS	70	130	-
Perchlorate	LCS/MS	70	130	
RDX	LCS/MS	70	130	-
Tetryl	LCS/MS	70	130	-
1,3,5-Trinitrobenzene	DUP/MSD	-	-	30
1,3-Dinitrobenzene	DUP/MSD	-	-	30
2,4,6-Trinitrotoluene	DUP/MSD	-	-	30
2,4-Dinitrotoluene	DUP/MSD	-	-	30
2,6-Dinitrotoluene	DUP/MSD	-	-	30
2-Amino-4,6-Dinitrotoluene	DUP/MSD	-	-	30
2-Nitrotoluene	DUP/MSD	-	-	30
3,5-Dinitroaniline	DUP/MSD	-	-	30
3-Nitrotoluene	DUP/MSD	-	-	30
4-Amino-2,6-dinitrotoluene	DUP/MSD	-	-	30
4-Nitrotoluene	DUP/MSD	-	-	30
HMX	DUP/MSD	-	-	30
Nitrobenzene	DUP/MSD	-	-	30
Nitrocellulose	DUP/MSD	-	-	30
Nitroglycerin	DUP/MSD	-	-	30
Nitroguanidine	DUP/MSD	-	-	30
PETN	DUP/MSD	-	-	30
Perchlorate	DUP/MSD	-	-	30
RDX	DUP/MSD	-	-	30
Tetryl	DUP/MSD	-	-	30
3-Nitrochlorobenzene	SURR	50	150	-

DATACHEM LABORATORIES, INC.

STANDARD OPERATING PROCEDURE APPROVAL SHEET

SOP TITLE: The Determination of Perchlorate in Water, Soil and Biota by Liquid Chromatography / Mass Spectrometry

DOCUMENT CONTROL NUMBER: LC/MS-CLO4 - Revision 5

EFFECTIVE DATE: February 15, 2008

APPROVALS:

MANAGER _____ Date _____

QA MANAGER _____ Date _____

LAB DIRECTOR _____ Date _____

STANDARD OPERATING PROCEDURE

THE DETERMINATION OF PERCHLORATE IN WATER, SOIL AND BIOTA BY LIQUID CHROMATOGRAPHY / MASS SPECTROMETRY

1.0 SCOPE AND APPLICATION

1.1 This DataChem Laboratories method uses a liquid chromatography / mass spectrometry (LC/MS) method applicable to the determination of perchlorate in water, soil, and biota matrices.

1.2 A 20 µL portion of the sample or extract is introduced into a LC/MS. Perchlorate is separated by liquid chromatography, and partially fragmented for measure at mass 83 using mass spectrometry.

1.3 This method meets requirements of SW846 Method 6850, and is recommended for use only by or under the supervision of analysts experienced in the use of liquid chromatography and in the interpretation of mass spectrometry data.

1.4 **Appendix A "DoD Perchlorate Handbook, August 2007, Revision 1 Change 1, Appendix G Requirements" specifies additional requirements and changes for DoD projects that are not included in the referenced method.**

2.0 CHANGES AND CLARIFICATIONS FROM THE REFERENCE METHOD

2.1 Not Applicable.

3.0 DETECTION LIMITS, INTERFERENCES, AND SAFETY

3.1 Limit of Quantitation (LOQ)

3.1.1 Limit of Quantitation (LOQ) under the conditions of this method are:

Analyte	LOQ Water (µg/L)	LOQ Soil (µg/kg)	LOQ Biota (µg/kg)
Perchlorate	0.2	2.0	6.0

3.2 Interferences

3.2.1 Method interferences can be caused by contaminants in the reagent water, reagents, glassware, and other sample processing apparatus. These interferences can lead to false positive results for the target analyte.

3.2.2 All reagent solutions and samples (including QC samples) must be filtered through no larger than a 0.45 micrometer nominal pore size membrane of frit to remove particulates and prevent damage to the instrument, columns and flow systems. Filters specifically designed for IC or LC applications should be used.

3.2.3 Hydrogen sulfate ion ($H^{34}SO_4^-$), formed from a minor sulfur isotope, is commonly present in samples. $H^{34}SO_4^-$ elutes before perchlorate but at high concentrations can tail into the retention time of the perchlorate peak and elevate its baseline at *m/z* 99. Quantitation of perchlorate based on *m/z* 83 and 89 avoids this potential interference from $H^{34}SO_4^-$. The validation study described in 15.16 notes that conductivity values at 21,100 µS will have minimal impact on this analysis. Therefore, an interference check (ICS) at conductivity equivalent to 2000 mg/L of Sulfate, Chloride and Carbonate can be added, if required, at the reporting limit to verify lack of interferences.

3.2.4 This method separates perchlorate from suppression interferences sufficiently to allow matrix diversion, if required, and an interference threshold study provides no conductivity threshold for this method. If conductivity levels are of concern for a specific project than the conductivity level of the Interference Check Standard listed in Appendix A can be increased. Site history should be used to determine the level of suspected suppressor interferences and conductivity should be measured on all samples to assure conductivity below levels set for the project.

3.3 Safety Precautions

3.3.1 Protective clothing must be worn when one works with corrosive or potentially corrosive materials or samples.

3.3.2 Safety glasses must be worn at all times in the laboratory.

3.3.3 Normal, accepted laboratory safety practices shall be followed during reagent preparation and instrument operation.

3.3.4 The toxicity or carcinogenicity of each reagent used in this method have not been fully established. Each chemical should be regarded as a potential health hazard and exposure should be as low as reasonably achievable.

3.3.5 Refer to: DataChem Laboratories SOP LAB-005, “General Laboratory Safety and Chemical Hygiene” and the Safety Manual and Chemical Hygiene Plan of DataChem Laboratories.

4.0 APPARATUS AND CHEMICAL REAGENTS

4.1 Glassware/Hardware

4.1.1 Volumetric flasks, 100-mL and other sizes as needed

4.1.2 Eppendorf pipettes (10-µL to 10,000-µL)

4.1.3 Disposable autosampler vials

4.1.4 Disposable centrifuge tubes

4.1.5 Disposable plastic micro-beakers

4.1.6 Sample bottles: Polyethylene (or glass) of sufficient volume to allow replicate analyses

4.1.7 Disposable PALL 0.45-µm IC Acrodisc filters, with plastic 5-mL luer-lock syringes.

4.1.8 Burdick & Jackson C18 (2000-mg) columns.

4.2 Instrumentation

4.2.1 The system is an Agilent 1100 LC/MS or equivalent. Agilent 1100 LC/MS instrument conditions are presented in Figure 1. Instrument tuning and instrument conditions are based on the manufacturer's instructions. Tuning is not required prior to daily analyses. Tuning parameters are available from the instrument manufacturer, along with mass tuning solutions and instructions on how to optimize the mass spectrometer. Similar LC/MS systems from other manufacturers may also be used.

Figure 1. LC/MS Instrument Parameters

Agilent 1100 LC/MS

Pump Control

Flow Rate:	0.5 mL/min for 5 min, to 0.3 ml/min at 6 min., hold till 14 min, 0.5 ml/min at 15 min, with 2 min post run.
Run Time:	15.0 min

HPLC Mobile Phase:
Isocratic
53.00%, Solvent A (95% ACN / 4.5% Water / 0.5% Acetic Acid)
47.00%, Solvent B (94.5% Water / 5% ACN / 0.5% Acetic Acid)

Mass Spectrometer

Ionization Mode:	Electrospray
Polarity:	Negative

SIM Parameters (Will vary with instrument condition)

SIM Ion	Fragmentor	Gain (EMV)
83.00	210V	30
85.00		
89.00		

Spray Chamber

Gas Temp:	350°C
Drying Gas (Nitrogen):	12.0 L/min
Nebulizer Pressure:	50 psig

Capillary Voltage (Will vary with instrument condition)

Negative:	3500 V

Autosampler and Column	
Injection Volume:	20 uL
Column Temp:	30°C

4.2.1.1 Analytical column: KP-RPPX K' (Prime) Technologies, Inc. or equivalent.

4.2.2 A Chemstation Data System is used to determine peak areas.

4.2.3 An Analytical Balance is used to accurately weigh reagents used in the preparation of eluent and aliquots of solid samples. Analytical Balances are 4 and 5 places and must meet the acceptance criteria of 0.05% on test weights. See DataChem Laboratories SOP LAB-015 "Balances".

4.2.5 A hand-operated stainless steel grinder (Back to Basics Model SJ-27, or equivalent) is used to grind up biota (plant) samples in order to ensure complete extraction of perchlorate from the matrix.

4.2.6 A standard laboratory centrifuge is used to spin down particulates in biota (plant) or soil samples that interfere with sample filtration.

4.3 Reagents

4.3.1 **ASTM Type II water** (ASTM D1193). Water shall be monitored for impurities.

4.3.2 **Acetonitrile (ACN)** (HPLC Grade) (CAS [75-05-8])

4.3.3 **Acetic Acid** (Glacial) (CAS [64-19-7])

4.3.4 **Sodium Perchlorate** ($NaClO_4$, CAS [7601-89-0]).

4.3.5 **Sodium Perchlorate ^{18}O**, containing 90% ^{18}Oxygen, Isotec Inc

4.3.6 **Mobile Phase Preparation**: ASTM Type II water and ACN are mixed in two one-liter bottles. Solvent A contains 95% ACN and 4.9% water (v/v) and the Solvent B contain 94.9% water and 5% ACN. 5ml acetic acid will be added to each bottle. The HPLC Mobile phase is an isocratic mixture of Solvent A (20%) and Solvent B (80%).

4.4 Reagents for Standard Preparation

4.4.1 Perchlorate stock standard solution, 1000µg/mL: A stock standard solution can be purchased as a certified solution or prepared from ACS reagent grade sodium salt as listed below. (NOTE: Sodium perchlorate represents a molar weight fraction of 81.2% perchlorate anion.)

4.4.1.1 Perchlorate (ClO_4^-) 1000µg/mL: Dissolve 0.123g of sodium perchlorate ($NaClO_4$, CAS [7601-89-0]) in ASTM Type II water and dilute to 100mL in a volumetric flask.

4.4.1.2 Stock standards may be stored at room temperature for a period up to 12 months. Expiration dates should be clearly specified on the label.

4.4.2 Intermediate Standard Solution (10ug/mL): Dilute 1000 µL of the stock standard solution to 100 mL with ASTM Type II water.

4.4.2.1 Calibration standards (See Section 5.2) may be made by further diluting the Intermediate standard.

4.4.2.2 Intermediate Standard Solutions may be stored at room temperature for a period up to 12 months. Expiration dates should be clearly specified on the label.

4.4.3 Internal Standard Stock Solution, approximately 1000ug/mL: A stock internal standard solution can be prepared from Oxygen-18 labeled Perchlorate salt as listed below.

4.4.3.1 O-18 labeled Perchlorate (ClO_4^-) approximately 1000 ug/mL: Dissolve 0.121g of Oxygen-18 labeled $NaClO_4$ in ASTM Type II water and dilute to 100mL in a volumetric flask.

4.4.3.2 Stock standards may be stored at room temperature for a period up to 12 months. Expiration dates should be clearly specified on the label.

4.4.4 Intermediate Internal Standard Solution (10ug/mL): Dilute 1000 µL of the stock internal standard solution to 100 mL with ASTM Type II water.

4.4.4.1 Intermediate Standard Solutions may be stored at room temperature for a period up to 12 months. Expiration dates should be clearly specified on the label.

4.4.5 Internal Standard Spiking Solution (approximately 1000 ug/L): Dilute 10.0 mL of the intermediate internal standard solution to 100 mL with ASTM Type II water.

4.4.5.1 Intermediate Standard Solutions may be stored at room temperature for a period up to 6 months. Expiration dates should be clearly specified on the label.

4.4.5.2 Each standard and sample requires 50µl of Internal Standard Spiking Solution per 10mL of sample or standard.

4.5 Reagents for QC Sample Preparation

4.5.1 Prepare QC Standard Solutions as described in Sections 4.4.1 and 4.4.2. Be sure to use a separate source from that used for the preparation of the calibration standards.

5.0 CALIBRATION AND STANDARDIZATION

5.1 Tune the Mass Spec manually after any maintenance to the Mass Spectrometer or electro spray apparatus. Manually set tune to use m/z 69 in the manufacturer provided tuning solution. By adding *m/z* 69 this solution will bracket the *m/z* range of perchlorate at 83, 85 and 89. See Appendix B for manual tune example.

5.1.1 Start with known "good" tuning file.

5.1.2 Add m/z 69 to target masses.

5.1.3 Do dynamic ramping for fragmentor, Lens2RFAmp (if applicable), and width offset. Be sure to adjust the parameters to include the lower target.

5.1.4 Manually adjust other instrument variables, if desired, according to software instructions.

5.1.5 Save file under new name.

Note: "Autotune", and "Checktune" commands can not be used when adding the additional target mass.

5.2 Demonstration and documentation of acceptable initial calibration is required prior to analysis.

5.3 Working calibration standards are generated using various dilutions of the intermediate standard solution (Section 4.4.2). Analyze a minimum of six calibration standards as well as a blank standard. A sufficient number of standards must be analyzed to allow an accurate calibration curve to be established.

5.3.1 Standard concentrations generally used to determine a calibration curve are 0.2, 0.5, 1.0,, 5.0, 10.0, and 50.0µg/L.

5.3.2 Internal Standard calibration (at 5.0µg/L) is used as per SW 846 8000B section 7.10.2.

5.4 *Initial Calibration:* The standard curve for each analyte is established by plotting the area ratio response for each standard against the concentration. The acceptance criterion for the initial calibration curve is a correlation coefficient of 0.995 or higher.

5.5 *Initial Calibration Verification (ICV):* Immediately after the calibration standards have been analyzed, the accuracy of the initial calibration shall be verified and documented by the analysis of an Initial Calibration Verification. The ICV is prepared from the QC stock standard solution at a concentration of 10.0 µg/L. When measurements exceed the control limits of ±15% of the true value, the analysis must be terminated, the problem corrected, the instrument recalibrated, and the calibration re-verified.

5.5.1 The Initial Calibration Verification analysis shall be conducted using an independent standard. An independent standard is defined as a standard comprising analyte material from a different source than that used in the standards for the instrument calibration.

5.6 *Continuing Calibration Verification (CCV):* Initial calibrations may be stable for extended periods of time. Once the calibration curve has been established, it MUST be verified for each analysis batch using a CCV prior to conducting any field sample analysis, every tenth field sample, and at the end of the analysis sequence. Percent recovery for the CCV must be ±15%.

5.6.1 CCV targets should alternate between high (10µg/L) and mid-range (1.0µg/L) levels.

5.7 *Retention Time Window*

A retention time window study need not be performed as per SW846 8000B section 7.6 when using an internal standard.

5.8 Refer to: the Environmental Quality Assurance Program Plan of DataChem Laboratories, Appendix 14.7, "Summary of Calibration and Corrective Action".

6.0 SAMPLE HANDLING AND PRESERVATION

6.1 Refer to DataChem Laboratories SOP QS-DC-001, "Sample Receipt and Log-In (Environmental)" and the Environmental Quality Assurance Program Plan of DataChem Laboratories, Appendix 14.8, "Sample Preservation and Holding Times".

6.2 Samples should be collected in scrupulously clean glass or polyethylene bottles that meet EPA cleaning procedure D protocols.

6.2.1 Water samples should be collected in 125-mL polyethylene bottles; soil samples should be collected in 4-oz amber glass bottles.

6.3 Sample preservation and holding times for anions (perchlorate) determined by this method are as follows:

Matrix	Preservation*	Holding Time
Water	None required	28 days
Soil/Solid	None required	28 days
Biota	Non Required	28 Days

*Care should be taken to avoid temperature extremes during shipment.

7.0 SAMPLE PREPARATION AND ANALYSIS

7.1 Sample Preparation QC Requirements

7.1.1 At least one method blank consisting of deionized ASTM Type II water for water samples and silica sand for soil samples, shall be processed through each sample preparation and analysis procedure at a frequency of one per batch of twenty samples.

7.1.2 A Laboratory Control Sample (LCS) must be analyzed using the same sample preparations and analytical procedures employed for the field samples. The LCS

shall be prepared from a separate source from the stock standards used for calibration. For water samples deionized ASTM Type II water is used and for soil samples a portion of silica sand is used.

7.1.3 One matrix spike (MS) sample shall be prepared at a frequency of at least one per 20 field samples.

7.1.4 One matrix duplicate (MD) or matrix spike duplicate (MSD) sample must be prepared at a frequency of at least one per 20 field samples. Duplicates are separate sample aliquots (soil or water) that are taken through the complete analytical process from preparation through analysis.

7.1.5 If required, a interference check standard is prepared by spiking perchlorate at the DoD reporting limit (Water = 1.0 µg/L, Soil = 10 µg/Kg, and Biota = 30 µg/Kg) in a solution containing 2000 mg/L of Chloride, Carbonate and Sulfate.

7.1.5.1 Using the sodium salts of chloride, sulfate and carbonate, prepare a 250-mL dissolved salt solution 2000 mg/L each of the anions chloride, sulfate and carbonate (i.e. 0.206 g NaCl, 0.277 g Na2SO4, 0.221 g Na2CO3, respectively, in 250 mL reagent water).

7.2 Water Sample Preparation

7.2.1 9.95 mL of sample (or standard) is aliquoted to a 15-mL disposable centrifuge tube.

7.2.2 50µL of Internal Standard Spiking Solution is added to each sample.

7.2.3 Samples are mixed prior to filter step.

7.2.4 Each sample is filtered through a PALL 0.45-µm IC Acrodisc filter into an autosampler vial for analysis.

7.3 Soil Sample Preparation

7.3.1 For soil samples requiring the DoD Perchlorate Handbook the sub-sampling procedures specified in DataChem SOP XX-DC-025 “Sub-sampling for Soils and Sediments”, section 7 must be followed.

7.3.2 9.95 mL of ASTM Type II water is added to 1 gram of sample soil in a 15-mL centrifuge tube. Internal Standard Spiking Solution is added to each sample (see section 7.2.2). The mixture is vortexed, sonicated for at least 10 minutes, and vortexed again. If necessary, the sample is centrifuged. The extract is then filtered through a PALL 0.45-µm Acrodisc IC filter into an autosampler vial for analysis.

7.4 Biota (Plant) Sample Preparation or High Organic Solid Samples

7.4.1 A sufficient portion (at least 10 grams) of sample is ground through a hand-operated stainless steel grinder.

7.4.2 30 mL of ASTM Type II water is added to 3 grams of sample matrix in a 50-mL centrifuge tube. Internal Standard Spiking Solutionis added to each sample (see section 7.2.2). The mixture is vortexed and left overnight, which allows for complete saturation of the sample.

7.4.3 Prior to analysis, the sample is vortexed again, then centrifuged at 5000 rpm for 30 minutes.

7.4.4 Approximately 6 mL of the supernatant is then drawn through an activated B&J C18 column, which removes a large portion of organic contaminants.

7.4.4.1 To activate the C18 cartridge column, draw approximately five mL of reagent-grade methanol through the column, followed by five mL of ASTM Type II water, being careful not to let the column go dry.

7.4.4.2 The first two mL of sample drawn through the C18 cartridge are discarded, as they are diluted by the liquid already in the column from the activation process.

7.4.5 The remainder (about 4 mL) of the resulting clear liquid is then filtered through a PALL 0.45-µm Acrodisc IC filter into an autosampler vial for analysis.

NOTE: Quantitative recovery of the sample through the C18 cartridge column is not necessary because there is no dilution or concentration of the sample. As noted in Section 7.4.4.2 above a portion of sample which elutes first is discarded because it is diluted with the activation solution on the cartridge.

7.5 Matrix Dilution: If analysis exceeds the calibration range the sample may be diluted.

8.0 PROCEDURE

8.1 Establish a stable baseline with working eluent running through the system. This requires approximately 15 to 30 minutes.

8.2 Establish a valid initial calibration as outlined in Section 5.3.

8.3 Load and inject a fixed amount of well-mixed sample. Record the resulting peak size in area units and the retention time. The autosampler and data system perform these functions automatically.

8.4 If the response for the peak exceeds the calibration range of the system, dilute the sample as per section 7.5 and reanalyze.

8.5 If the internal standard peak area response is greater than ± 50 % from the Initial CCV the sample must be reanalyze.

8.6 Due to software limitations, manual integration of observed peaks in samples and standards is routinely required for accurate quantitation. Care is taken by the analyst to ensure that such manual integrations are done as accurately and consistently as possible.

When manual integrations are performed, they are noted on the analyst notebook page. The raw data and manually integrated data are stored electronically for reprocessing if needed, Manually integrated peaks are identified with m codes on chromatograms. The documentation requirements specifed above supersede the documentation requirements of the DataChem SOP Lab-032 "Manual Integration".

9.0 DATA ANALYSIS AND CALCULATIONS

9.1 Identify perchlorate in the sample chromatograms by:

9.1.1 Using the retention time of the perchlorate mass 83 versus internal standard mass 89 calculate the Relative Retention Time (RRT). The RRT must be 1.0 ± 0.02.

9.1.2 Evaluation of the relative abundance of masses 83 and 85 ions in the chromatogram is required. This ratio should be within ± 30% from the average ratio of the mid level standards (≈ 1.96 to 3.64). The ratio derived from the natural abundance of chlorine isotopes 35 and 37 is estimated at 2.2 to 3.3. The 83/85 ratio can vary significantly at low perchlorate levels, usually due to interference and/or intensity of *m/z* 85. Analyst judgment should be used to identify perchlorate at low levels along with documentations outside established control limits.

9.1.3 Use mass 83 for quantitation.

9.2 Sample concentration is calculated using internal standard calculation as per SW846 8000C and reported as follows:

9.2.1 Water Samples

Final Result (µg/L) = (C)(D)

Where:

C = Concentration from internal standard curve (µg/L)
D = Dilution factor (if needed)

9.2.2 Soil and Biota Samples

$$\text{Final Result } (\mu\text{g/g}) = \frac{(\text{C})(\text{V})(\text{D})}{\text{M}} = \frac{(\text{C})(30\text{mL})(\text{D})}{(3.0\text{g})}\left(\frac{1\,\text{L}}{1000\,\text{mL}}\right)$$

Where:
C = Concentration in extract from internal standard curve (µg/L)
V = Volume of sample extract used for analysis (mL)
D = Dilution factor (if needed)
M = Mass of initial sample extracted (g)

10.0 QUALITY CONTROL

10.1 The requirements for the quality control (QC) program for this method consist of a, Laboratory Method Blank (MB), Laboratory Control Sample (LCS), Initial Calibration

Verification (ICV), Continuing Calibration Verification (CCV), Matrix Spike (MS), and either a Field (MD), Laboratory (QD), or Matrix Spike duplicate (MSD) sample analysis. This section details the specific requirements for each of these QC parameters.

10.1.1 Refer to: DataChem Laboratories SOP XX-DC-018, "Evaluation of Quality Control Data" and the DataChem Laboratories Environmental Quality Assurance Program Plan, Section 10, "Quality Control Procedures", Section 11, "Data Reduction, Verification, and Reporting", Section 12, "Corrective Action", Appendix 14.7, "Summary of Calibration and Corrective Action", and Appendix 14.10, "Batch QC and Corrective Action Flowcharts". Nonconformance procedures are in accordance with DataChem Laboratories SOP LAB-020, "Nonconformance/Corrective Action Report (NC/CAR) Procedures".

10.2 Method Detection Limit (MDL)

10.2.1 An MDL must be established for the instrument prior to any sample analysis. Follow the procedure outlined in DataChem Laboratories SOP Lab-024 "Calculation of Method Detection Limits". MDLs will be analyzed in reagent water. Additionally, MDL verifications must be analyzed as per section 4.3 of the DataChem Laboratories SOP Lab-024.

10.2.2 MDLs should be verified at least annually.

10.3 Limit of Quantitation (LOQ)

10.3.1 The LOQ is the threshold concentration of an analyte that a laboratory can expect to accurately quantitate in an unknown sample. The LOQ must be established at an analyte concentration at least three times the MDL. Although the lowest calibration standard may be below the LOQ, the LOQ must never be lower than the lowest calibration standard.

10.4 Assessing Laboratory Performance: The following must be included in every analytical batch.

10.3.1 A Method Blank (MB) must be prepared and treated exactly as a field sample, including exposure to all glassware, equipment, solvents, filtration, and reagents that are used with field samples. Data produced are used to assess instrument performance of a blank sample and evaluate contamination from the lab equipment. Any perchlorate recovery in the MB that exceeds the 1/2 the LOQ indicates that contamination is present. The source of the contamination must be determined prior to conducting any sample analysis. Any sample included in an analysis batch that has an invalid MB must be reanalyzed in a subsequent batch after the contamination problem is resolved.

10.3.2 A Laboratory Control Sample (LCS) must be prepared and treated exactly as a field sample, including exposure to all glassware, equipment, solvents, filtration, and reagents that are used with field samples. Data produced are used to assess efficiency of the instrument performance and preparation procedures. Perchlorate recovery in the LCS must be within required limits of 85 – 115%. Alternate limits, historical or client supplied, may be used for specific projects. If

perchlorate recovery is outside control limits the preparation batch in question must be re-prepared and reanalyzed.

10.5 Assessing Analyte Recovery and Data Quality: The following must be included in every analytical batch.

10.5.1 Matrix Spike (MS): At least one matrix spike sample should be prepared at 1.0 µg/L for every analysis batch.

10.5.1.1 Individual analyte percent recoveries (%Rec) are calculated as follows:

$$\% \text{ Rec} = \frac{(\text{SSR} - \text{SR})}{\text{SA}} \text{x}100$$

Where:
SSR = Spiked Sample Result
SR = Sample Result
SA = Spike Added

When sample concentration is less than the method detection limit, use SR = 0 for purposes of calculating %Rec.

10.5.1.3 The method control limits for %Rec are 80.0 – 120.0 for perchlorate. Clients may specify alternate limits for specific projects.

10.5.1.3.1 If the perchlorate concentration in the field sample does not exceed the spiked concentration by a factor of four, and the MS recovery is outside the control limits, a matrix effect is suspected, especially if all other QC data is within limit. The associated data should be flagged according to project specifications or noted in the comments section of the report.

10.5.1.3.2 If the perchlorate concentration in the field sample exceeds the spike concentration by a factor of four, the MS amount is considered negligible and the %Rec is not representative of the analytical procedure. Associated data are not flagged in the analytical report.

10.5.1.3.3 Repeated failure to meet method MS recovery criteria indicates potential problems with the procedure and should be investigated.

10.5.2 Matrix Spike Duplicates: A matrix spike duplicate (MSD) must be included in every analytical batch in order to establish the precision of the data. Generally, an MSD prepared at 1.0µg/L is the best alternative.

10.5.2.1 Calculate the relative percent difference (RPD) between the duplicate sample recovery and the initial sample recovery as follows.

$$RPD = \frac{|S - D|}{(S + D)/2} x100$$

Where:
RPD = Relative Percent Difference
S = Sample Result
D = Duplicate Sample Result

10.5.2.2 The method control limit for RPD is 15% for Perchlorate for all samples above the reporting limit. Clients may specify alternate limits for specific projects.

10.5.2.3 If the analyte concentration in the sample and duplicate are greater than reporting limit and a matrix effect or non-homogeneous sample matrix is suspected, the project manager is contacted and the associated data must be flagged according to project specifications and noted in the comments section of the report.

10.5.2.4 RPD failure should not be a chronic problem. If it frequently recurs (>20% of duplicate analyses), it indicates a problem with the instrument or individual technique that must be corrected.

10.6 Responsibility for Inspection

10.6.1 The operations manager or designee is responsible for inspecting the work performed by the analysts to verify completeness and data quality.

10.6.2 The analysts performing this procedure have the responsibility to inspect: notebooks and worksheets for accuracy and completeness; samples for proper volume/size; labels, forms, and tags for accuracy; and equipment for proper maintenance and operation. (See DataChem Laboratories SOP LAB-028, “Documentation - Maintaining Instrument Records, Notebooks and Logbooks”)

10.7 Before performing any analyses, the analyst must demonstrate the ability to generate acceptable accuracy and precision with this method using laboratory control samples and/or Proficiency Testing Samples. See DataChem SOP Lab-006 :Training”.

11.0 REPORTING RESULTS

11.1 Results shall be reported in the units and format consistent with the requirements of the contract or project covered by this procedure. Analytical anomalies shall be reported consistent with the above requirements, such as suspected matrix effects determined by matrix spike data or matrix duplicate data.

11.2 It is the responsibility of the operations manager or designee to verify that the results are accurate, precise, complete, and in compliance with Section 11.1.

11.3 It is the responsibility of the operations manager or designee to approve all reports issued by DataChem Laboratories.

12.0 PREVENTATIVE MAINTENANCE

12.1 Refer to DataChem Laboratories SOP LAB-002, "Preventive Maintenance for Analytical Instrumentation."

12.2 The LC/MS system should be flushed with isopropanol periodically (at least monthly) in order to clear out contaminants and/or blockages that may build up in the system.

12.3 The source module on the mass spectrometer should be checked daily. Any salt buildup on the source cone should be removed (using DI water) and the spray needle should be inspected for wear. The shape of the mist cone sprayed from the needle will indicate if the needle needs to be replaced.

13.0 WASTE MANAGEMENT

13.1 Refer to: DataChem Laboratories SOP LAB-004, "Hazardous Waste Handling and Disposal" and LAB-005, "General Laboratory Safety and Chemical Hygiene".

13.2 All processed samples are stored and disposed of following the procedures outlined in EA-DC-002, "Processed Sample Storage and Disposal Control."

14.0 DEFINITIONS

14.1 Refer to: the Environmental Quality Assurance Program Plan of DataChem Laboratories, Appendix 14.12, "Definitions and Terms".

15.0 REFERENCES

15.1 "*Determinative Chromatographic Methods*" SW846 8000C.

15.2 *Annual Book of ASTM Standards*, (Volume 11.01, 1990), Method D4327-88.

15.3 DataChem Laboratories SOP QS-DC-001, "Sample Receipt and Log-In (Environmental)".

15.4 DataChem Laboratories Environmental Quality Assurance Program Plan.

15.5 DataChem Laboratories SOP LAB-002, "Preventive Maintenance for Analytical Instrumentation."

15.6 DataChem Laboratories SOP XX-DC-018, "Evaluation of Quality Control Data."

15.7 DataChem Laboratories SOP QC-DC-001, "Internal Review of QA/QC Data."

15.8 DataChem Laboratories SOP LAB-030, "Documentation—Maintaining Instrument Records, Notebooks and Logbooks."

15.9 DataChem Laboratories SOP LAB-020, "Nonconformance/Corrective Action Report (NC/CAR) Procedures".

15.10 DataChem Laboratories SOP LAB-004, "Hazardous Waste Handling and Disposal".

15.11 DataChem Laboratories SOP LAB-005, "General Laboratory Safety and Chemical Hygiene".

15.12 DataChem Laboratories SOP LAB-024, "Calculation of Method Detection Limits."

15.13 DataChem Laboratories SOP LAB-015, "Balances".

15.14 DataChem Laboratories SOP Lab-032, "Manual Integration".

15.15 *"Solvent Extractable Nonvolatile Compounds by High Performance Liquid Chromatography/Thermospray/Mass Spectrometry (HPLC/TS/MS) or Ultraviolet (UV) Detection*" SW846 8321A

15.16 "Analysis of Perchlorate in Difficult Matrices by LC/MS", Robert P. Di Rienzo, Kham Lin, Richard W. Wade, Federal Facilities Environmental Journal/Winter 2005

15.17 *PERCHLORATE IN WATER, SOILS AND SOLID WASTES USING HIGH PERFORMANCE LIQUID CHROMATOGRAPHY/ELECTROSPRAY IONIZATION/MASS SPECTROMETRY (HPLC/ESI/MS)"* SW846 Method 6850

15.18 **DoD Perchlorate Handbook, August 2007, Revision 1 Change 1, Appendix G**

Appendix A

DoD Perchlorate Handbook, August 2007, Revision 1 Change 1, Appendix G Requirements

Additional Requirement	Corrective Action	Acceptance Criteria	Frequency
Verification of Mass Calibration – Full Scan of Perchlorate Stock Standard	**Retune Mass Spectrometer as per section 5.1**	**± 0.3 *m/z* of mass 83, 85 and 89**	**Prior to initial calibration**
Initial Calibration: Five standards, linear calibration, not forced through zero. See section 5.3	**Recalibrate as per section 5.3**	**R > 0.995 or RSD < 20%** **Y-intercept ≤ MDL**	**As Needed**
Limit of Quantitation (LOQ) **At or above the lowest calibration standard and at least 3 times the MDL**		**Apply J Flag to all values between the MDL and LOQ**	
Reporting Limits (RL) for DoD Projects **At or below the applicable regulatory limit and at or above the lowest calibration standard.**		**Water = 1.0 µg/L** **Soil = 10 µg/Kg** **Biota = 30 µg/Kg**	
Internal Standard Recovery	**Rerun sample at increasing dilutions until the acceptance criteria is met using the internal standard area counts of the average from the initial calibration standards.**	**± 50%**	**Addition of IS to all samples, QC, blanks and standards.**

Appendix A

DoD Perchlorate Handbook, May 2007, Appendix G Requirements

Additional Requirement	Corrective Action	Acceptance Criteria	Frequency
Retention Time Study – Set the initial retention time of perchlorate equal to the first ICV or CCVcalibration standard.	**None**	**The is no acceptance criteria because this method uses relative retention time as specified in section 9.1.1**	**Each Day**
Preservation Requirements	**Documentation of non-conformance in Case Narrative**	**Shipment and storage at 4°C ± 2°C**	**All Samples and matrices**
Evaluating the relative abundance of masses 83 and 85 ions in the chromatogram.	**1)Rerun Sample** **2) Pre-treat sample appropriate from section 7 and rerun sample.** **3) Spike sample with Perchlorate and rerun sample.**	**2.3 to 3.8**	**All Positive Identifications** **If 1, 2 and 3 fail flag data as estimated (J) and note in case narrative**
Laboratory Reagent Blank	**Reanalyze reagent blank (until no carryover exists) and all samples processed since the contaminated blank.**	**< ½ LOQ**	**Before initial calibration, after all overange samples and after each batch.**
LCS Recovery – Spiked at the RL	**Reanalyze entire preparation batch.**	**80% to 120% or laboratory generated limits if tighter**	**One per preparation batch**
MS/MSD Recovery – Spiked at the RL	**For matrix evaluation only. Apply J flag to parent sample**	**80% to 120% or laboratory generated limits if tighter**	**One per preparation batch**

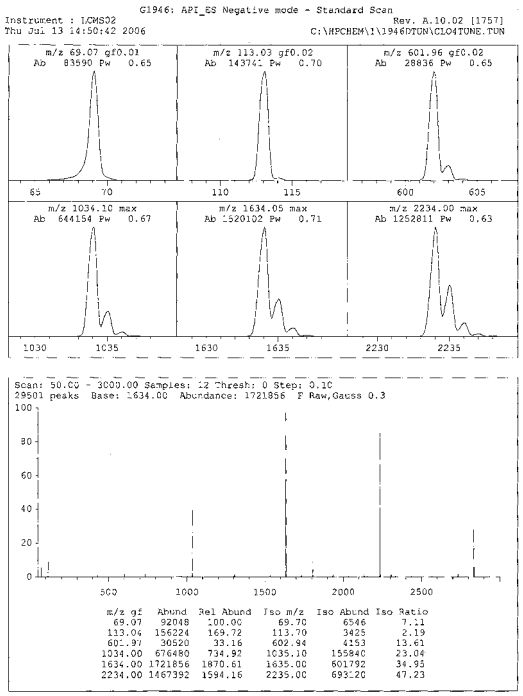
ICV and CCV – The concentration of these initial and continuing calibration standards must be 25 ug/L and must be analyzed in accordance with section 5.5.and 5.6 respectively.	**For ICV, when measurements exceed the control limit the analysis must be terminated, the problem corrected, the instrument recalibrated, and the calibration re-verified.** **For CCV - when measurements exceed the control limit, correct problem and rerun CCV and all samples analyzed since last successful CCV. If that fails, apply Q-flag to all results in all samples since the last acceptable calibration verification, if reanalysis is not possible.must be terminated, the problem corrected, the instrument recalibrated, and the calibration re-verified.**	**±15% of true value**	**ICV – After Calibration** **CCV - Once the calibration curve has been established, it MUST be verified for each analysis batch using a CCV prior to conducting any field sample analysis, every tenth field sample, and at the end of the analysis sequence.**

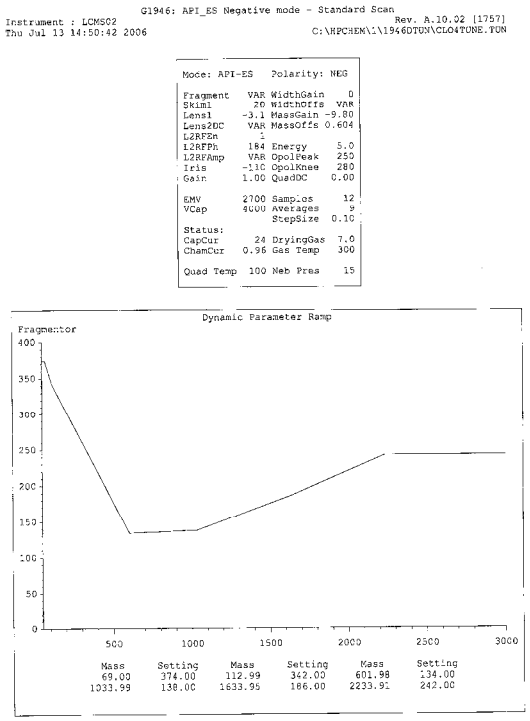
Appendix A

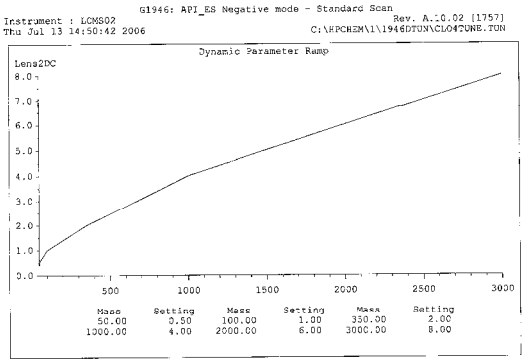
DoD Perchlorate Handbook, May 2007, Appendix G Requirements

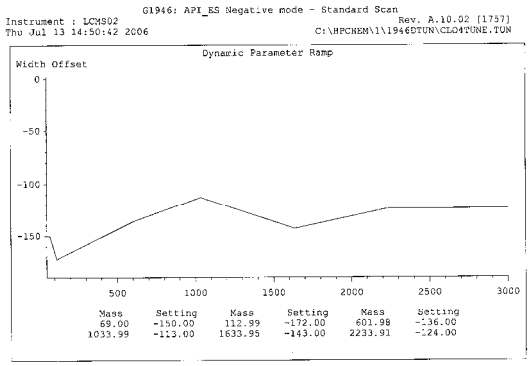
Additional Requirement	Corrective Action	Acceptance Criteria	Frequency
Interference Check Sample at the RL consisting of 2000 mg/L of Chloride, Carbonate and Sulfate	**Correct problem a reanalyze samples** **If reanalysis is unsuccessful, apply Q flag to all sample results for Perchlorate**	**± 30%**	**One per preparation Batch or analyzed daily whichever is more frequent.**
Low Level CCV (LODV) – A low level calibration standard at approximately 2 times the detection limit (Concentrations equivalent to 0.1 ug/L for Water and 1.0 ug/Kg for Soil)	**For perchlorate results between LOD and RL reanalyze all samples to last acceptable LODV.** **If LODV fails a second time apply Q flag to all sample results since last acceptable LODV.**	**± 30%**	**After every 10 samples as per section 5.5**

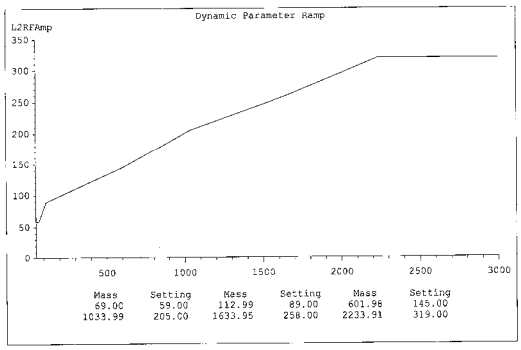
Appendix B
Example of Manual Tune for Perchlorate











DATACHEM LABORATORIES, INC.

STANDARD OPERATING PROCEDURE APPROVAL SHEET

SOP TITLE: Sample Receipt and Log-In (Environmental)

DOCUMENT CONTROL NUMBER: QS-DC-001 – Revision 14

EFFECTIVE DATE: October 2, 2006

APPROVALS:

MANAGER _____ Date _____

QA MANAGER _____ Date _____

LAB DIRECTOR _____ Date _____

STANDARD OPERATING PROCEDURE

SAMPLE RECEIPT AND LOG-IN (ENVIRONMENTAL)

1.0 SCOPE

1.1 DataChem Laboratories (DCL) Sample Receipt and Log-in procedures provide direction for documenting the condition of a sample shipment and for creating and maintaining a strict chain-of-custody for each sample. Direction is also provided for the initiation of laboratory sample tracking procedures.

1.2 This SOP addresses the requirement of NELAP 5.13f, ensuring client confidentiality of final results via transmission utilizing telephone, telex, facsimile, or other electronic or electromagnetic means. The DCL staff shall follow the procedures documented in this Standard Operating Procedure (SOP) and section 1.5 of the Quality Assurance Program Plan (QAPP) to meet this standard and preserve confidentiality.

1.3 This SOP is applicable to environmental and radiological samples.

1.4 An additional SOP, QS-EP-100, "EPA Sample Receipt and Logging," has been developed to address specific receipt and log-in requirements for EPA samples.

2.0 RESPONSIBILITY

2.1 The Sample Receipt Technician or designee is responsible for the receipt and logging of samples received at DCL.

2.2 The Radiation Safety Officer (RSO) is responsible for training Sample Receipt personnel in correct procedures for receipt of radiological samples.

2.3 The assigned DCL Project Manager is responsible for submitting a Project Protocol Worksheet (PPW) for each project to sample receiving personnel. This shall be done preferably before samples arrive at the laboratory, but at least within 24 hours following receipt. The PPW shall include precise and complete instructions pertaining to parties authorized to receive final results via any means. Any subsequent request for client results by unauthorized parties shall require written permission from the authorized client representative.

3.0 SAMPLE RECEIPT PROCEDURES (STANDARD)

3.1 Sample Receipt personnel must wear a laboratory coat, safety glasses, and protective gloves while unpacking and handling samples.

3.2 Upon delivery of shipping coolers to DCL, the Sample Receipt Technician receives the shipping coolers and examines them to document whether they arrived in acceptable condition. After a visual inspection, the custodian checks the coolers against the shipping documentation to determine whether the appropriate number of shipping coolers was

delivered. Monitors are present in the sample receipt area to detect levels of radiation as described below.

3.2.1 Coolers that register an activity dose rate of <.05 mR/hr or <5 x background are received following the nonradioactive procedures outlined in sections 3.3 – 3.10 of this SOP.

3.2.2 Coolers labeled "Radioactive" or that register an activity dose rate of >.05 mR/hr or >5 x background are received following the procedures outlined in section 4.0 of this SOP.

3.2.3 If DCL was not notified by the client to expect radioactive samples, the Sample Receipt Technician shall notify the cognizant DCL Project Manager of the measured activity dose rate of the cooler. The Project Manager contacts the client to obtain information concerning the samples.

3.2.4 If a cooler registers a dose rate >0.5 mR/hr, the Sample Receipt Technician shall notify the RSO and the DCL Project Manager immediately. Do not open this cooler.

3.3 The Sample Receipt Technician must assign a unique consecutive number to each shipping cooler. This number is used to track the condition of the shipping cooler and temperature and condition of the samples contained in each shipping cooler. The cooler number is recorded in a cooler number logbook to ensure there are no duplications of the cooler number; the number is also recorded on the DCL Client-Related Information Report (CRIR).

3.3.1 The Sample Receipt Technician shall, when applicable, sign, date/time, and mark as received, the air bill accompanying the cooler(s).

3.3.2 The Sample Receipt Technician shall include a hard copy of any email from after hours delivery as specified in section 6.1 of this SOP.

3.4 The Sample Receipt Technician shall complete a CRIR for each client's samples received in one shipment and record the following information:

- Client name
- Project/Task/Site (if available)
- Time/Date of receipt
- Number of coolers received
- Condition of the custody seals, coolers, ice, and samples
- Cooler temperature and location where the temperature was taken
- Activity of coolers
- pH as applicable (see Table 1)
- Residual chlorine check (Methods 8270C, 8310, 8081, 8151, and 8330)

NOTE: One report can be used for up to nine coolers from an individual client.

3.5 The cooler must be opened in a hood in the sample receiving area. The temperature is taken using a calibrated thermometer. Record on the CRIR the reading indicated on the

thermometer, whether a temperature control was present, and the conditions of the ice in the cooler. If no control is provided, record the average temperature of the samples. The temperature requirements are 2 °C – 6 °C. If any cooler temperature is not within project-specific guidelines, the temperature is indicated on the CRIR along with the client ID numbers of the affected samples (if there is more than one cooler in the shipment).

3.6 The Sample Receipt Technician removes the enclosed documentation from the shipping cooler and checks the sample containers received against the field chain-of-custody document(s) to note discrepancies. Discrepancies are noted in the *Problem* section of the CRIR.

3.7 The Sample Receipt Technician signs the field chain-of-custody in the appropriate *Received by* section and inserts the date and time of receipt.

3.8 The Sample Receipt Technician inspects the sample containers and records whether any samples are broken, leaking, or unacceptable. Also, pH is checked using narrow-range pH paper (see Table 1). Results are recorded on the CRIR.

3.8.1 pH Procedure

3.8.1.1 Place the liquid sample in a hood, mix well, and unscrew the cap. Pour a small aliquot into a disposable plastic beaker. Place a small piece of appropriate narrow-range (1 – 7 or 7 - 14) pH paper in the beaker and compare the color to the posted color chart. Acceptable pH ranges vary according to the required analysis. Refer to Table 1 for the correct range for each type of sample. If the pH is out of range, note the sample number and approximate pH on the CRIR.

3.8.2 Residual chlorine procedure (Methods 8270C, 8310, 8081, 8151, and 8330)

3.8.2.1 Place the liquid sample in a hood, mix well, and unscrew the cap. Pour a small aliquot into a disposable plastic beaker. Place a residual chlorine test strip in the beaker and verify the presence/absence of residual chlorine. If residual chlorine is present, note the sample number and record the problem on the CRIR.

3.8.3 VOA Headspace

3.8.3.1 Visually inspect all VOA bottles for headspace (air bubbles). Any VOA sample with air bubbles greater than 0.5 cm in diameter shall be noted on the CRIR. Determination of headspace is a visual estimation using 0.5 cm as an approximate value and not an exact measurement. A handy visual criterion is a comparison to the size of a pea.

3.9 If problems are noted, the Sample Receipt Technician makes a copy of the CRIR.

3.9.1 The original is given immediately to the cognizant DCL Project Manager, who contacts the client for resolution.

3.9.2 The Project Manager returns the original report to the Sample Custodian, with directions for handling the problems, within 24 hours of report receipt so that samples can be processed in a timely manner.

3.9.2.1 If sample preservation is required by the client the appropriate reagent identification will be recorded on the CRIR in the section labeled "BRIEFLY DESCRIBE THE PROBLEM AND THE ACTION TAKEN".

3.9.3 If no discrepancies are found, the original CRIR is filed with the field chain-of-custody document(s).

3.10 Upon completion of the inspection process, the samples are placed in the appropriate refrigerator.

3.10.1 Samples including potential gasoline and diesel contamination samples, with the exception of volatiles, are placed on a laboratory cart in refrigerator R-33-1.

3.10.2 Volatile samples are placed in a designated refrigerator within the VOA lab along with storage blanks (when required). See SOP XX-EP-200 Section 7.1.3.

4.0 SAMPLE RECEIPT PROCEDURES (RADIOLOGICAL)

4.1 Any samples designated as radioactive by project management on the PPW or by the RSO on the "Authorization for Radioactive Sample Receipt" or any cooler labeled "Radioactive" or registering an activity dose rate of >.05 mR/hr or >5 x background must be received under the radiological sample receipt procedures.

4.1.1 The Sample Receipt Technician must immediately inspect the coolers to ensure that they are not damaged or leaking.

4.1.1.1 Upon detecting a damaged or leaking cooler, the Sample Receipt Technician detains the delivery carrier and summons the RSO or designee to perform removable contamination surveys.

4.2 The Sample Receipt Technician places the un-opened coolers or containers in the radiation laboratory.

4.3 The radiological sample receiving personnel must complete the proper documentations as required for environmental samples specified in this SOP or the DCL SOP IH-GL-006 for industrial hygiene samples.

4.4 If the samples require radioactive materials inventory tracking (RMITS) as designated by the radioactive sample approval procedures, See DCL SOP WA-DC-002, a copy of complete paperwork will be given to the RSO.

5.0 SAMPLE LOG-IN PROCEDURES

5.1 For long-term projects, the original PPWs are filed alphabetically in the Sample Receiving area.

5.2 The Sample Custodian assigns a unique DCL identification number to each of the samples. The DCL sample number is recorded on the field chain-of-custody adjacent to the corresponding client ID number.

5.2.1 The DCL identification numbers are stream-specific alphanumeric numbers and are assigned sequentially in increasing order.

5.2.2 The DCL sample identification numbers are printed on labels with unique alphanumeric numbers and client ID numbers. They are affixed to the sample container without covering up vital information. This step provides verification of samples received.

5.2.3 DCL identification numbers and client sample numbers are also recorded on the DCL chain-of-custody form.

5.3 The Sample Custodian initiates the DCL chain-of-custody document(s) and a DCL work order. This is accomplished by entering data from the field chain-of-custody into the computer to generate the forms.

5.4 After completing the DCL chain-of-custody, a different Sample Technician or designee visually and electronically compares the field chain-of-custody and PPW with the DCL chain-of-custody for the following items:

- Client data (e.g., PPN, rush/non-rush, due date)
- Date/Time sampled
- Field ID numbers and DCL numbers
- Site ID/Customer ID (IRDMIS information if applicable)
- Types of analyses or analytes requested
- Number of bottles submitted per analyte for each sample
- Disposal Information: If Project Management permission is required prior to disposing of Field Samples, the chain-of-custody will be stamped in the upper right hand corner indicating "Disposal Permission Required".

5.4.1 If an error is noted, the paperwork is immediately corrected.

5.4.2 Upon completion of verification, the person doing the verification initials and dates the *Verified* section of the DCL chain-of-custody.

5.4.3 After electronic verification is completed for the entire sample set, a pre-invoice is generated and given to the Project Manager.

5.5 The DCL sample labels are applied to the pertinent bottles.

5.5.1 Ensure that DCL labels are verified against client sample numbers and are placed on the correct bottles in a location as close as possible to the client ID without covering any vital information on the original bottle label.

5.6 The samples are placed on the shelves in the appropriate refrigerator (R-33-1, or R-24-2).

5.7 The Sample Receipt Technician signs the DCL chain-of-custody in the first *Relinquished by* space, including the date, time, and storage location.

5.8 A copy of the completed and verified DCL chain-of-custody is made to accompany the work order and filed with the original field chain-of-custody and air bill in a central location in the Sample Receiving area.

5.9 The Sample Receipt Technician files the following documentation in the analyst file cabinet located in Sample Receipt.

- DCL Chain-of-Custody (original)
- PPW (copy)
- Field Chain-of-Custody (copy – for IRDMIS sets only)
- DCL Cooler Receipt Checklist (copy – only if a problem is noted on the CRIR)

6.0 AFTER-HOURS, HOLIDAY, AND SATURDAY SAMPLE RECEIPT

6.1 The responsible party shall perform the following sample receiving activities:

6.1.1 Perform **visual** inspection of container and contents only for items specified on the CRIR (Exhibit 7.2) for any anomalous conditions.

6.1.2 Immediately upon opening, perform temperature reading of interior of container.

6.1.3 Remove any water, ice, or packing material from container.

6.1.4 Review all paperwork submitted with the samples and sign any Chain of Custody (CoC) documents, making sure all samples listed on the CoC are accounted for.

6.1.5 Document receipt by sending an email to all pertinent project managers, sample receiving, and operations managers detailing items 6.1.1, 6.1.2, any anomalies from 6.1.4 and any additional appropriate information pertaining to the deliveries.

6.1.6 Samples and appropriately signed submittal paperwork are left in shipping containers and placed in the walk-in cooler in sample receipt area (R-33-1).

6.2 Receipt of samples known or suspected to be potentially radioactive must be coordinated in advance with trained and qualified personnel available to process the receipt of these samples. If samples known or suspected to be potentially radioactive are delivered without prior arrangement, the containers are to be placed, unopened, in the area designated for such samples. Notification is then to be made via telephone and email to the responsible project manager and operations manager. No further action is to be taken.

6.3 On a project specific basis, other project specific requirements for sample receipt may be performed if requested by the client through instructions given by the project manager. These task may include but not limited to: chemical preservation, COC procedures, storage requirements, paperwork, CRIR completion and sample sorting.

7.0 EXHIBITS

7.1 Example Project Protocol Worksheet

7.2 DataChem Laboratories Client-Related Information Report (CRIR)

7.3 DataChem Laboratories Chain-of-Custody

7.4 Sample Work Order

7.5 Radiological Survey and Screening Report

7.6 Action Levels Pertaining to Surveys Performed upon the Receipt of Radioactive Material(s)

TABLE 1. PRESERVED WATER SAMPLES FOR PH CHECK UPON RECEIPT

Analyte	pH
Metals	< 2
Cyanide	> 12
Sulfide	> 9
Ammonia	< 2
Total Phenolics	< 2
TPH – Method 418.1	< 2
COD	< 2
TKN	< 2
NO_3/NO_2	< 2
Oil & Grease	< 2
Total Phosphorus	< 2
TOC	< 2
Gross A/B, Gamma Spec	< 2

EXHIBIT 7.1
PROJECT PROTOCOL WORKSHEET EXAMPLE

DATA CHEM LABORATORIES, INC.
A SORENSON COMPANY

PROJECT PROTOCOL WORKSHEET
FAX -- YES/NO
Final by: FedEx/USPS

PPN:

Project Name:
Contract/PO#:
Account: 08001
Site ID:
Set Info:
Billing ID:

Project Manager: [ext]
e-Mail: Aurum -- Tigger
Sample Stream: E
Disposal Code: R-D-30R-N
MW Screen:

MS/MSD/MD: CLIENT/DCL/METHOD
Solids: NONE/TOTAL/MOISTURE
Reporting Basis: AS RECEIVED/DRY
Batch with other clients samples: YES/NO
Report TICs: N/A
Detection Limits: DCL /CLIENT
QA/QC Requirements: METHOD/CLIENT

Client Contact:
Name-
Company-
Street-
City/State-
Telephone- ()
Fax- ()

Invoice Contact: Same

Bill for field samples only: YES (plus MS/MSD)

Type of report:

Report by: Fraction/Set/SDG
Case Narrative: YES/NO
Raw Data: YES/NO
No. of copies: 1

Prep, Analysis and Reporting:

Sample Receipt Instructions:

Parameter	Matrix	Units	Sec. Code	Inst. Code	DCL SOP or Method	Analyte List	Hold Code	Verbal TAT	Mail TAT	Analyte Group	Price Code

EXHIBIT 7.2
DCL CLIENT-RELATED INFORMATION REPORT (CRIR)

DATACHEM LABORATORIES CLIENT-RELATED INFORMATION REPORT (CRIR)

COOLER OR CONTAINER INFORMATION CHECKLIST (Fill In or Circle)

Client Name: _____ Project/Task/Site: _____

Date/Time of Receipt: _____ Number of Coolers Received: _____

Condition of Coolers:	Acceptable/Unacceptable	Temperature Control:	Present/Not Included
Custody Seals:	Present/Absent/NA	Location Temp Taken:	Control/Between Samples
	Intact/Broken/NA	Are all temperatures within	
Tamper Evident:	Yes/No/NA	project specific guidelines?	Yes/No/NA
Ice Present:	Yes/No/NA	Are all applicable pHs within	
	Frozen/Melted/NA	specific guidelines?	Yes/No/NA

pH Check Performed:	Metals	Yes/No/NA	Total Phenolics	Yes/No/NA	NO3/NO2	Yes/No/NA
	Cyanide	Yes/No/NA	TPH – 418.1	Yes/No/NA	Oil & Grease	Yes/No/NA
	Sulfide	Yes/No/NA	COD	Yes/No/NA	Total Phosphorous	Yes/No/NA
	Ammonia	Yes/No/NA	TKN	Yes/No/NA	TOC	Yes/No/NA
Residual Chlorine Check Performed:	8270	Yes/No/NA	8310	Yes/No/NA	8330	Yes/No/NA
	8081	Yes/No/NA	8151	Yes/No/NA		

Cooler Received	DCL Cooler No.	Temp.	Cooler Received	DCL Cooler No.	Temp.	Cooler Received	DCL Cooler No.	Temp.
1	C05 -	°C	4	C05 -	°C	7	C05 -	°C
2	C05 -	°C	5	C05 -	°C	8	C05 -	°C
3	C05 -	°C	6	C05 -	°C	9	C05 -	°C

Taken By: _____ Signature _____ Printed Name _____ Date

CLIENT-RELATED INFORMATION

☐ Missing Cooler	☐ Missing Samples/Bottles	☐ Incorrect Preservation	☐ Insufficient Sample Volume
☐ Cooler Conditions	☐ Broken/Leaking Samples	☐ pH Criteria Not Met	☐ Chain of Custody Problems
☐ Missing Paperwork	☐ Incorrect Bottle Type	☐ Residual Chlorine Present	☐ Other:
☐ Missing/Incorrect Bottle Labels	☐ Cooler Temperatures Out of Range	☐ Head Space in Bottles	EPA Custody Seal:

BRIEFLY DESCRIBE THE PROBLEM AND THE ACTION TAKEN:

Faxed to Client? YES ☐ NO ☐ (if yes, attach Fax Cover Sheet)

Response Required Within 24 Hours

PROJECT MANAGEMENT

PROJECT MANAGER COMMENTS:

DCL Project Manager: _____ Printed Name Returned to Sample Receipt by: _____ Signature Date: _____

Earliest Sampling Date:

DataChem Laboratories
CHAIN-OF-CUSTODY

DISPOSAL PERMISSION REQUIRED

Page 1 of

Results due by:

Project/Job/Task: | *Split:* | **Root Set ID:** | **Reporting Group**

Client: | **Account:**

Comments:

Verified:

Analysis

Date Sampled	Field ID Number	DCL Sample Name	DCL Sample ID	QC	Matrix	Customer ID 2														# Bottles

ORIGINAL FIELD SAMPLE CHAIN-OF-CUSTODY

Relinquished By: (Signature)	Date/Time	Received By: (Signature)	Reason for Transfer/ Storage Location
Walk-in/ Room/ Shelf/ Fridge			

SAMPLE PREPARATION / ANALYSIS CHAIN-OF-CUSTODY

Sample Prep/Analysis for: ______ Lab Notebook No.: ______

Prepared/Analyzed by: ______ Date/Time: ______

Relinquished By: (Signature)	Date/Time	Received By: (Signature)	Reason for Transfer/ Storage Location

Check box if there is a continuation page ☐

Form: COFC1.01-SWV2.30

Printed

EXHIBIT 7.4
SAMPLE WORK ORDER

Sample Work Order

QC Clearance: _____
Project Manager:
Client:
Account: **SDG:**
Project/Task:
Date Received:
Date for Mailing Report:

DCL Root Set ID:
DCL Lab. Name:
Total # Samples:
Sample Entry:
Section:
Earliest Sampling Date:
Preparation Type:

Rep. Group	Environmental Inorganic. Analytes Requested	Latest Prep. Date	Latest Anal. Date	No. of Samp.	Storage Location	Analysis/Prep. Method	Inst.	Matrix
01								
02								

Special Instructions: _____

Section Manager:

Other Sections Receiving Sample Portions:

DataChem Laboratories/ 960 West LeVoy Drive / Salt Lake City, Utah 84123

Form: WO1.04-SWV2.12 PRINTED 4/14/1999 14:46

EXHIBIT 7.5
RADIOLOGICAL SURVEY AND SCREENING REPORT

RADIOLOGICAL SURVEY AND SCREENING REPORT

To be filled in by Sample Receiving

DCL Set ID Number _____ Account Number _____

Client _____ Number of Shipping Containers _____

(use additional forms if greater than 3 containers are received)

Shipping Container	Activity (mR/hr) Contact	1 Meter	Comments
(1)			
(2)			
(3)			

Shipping Container	DCL Sample Numbers	Activity (mR/hr) Contact	Comments

Survey Instrument Type _____ Survey Instrument ID _____

_____
Signature/Date

To be filled in by the Radiochemistry Laboratory

Primary Isotope(s) _____

Activities

DCL Sample Numbers	Alpha (pCi/g)	Alpha (pCi/sample)	Beta (pCi/g)	Beta (pCi/sample)	Total α+β (pCi/g)	Gamma (pCi/sample)	Mass (g)	Category

_____
Signature/Date

To be filled in by the RSO or Designee (Above) DCL Sample Category (I, II, or III)

_____
Signature/Date

EXHIBIT 7.6
ACTION LEVELS PERTAINING TO SURVEYS PERFORMED UPON THE RECEIPT OF RADIOACTIVE MATERIAL(S)

INITIAL SURVEY

INSTRUMENT: Portable dose rate survey meter (Ludlum Model 19, Eberline Model RO-3C).

APPLICATIONS: Survey the following:
1. Any package displaying "Radioactive I" or "Radioactive II" labels
2. Any package that has potential to exhibit radioactivity, as indicated by labeling, paperwork, or origin of shipment

ACTION LEVELS:
1. Above background reading at external surface of package or container:
   - Record readings in logbook.
2. ≥ 0.5 mR/hr at external surface of package:
   - Notify RSO or designee to check for proper labeling.
3. ≥ 0.1 mR/hr at external surface of individual sample container:
   - Notify RSO or designee to handle samples.

WIPE TESTS

INSTRUMENT: Ludlum Model 2929 Dual-Channel Scintillation Counter

APPLICATIONS: Wipe test the following:
1. Any package displaying "Radioactive I" or "Radioactive II" labels
2. Any package that induced a significant response (i.e., 5 x background) on the portable survey meter
3. Any damaged package that has potential to exhibit radioactivity, as indicated by labeling, paperwork, or origin of shipment.

ACTION LEVELS:
1. > 20 dpm (alpha) or > 200 dpm (beta/gamma), above background, removable contamination per 100 cm^2:
   - Decontaminate in accordance with R.S. 11.0 until below the action level on the next wipe. If unable to decontaminate below the action level, place in a sealed bag and label "CONTAMINATION."
2. 22,000 dpm above background, removable contamination per 100 cm^2, where:

$$\text{dpm} = \frac{\text{Gross cpm} - \text{cpm (bkg)}}{\text{efficiency}}$$

   - Notify the following:
     1. RSO and Safety personnel (ext. 366)
     2. Final delivering carrier
     3. Utah Division of Radiation Control (538-6734)
     4. Nuclear Regulatory Commission, Regional Office (Region IV) at (817) 860-8100

IMPORTANT:

1. The preceding wipe tests must be performed within three hours of package receipt during normal working hours (8:00 a.m. to 5:00 p.m.), and within 18 hours of receipt during the evening/graveyard shifts. Packages received during weekends or holidays must be screened within the first three hours of the first work day following that weekend or holiday.
2. Enter all readings in the survey logbook. Submit "Radiological Survey and Screening Report," along with sample weight and client supplied data, to the RSO or designee for categorization of samples.

Revised 11/03/00

DATACHEM LABORATORIES, INC.

STANDARD OPERATING PROCEDURE APPROVAL SHEET

SOP TITLE: Chain-of-Custody and Laboratory Tracking

DOCUMENT CONTROL NUMBER: XX-DC-006 – Revision 6

EFFECTIVE DATE: December 1, 2002

APPROVALS:

MANAGER _____ Date _____

QA MANAGER _____ Date _____

LAB DIRECTOR _____ Date _____

STANDARD OPERATING PROCEDURE

CHAIN-OF-CUSTODY AND LABORATORY TRACKING

1.0 SCOPE AND APPLICATION

1.1 This Standard Operating Procedure (SOP) describes the origination, responsibilities, tracking, and documentation of the chain-of-custody.

1.2 Procedures provided in this SOP are followed for environmental samples received at DataChem Laboratories (DCL). Additional project-specific instructions might be necessary and are provided in project-specific SOPs and as part of the Project Protocol Worksheet (PPW).

1.3 Environmental samples and their subsequent preparations are physical evidence in client enforcement actions. DCL shall provide documentation of the transfer of custody of samples (and/or subsequent preparations when required) from one person to another from the time of sample receipt through final sample disposition.

1.4 If permission is required from Project Management for final disposition of the sample, instructions will be given on the PPW and the chain-of-custody will be stamped on the upper right hand corner with "Disposal Permission Required".

2.0 DEFINITIONS

2.1 **Custody** is defined in the following ways in reference to a sample or a sample preparation:

2.1.1 It is in your actual possession.

2.1.2 It is in your view after being in your physical possession.

2.1.3 It was in your possession or in a designated secure storage area. The entire DCL facility is considered a secure area.

2.1.4 It is in a secured storage area designated to receive custody for the purpose of storage during transfer.

2.1.5 During sample preparation, sample custody is tracked in appropriate preparation logbooks, copies of which are included in final data packages. While samples are being processed custody is maintained by the person whose signature appears last in the preparation logbooks.

2.1.6 During sample analysis samples or sample preparations in an autosampler (preparatory to being introduced into an analytical system) remain in the custody of the analyst who last signed the chain-of-custody.

2.2 **Chain-of-Custody** is used to document physical transfers of field sample(s) and subsequent preparations throughout the laboratory.

2.3 **Preparation Holding Time** – The time period in which sample preparation must be completed (e.g., 7 days).

2.4 **Preparation Deadline** (the holding time expires) – This is the *date* by which the samples must be prepared before the hold time expires (e.g., December 15, 2001).

2.5 **Analysis Hold Time** – The time period in which sample analysis must be completed (e.g., 40 days).

2.6 **Analysis Deadline** (the hold time expires) – This is the *date* by which the samples must be analyzed before the hold time expires (e.g., March 20, 2001).

2.7 **Sample Preparation** – A sample that has been extracted, digested, or leached producing an extract, digestate, or leachate of the original sample.

2.8 **Aliquot** – A portion of a sample that has been dispensed from the original sample into separate fractions.

2.9 **Sample** – Client submitted, or generated within DCL. Various matrices to be analyzed for known or unknown compounds or analytes. Various types include field or QC type samples.

3.0 RESPONSIBILITY

3.1 It is the responsibility of each person having custody of environmental samples or their subsequent preparations to ensure that custody is maintained and that the appropriate laboratory tracking documentation is maintained for each transfer of custody.

3.2 It is the responsibility of the Sample Custodian or designee to initiate the DCL Chain-of-Custody form for each field sample as part of the sample log-in procedure. (Refer to DCL SOP QS-DC-001, "Sample Receipt and Logging," for sample log-in procedures.)

3.3 It is the responsibility of the authorized sample preparation individual to document the tracking of the field sample on the chain-of-custody or appropriate custody logbook.

3.4 It is the responsibility of the analyst to document transfers subsequent to sample preparation and include all custody documentation in the data package.

3.5 It is the responsibility of each project manager to supply a Project Protocol Worksheet (PPW) to sample receiving personnel. Samples will not be processed until sample receiving personnel have been given a PPW.

4.0 DETAILED OUTLINE OF AND INSTRUCTIONS TO GENERATE THE DATACHEM LABORATORIES CHAIN-OF-CUSTODY FORM

4.1 At the time of sample log-in at the DCL facilities, a laboratory chain-of-custody form must be generated by sample receiving personnel. This chain-of-custody may either be hand-entered on a blank chain-of-custody or electronically generated after all client and DCL information has been entered into the computer system.

4.1.1 It is the responsibility of sample receiving personnel to sign "Received" on all customer chain-of-custodies as soon as the samples have been verified as received. A Client Related Information Report is complete for each cooler. Any discrepancies between the client chain-of-custody and samples received will be documented on this form. This will be sent to the project manager for resolution prior to log-in. As necessary, these samples can then be relinquished on this chain-of-custody to a secure storage area in the laboratory. For example, the following may be written in a "Received By" box: Sample Control Group R-23 with the sample custodian's initials.

4.1.2 When sample control personnel receive a client chain-of-custody that has not been relinquished to the Sample Control Custodian or designee or a courier (i.e., Federal Express, UPS, etc.), the custodian must sign for the person who did not relinquish the samples (e.g., H. Lynch for M. Smith). The Sample Control Custodian must also receive the samples by signing, dating, and including the current time in the "Received By" box and initiating a Client Related Information Report (CRIR).

4.1.3 If a courier such as Federal Express has been used to deliver the samples to DCL, the air bill (when available) must also be signed "Received" by sample receiving personnel. The air bill number must be documented on the client chain-of-custody; if not documented, the Sample Control Custodian must record the number on the client chain-of-custody. It might also be necessary to relinquish the samples on the client chain-of-custody from the courier to the Sample Control Custodian. This is accomplished by writing the name of the courier (i.e., FED EX, UPS, etc.) in the "Relinquished By" box on the client chain-of-custody and then signing in the "Received By" box.

4.2 Refer to Exhibit 1 with highlighted "section" numbers for easier reference. Sections 1 through 20 are completed by sample receiving personnel.

4.3 **Section 1** documents the earliest collection date of samples recorded on the chain-of-custody. From this date, analysts are responsible to determine hold times and deadline dates.

4.4 **Sections 2 through 10** document the information provided by the client, project manager, or sample receiving personnel for a group of samples. These are the records that identify the set.

4.4.1 **Section 2** identifies the Project/Job/Task/Site for the set. This information is provided by the project manager on the Project Protocol Worksheet (PPW) and is entered by sample receiving personnel.

4.4.2 **Section 3** is the DCL Set ID number. The Set ID number is generated at the time of sample log-in by sample receiving personnel and uniquely identifies a group of related samples.

4.4.3 In **Sections 4 and 5**, the client who has requested the analysis and the client's DCL account number are documented. The appropriate account number for a specific project is provided by the project manager in the PPW.

4.4.4 **Section 6** is the comment section for sample receiving personnel. This section is filled out with any additional information pertaining to the set.

4.4.5 **Section 7** is for the initials of the person and date when the chain has been visually or electronically verified. Visual verification can be done by anyone in the laboratory who did not enter the client and DCL information originally into the computer system. The purpose of verification is to ensure that the DCL chain-of-custody information matches the client chain-of-custody and that all DCL-assigned information is correct. Electronic verification is done by trained personnel only.

4.4.6 **Sections 8** and **9** are the client's first and second field identification numbers, respectively. These numbers correspond to the numbers on the sample bottle and the client chain-of-custody. (Note: A second client identification number is not always provided.)

4.4.7 **Section 10** is the matrix of the set (i.e., water, soil, sludge).

4.4.8 **Section 11** indicates the date the sample was collected in the field.

4.5 Sections 12 through 20 document sample information generated by DCL.

4.5.1 **Section 12** is DCL's identification sample number, which is assigned by sample receiving personnel. This number corresponds with the number on the DCL label on the sample bottle. This number is assigned to track the individual sample throughout DCL.

4.5.2 **Section 13** indicates the samples the client requires for a specific QC (i.e., matrix spike, matrix duplicate, or matrix spike duplicate). The appropriate acronym is found following the DCL identification number (Section 11) and in the QC box. (For example: matrix spike = MS, matrix duplicate = MD, and matrix spike duplicate = MSD.)

4.5.3 **Section 14** is the reporting group of the set. These numbers are generated sequentially. Only one reporting group is assigned per analysis.

4.5.4 **Section 15** documents the different types of analyses performed on a set of samples. For example: ICP METALS, ICP TRACE METALS, AND MERCURY.

4.5.5 **Section 16** identifies which analysis is required for which sample. Each box marked will indicate which analysis will be performed on each sample.

4.5.6 **Section 17** indicates the total number of bottles per sample that are available for this chain-of-custody.

4.5.7 **Section 18** indicates the number of pages in the original DCL chain-of-custody, "Page __of __." This is required in case a page is separated from additional pages. The analyst should verify that all chain-of-custody pages are present when receiving the chain-of-custody. If a page or the entire chain-of-custody is lost, the

analyst must request a regenerated copy from sample receiving personnel. However, all original dates and signatures, as well as the date of the chain-of-custody regeneration, must be clearly documented.

4.5.8 **Section 19** displays the date when the report for the samples on the chain-of-custody is to be mailed to the client. This is not a verbal date.

4.6 Sections 20 through 22 document the actual tracking of the original field sample throughout the laboratory.

4.6.1 All original field sample transfer documentation that occurs at DCL must be recorded on the chain-of-custody in **Section 20**. Refer to Section 6.0 of this SOP for relinquishing and receiving an original field sample. Section 20 also tracks the "Reason for Transfer/Storage Location" of the original field sample.

4.6.1.1 A Sample Control Custodian will fill in the first two lines of this section by relinquishing the samples to the secure storage area, with the shelf number where they can be found, in the "Reason for Transfer/Storage Location" in the last column.

4.6.2.4 **Section 21** records all transfers of the leachate, digest, or extract of the field sample. Refer to Section 7.0 for transfer procedures.

4.6.3 **Section 22** is completed by the last person filling out the chain-of-custody or by the person who requires extra signature space by checking the box. If the box is marked, a continuation chain-of-custody must be generated. Refer to Section 5.0 for continuation chain-of-custody procedures.

4.7 **Section 23** will designate "Disposal Permission Required" when designated as part of the PPW by Project Management. Stamp will be affixed to the chain-of-custody by sample receiving personnel at time of log-in.

5.0 DETAILED OUTLINE OF THE CONTINUATION CHAIN-OF-CUSTODY FORM

5.1 The Continuation Chain-of-Custody (Exhibit 2) is used when all the signature boxes are filled on the original chain-of-custody and a transfer is necessary, but no space is available. The form is not to be used for correcting the original chain-of-custody.

5.2 When all signature boxes are completed and a transfer is necessary, the person transferring the samples must generate a Continuation Chain-of-Custody form. The forms are available from the DCL Quality Assurance Officer.

6.0 PROCEDURES FOR TRANSFERRING CUSTODY

6.1 Sample Receiving Transfer Procedures

6.1.1 Sample receiving personnel must either transfer samples directly to a person or to a designated secure area for sample storage.

6.1.2 The placing of samples in a secure area is documented on the chain-of-custody by the Sample Receiving Custodian as follows:

6.1.2.1 Section 20 – Relinquish the samples from the secure storage area they were placed in upon receipt by listing this storage area in the first available "Relinquished By" box and initialing in this box. In the next box write the date and time the samples are taken from the secure storage area. The sample custodian must then sign his/her name in the next "Received By" box and list the reason for taking the samples in the following box. After the sample custodian is finished with the samples, he/she must sign the next available "Relinquished By" box and write the date and time the samples are to be released back to a secure storage area. In the next "Received By" box list the storage area where the samples are to be placed and initial next to the storage area name. Finally, in the following box, write the shelf name (when applicable) where the samples can be found.

6.1.2.2 Analysts who receive samples from the secure storage area must relinquish the samples by documenting the storage area (e.g., R-23 or Room 24) in the next "Relinquished By" box, initial, date, record the time of receiving, then sign their name in the "Received By" box and document the "Reason for Transfer/Storage Location" (e.g., Hg prep/R-83). "Storage Location" refers to the secure area where samples will be kept while still in the individual's custody, but not in his immediate possession. If the samples will not be stored while in the individual's custody, "Hg prep" should be entered.

6.1.2.3 Samples may also be relinquished directly from the storage area they were placed in upon arrival at DCL to an analyst by following the procedures outlined in Section 6.1.2.2.

6.1.2.4 Samples may be directly transferred from the sample custodian (if the samples were never placed in a storage facility upon receipt) to an analyst by following the instruction in Section 6.2.

6.2 Direct "Person-to-Person" Transfer Procedures

6.2.1 For "person-to-person" transfer, the DCL chain-of-custody is signed by both parties in the transfer. The date and time must be recorded by the person relinquishing the samples. The "Reason for Transfer/Sample Location" must be recorded by the person receiving the samples.

6.2.2 For "person-to-secure area" transfer, the person must designate the name of the secure area (i.e., refrigerator number, etc.) on the chain-of-custody. Also, their initials must be written next to the secure area identification.

7.0 TRANSFER PROCEDURES

7.1 Long-Term Sample Storage (LTSS) Transfer Procedures

7.1.1 When original sample container(s) arrive at their designated Long-Term Sample Storage (LTSS) area, they must be accompanied by the original chain-of-custody.

7.1.2 The transfer of the sample from the custody of the individual to LTSS is documented on the original DCL chain-of-custody.

7.1.3 The transfer of custody is performed as follows:

7.1.3.1 Find a shelf location in LTSS (...). Write the shelf location on the upper right hand corner of the chain-of-custody.

7.1.3.2 Relinquish custody of samples with date and time and have samples received by LTSS. Place samples on the shelf.

7.1.3.3 File original chain-of-custodies alpha numerically by DCL set ID. The applicable file cabinets are located adjacent to the storage area.

7.1.4 Samples are stored in LTSS until disposed. Disposal is determined by specific contracts.

7.1.5 Samples are removed from LTSS by reversing the order of 6.1.2.2.

7.2 Repreparation Transfer Procedures

7.2.1 If sample(s) are required to be reprepared and have been transferred to Long-Term Sample Storage, the following procedure must be followed:

7.2.1.1 LTSS will relinquish all samples via the original chain-of-custody residing in LTSS. The analyst will receive the samples by dating, signing, and recording the reason for transfer/storage (e.g., Reanalysis of Hg/Walk-in) on the Chain-of-Custody. The chain-of-custody will follow the field samples back to LTSS.

8.0 GENERAL GUIDELINE PROCEDURES FOR ALL CHAIN-OF-CUSTODY DOCUMENTS

8.1 Chain-of-Custody documents must not be accepted/received with blank signature boxes or missing information. If it is observed that information is missing, the section manager of the section where the error occurred must be notified of the error, and the error must be corrected immediately by that section.

8.2 Crossed-out information that is correct must include a comment noting that the cross-out was made in error (e.g., "information is correct").

8.3 Signatures in wrong areas are to be crossed-out, initialed, and dated. Arrows **may not** be used to show where the signature should be.

8.4 The "Reason for Transfer"section must include the type of analysis, not simply "analysis," for example, "VOA analysis."

8.5 All chain-of-custody documents will be included in the data package.

9.0 FINAL SAMPLE DISPOSITION

9.1 When samples or sample preparations are eligible for disposal, criteria specified in DCL SOP EA-DC-002, "Processed Sample Storage and Disposal Control," must be applied.

10.0 CORRECTIVE ACTION PROCEDURES AND QUALITY CONTROL MONITORING

10.1 Erroneous data shall not be obliterated or erased.

10.1.1 Erroneous data may be lined through with a single straight line such that the erroneous data can still be read. Erroneous data may not be written over (e.g., writing a 6 over a 5).

10.1.2 All strike-outs must be dated and initialed by the person making them.

10.1.3 No correction fluid (e.g., "white-out") or correction tape may be used to correct information.

10.1.4 As appropriate for clarity and future reference, a three- or four-word explanation of why the information was lined through should be given with the strike-out (e.g., "signed on wrong line"). "Data not used" is **NOT** an acceptable notation.

10.2 All entries must be in permanent black ink. Pencil and other ink colors are not acceptable for record keeping.

10.3 All entries must be legible, dark, and distinct enough for clear photocopying.

10.4 Entries must be made at the time of the event being recorded.

10.5 Refer to QC-DC-006, "Nonconformance/Corrective Action Report (NC/CAR) Procedures," for procedures to document deviations.

10.6 Any deviations or incorrect recordings are to be corrected at the time of discovery. If the chain-of-custody is not correct as received, the data package and the chain-of-custody shall be routed to the cognizant manager. The manager is responsible to correct any deviations. If multiple managers are responsible, the chain-of-custody is routed to each appropriate manager, in logical order, for corrections. The set/lot will not be processed until the corrections have been made. Corrections are to be dated the actual date they are made with an explanation that they are made "after the fact." Example: A missing signature should be made and dated the actual date of signing with an explanation such as "signature signed August 14, 1990. Actual transfer occurred August 1, 1990."

11.0 REFERENCES

11.1 DCL SOP XX-EP-200, "Sample Storage and Security."

11.2 DCL SOP QS-DC-001, "Sample Receipt and Logging."

11.3 DCL SOP XX-EP-1210, "Chain-of-Custody and Laboratory Tracking."

11.4 DCL SOP EA-DC-002, "Processed Sample Storage and Disposal Control."

Earliest Sampling Date: *1*

Exhibit 1
DataChem Laboratories
Chain-of-Custody

23

DISPOSAL PERMISSION REQUIRED

Results due by: *19*

Project/Job/Task: *2*	*Split:*	Root Set ID: *3*	Reporting Group	*14*									#
Client: *4*		Account: *5*											
Comments: *6* Verified: *7*			Analysis		*15*								BOTTLES

Date Sampled	Field ID Number	DCL Sample Name	DCL Sample ID	QC	Matrix	Customer ID 2													
11	*8*	*12*		*13*	*10*	*9*							*16*						
																			17

ORIGINAL FIELD SAMPLE CHAIN-OF-CUSTODY				SAMPLE PREPARATION/ANALYSIS CHAIN-OF-CUSTODY Sample Prep/Analysis for:_____ Lab Notebook No.:_____ Prepared /Analyzed by:_____ Date/Time:_____			
Relinquished by: (Signature	Date/Time	Received by: (Signature)	Reason for Transfer/ Storage Location	Relinquished by: (Signature	Date/Time	Received by: (Signature)	Reason for Transfer/ Storage Location
			Labeling/Shelving				
		Walk-in/Room/Shelf/Fridge	Storage:				
	20				*21*		

Check box if there is a continuation page ☐ *22*

EXHIBIT 2

DataChem Laboratories

Continuation CHAIN-OF-CUSTODY

Page _____ of _____

HOLD TIMES (DAYS/DATE)

Preparation

Analysis

SDG/Batch #:

DCL Set ID:

Client: **Account:**

Comments: Continuation of Original Chain-of-Custody

DIRECTIONS: (1) Fill in header information exactly as written on the Chain-of-Custody which must be continued. (2) Sign the "Continuation Initiated by". (3) Check "YES" at bottom of Chain-of-Custody which must be continued. (4) Change pages ___ of ___ by single-line cross-out, initial, and date.

ORIGINAL FIELD SAMPLE CONTAINER(S) FOR ANALYSIS OF: _____

Continuation Initated by:

Date/Time/Signature _____ / _____

ORIGINAL FIELD SAMPLE CHAIN-OF-CUSTODY

Relinquished By: (Signature)	Date/Time	Received By: (Signature)	Reason for Transfer/ Storage Location

SAMPLE PREPARATION / ANALYSIS CHAIN-OF-CUSTODY

SAMPLE PREP /ANALYSIS FOR: _____ LAB. NOTEBOOK NO. _____

Prepared/Analyzed by _____ Date/Time _____

Relinquished By: (Signature)	Date/Time	Received By: (Signature)	Reason for Transfer/ Storage Location

Revised 04/03/92

DATACHEM LABORATORIES, INC.

STANDARD OPERATING PROCEDURE APPROVAL SHEET

SOP TITLE: Hazardous Waste Handling and Disposal

DOCUMENT CONTROL NUMBER: LAB-004 – Revision 3

EFFECTIVE DATE: October 31, 2005

APPROVALS:

SAFETY MANAGER _____ Date _____

QA MANAGER _____ Date _____

LAB DIRECTOR _____ Date _____

STANDARD OPERATING PROCEDURE

HAZARDOUS WASTE HANDLING AND DISPOSAL

1.0 INTRODUCTION

1.1 To protect human health and the environment from improper handling of hazardous wastes and to encourage conservation of natural resources, Congress, in 1976, passed the Resource Conservation and Recovery Act (RCRA). This law gave authority to the Environmental Protection Agency (EPA) to develop a national program to regulate hazardous waste from "cradle to grave", that is, from the time waste is generated to its final disposal. The EPA regulatory program came into effect May 19, 1980.

DataChem Laboratories (DCL) is a small quantity generator of hazardous waste and is subject to these regulations.

2.0 DEFINITIONS

2.1 *Generator* – A generator is anyone who disposes of a waste that is defined by the EPA to be a "hazardous waste". You are a generator if in your work at DCL you produce a hazardous product that you intent to discard. It is your responsibility to ensure that this waste is handled correctly as described in Part 4 of these instructions. Be aware that there are substantial civil and criminal penalties for any person, company, corporation, or association that improperly disposes of hazardous waste.

2.2 *Hazardous Waste* – **A waste is defined by the EPA to be hazardous if it meets any of the following:**

2.2.1 It is "a solid waste or combination of solid wastes* which, because of its quantity, concentration, or physical, chemical, or infectious characteristics may cause or significantly contribute to an increase in mortality, or an increase in serious irreversible or incapacitating illness, or may pose a substantial present or potential hazard to human health, or the environment when improperly treated, stored, transported, or disposed of, or otherwise managed."

2.2.2 It is included in lists of specifically identifiable compounds published by the EPA.

2.2.3 It is listed waste and is mixed with non-hazardous materials.

2.2.4 It has the characteristics of being ignitable, corrosive, reactive, or E.P. toxic (see Section 3 below) as defined by the EPA.

2.2.5 It is personally known to you to be hazardous based upon knowledge of the materials or processes used in producing the waste.

---

* A solid waste includes semisolid, liquid, or contained gaseous material.

3.0 CHARACTERISTICS THAT DETERMINE WHETHER A WASTE IS HAZARDOUS

3.1 Characteristics of Ignitability

3.1.1 It is a liquid, other than an aqueous solution, containing less than 24% alcohol by volume and having a flash point of less than 60 °C (140 °F).

3.1.2 It is not a liquid and is capable, under standard temperature and pressure, of causing fire through friction, absorption of moisture, or spontaneous chemical changes and when ignited burns so vigorously and persistently that it creates a hazard.

3.1.3 It is an ignitable compressed gas – any material or mixture having an absolute pressure in the container exceeding 40 p.s.i. at 70 °F, or any liquid flammable material having a vapor pressure exceeding 40 p.s.i. absolute at 100 °F.

3.1.4 It is an oxidizer – a substance such as chlorate, permanganate, inorganic peroxide, or a nitrate that yields oxygen readily to stimulate the combustion of organic matter.

3.2 Characteristics of Corrosivity

3.2.1 It is aqueous and has a pH less than or equal to 2 or greater than or equal to 12.5, as determined by a pH meter.

3.2.2 It is a liquid and corrodes steel (SAE 1020) at a rate greater than 6.35 mm (0.250 inch) per year at a test temperature of 55 °C (130 °F) as determined by the test method specified by the National Association of Corrosion Engineers.

3.3 Characteristics of Reactivity

3.3.1 It is normally unstable and readily undergoes violent change without detonating.

3.3.2 It reacts violently with water.

3.3.3 It forms potentially explosive mixtures with water.

3.3.4 When mixed with water, it generates toxic gases or vapors in a quantity sufficient to present a danger to human health or the environment.

3.3.5 It is a cyanide- or sulfide-bearing waste which, when exposed to pH conditions between 2 and 12.5, can generate toxic gases or vapors in a quantity sufficient to present danger to human health or the environment.

3.3.6 It is capable of detonation or explosive reaction if it is subjected to a strong initiating source or if heated under confinement.

3.3.7 It is readily capable of detonation or explosive decomposition or reaction at standard temperature and pressure.

3.3.8 It is a Class A, Class B, or Forbidden Explosive as defined in the code of *Federal Regulations* title 49 part 173.

3.4 Characteristics of EP (Extraction Procedure) Toxicity

A solid waste exhibits the characteristics of EP toxicity if, using the test methods described by the EPA, the extract from a representative sample of the waste contains any of the contaminants listed below at a concentration equal to or greater than the respective value given.

EPA Hazardous Waste Number	Contaminant	Maximum Concentration (milligrams per liter)
D004	Arsenic	5.0
D005	Barium	100.0
D006	Cadmium	1.0
D007	Chromium (VI)	5.0
D008	Lead	5.0
D009	Mercury	0.2
D010	Selenium	1.0
D011	Silver	5.0
D012	Endrin (1,2,3,4,10,10-hexachloro-1,7-epoxy-1,4,4a,5,6,7,8a-octahydro-1,4-endo, endo-5,8- naphthalene)	0.02
D013	Lindane (1,2,3,4,5,6-hexachlorocyclo-hexane, gamma isomer)	0.04
D014	Methoxychlor (1,1,1-Trichloro-2,2-bis (p-methoxyphenyl)ethane)	10.0
D015	Toxaphene (C10H10C18, Technical chlorinated camphene, 67-69 percent chlorine)	0.5
D016	2,4-D (2,4-Dichlorophenoxyacetic acid)	10.0
D017	2,4,5-TP Silvex (2,4,5-Trichlorophenoxypropionic acid)	1.0

3.5 A list of EPA hazardous materials and acutely toxic material can be found in 40 CFR Part 261

3.6 EPA Acute Toxic Materials

These materials may be accumulated at the point of generation (Satellite Accumulation point) under the direction and control of the person generating the wastes up to a maximum of one Quart. When or before, the maximum accumulation of one Quart is reached the materials must be transferred to the 180-day storage room for proper disposal.

4.0 PROCEDURE

4.1 Waste Profiles: The following procedures are used to determine a waste profile at DataChem Laboratories:

4.1.1 40CFR Part 262.11 states
"(c) For purposes of compliance with 40 CFR part 268, or if the waste is not listed in subpart D of 40 CFR part 261, the generator must then determine whether the waste is identified in subpart C of 40 CFR part 261 by either:
(1) Testing the waste according to the methods set forth in subpart C of 40 CFR part 261, or according to an equivalent method approved by the Administrator under 40 CFR 260.21; or
(2) Applying knowledge of the hazard characteristic of the waste in light of the materials or the processes used."

4.1.2 The determination of profiles is updated upon request by the disposal facility or any time changes in the hazard characteristics are identified through process change by laboratory supervisors.

4.1.3 Hazardous waste profiles established at DataChem Laboratories can be found on DCL On-Line on the Health and Safety page and are posted in the 180-day storage area. Hazardous materials not included in an established profile are to be brought to the attention of the Health and Safety Manager for separate disposal or to create an additional profile.

4.2 Each hazardous waste drum is labeled with an identification number from a drum log. The drum log contains information for each drum and indicates the date started and the hazardous waste profile used.

4.2.1 This drum log is completed upon disposal with the manifest number and disposal date.

4.2.2 All completed Chain-of-Custody forms are stored electronically on a DCL Computer network drive according to drum number. The electronic folder should be characterized by year and drum number.

4.2.2.1 Chain-of-Custody forms for hazardous waste disposal are saved by Root Set ID in accordance with the procedures listed in section 7.4 of DCL SOP EA-DC-002. These documents are placed in the folder for each disposal drum used.

4.3 Each laboratory supervisor shall be responsible for the proper disposal of hazardous waste generated in his/her work area as established by the Safety Manager. All hazardous waste must be stored in properly labeled containers that are adequate in strength, construction, size, and compatible with the chemicals being stored. Chemical waste must never be discarded improperly, such as pouring down a drain. The only exceptions to this are acid wastes which do not contain other regulated hazardous materials and that have been diluted or neutralized for acid disposal.

Wastes which are hazardous due to corrosive pH and the presence of other hazardous materials are to be neutralized and stored in the appropriate accumulation container in the 180-day hazardous waste accumulation room.

4.3.1 Satellite Accumulation is the accumulation point at, or near, the point of generation. Although EPA regulations allow storage of up to 55 gallons, **(1 quart for acutely hazardous materials)** in satellite accumulation areas DataChem Laboratories policy is to limit satellite accumulations to 20 gallons. Satellite accumulations are the responsibility of the person generating the waste under the direction of their laboratory manager. When Satellite accumulation quantities reach maximum it is the generators responsibility to request transfer to the 180-day accumulation storage room. Satellite accumulation containers are to be kept closed except when adding or transferring wastes.

EPA rules limit the storage of acutely hazardous materials in satellite storage areas to 1 Quart. When quantities reach this level they are to be transported, by trained and authorized employees, to the 180-day storage area, within three days, for disposal. Normal labeling (as described in 4.3.1.1), as well as the 180-day time limit apply

4.3.1.1 Labeling satellite accumulation containers:
Satellite accumulation containers must be properly labeled as Hazardous waste. Following is an example of an acceptable label for solvent wastes. Labels can be obtained from the Safety manager. Labels are available for acids or other chemical wastes.

WASTE SOLVENT

Source of Waste: _____

MAJOR CONTENTS (Please Check)

<> Acetone	<> Ethylene Acetate	<> Methylene Chloride
<> Acetonitrile	<> Ethyl Ether	<> Pentane
<> Benzene	<> Ethylene Glycol	<> Petroleum Ether
<> Carbon Disulfide	<> Heptane	<> Tetrahydrofuran
<> Carbon Tetrachloride	<> Hexane	<> Toluene
<> Chloroform	<> Isooctane	<> Xylene
<> Cyclohexane	<> Ispropanol	<> _____
<> Ethanol	<> Methanol	<> _____
<> _____	<> _____	<> _____

MINOR CONTENTS (Please List)

_____	_____	_____
_____	_____	_____
_____	_____	_____

It is DataChem Laboratories policy that waste accumulation transfers from satellite accumulation to 180-day accumulation, be done only by trained and authorized personnel.

4.3.2 The 180-Day accumulation area is the storage area where satellite accumulations are taken for storage until sufficient quantities are accumulated for shipment to the final disposal site. There is an exception, which allows 270 days if the waste must be transported more than 200 miles for recovery, treatment or disposal. EPA policy states that the 180-day accumulation time limit starts when wastes are first put in the accumulation container.

4.3.2.1 The 180-day accumulation area is a secure location with limited access. It is located near the loading dock. Employees who transfer chemical wastes into 180-day storage must complete all training in the DataChem Chemical Hygiene Plan, Waste Management Plan, and a minimum of one week working with a trained and authorized waste transfer employee.

4.3.3 Managing 180-Day storage of HAZARDOUS WASTE.

Label each container with the words "HAZARDOUS WASTE" a description of the contents (usually the name of the waste stream), the hazardous waste drum number, and the date that waste was first put in the container. Labels are supplied by the waste disposal contractor and are available in the 180-day storeroom.

Containers must be of suitable construction, strength, and size and be compatible with the waste being stored.

Containers must be closed except when adding or removing wastes.

Areas where containers are stored must be inspected at least weekly for leakage, corrosion, security, proper labeling, accumulation time, and safe storage. This inspection must be documented on the form shown in Appendix A. Forms are filed in the safety office and maintained for two years.

Do not mix incompatible wastes. Incompatible waste can be found in the Chemical Hygiene Plan Section 1, Part 6, section 3.5. Wastes should only be stored as part of an established waste stream. If wastes do not fit into established waste profiles notify the Safety Manager.

For storage and disposal of acutely hazardous materials, see 40 CFR Part 261 Subpart D for a listing of EPA Acutely hazardous materials

EPA rules limit the storage of acutely hazardous materials in satellite storage areas to 1 Quart. When quantities reach this level they are transported to the 180-day storage area, within three days, for disposal. Normal labeling (as described in 4.3.1.1), as well as the 180-day time limit apply.

4.4 Individual Laboratory Responsibilities

4.4.1 Satellite accumulations are the responsibility of the person generating the waste under the direction of their laboratory manager. When Satellite accumulation quantities reach maximum it is the generators responsibility to request transfer to the 180-day accumulation storage room. Satellite accumulation containers are to be kept closed except when adding or transferring wastes.

4.4.2 Hazardous liquid chemical waste (usually solvents) is normally accumulated in one-gallon bottles or five-gallon cans, but other suitable sizes can be used. Containers must be of suitable construction, strength, and size and be compatible with the waste being stored. Refer to 4.3.1 above for total quantity limitations and 4.3.1.1 for labeling requirements.

4.4.3 Periodically, and preferably when one or two hazardous waste containers are full, a Designated, trained and authorized employee in the laboratory transfers the waste to the drums in the 180-day Waste Storage Room located near the loading dock. The persons transferring the chemicals shall wear, and be properly trained in the use of, protective equipment (e.g., respirator, gloves). Each drum is labeled, and special care shall be taken that waste chemicals are transferred to the proper drums.

4.5 Responsibilities of assigned DCL personnel: The Safety Manager is responsible for the ultimate disposal of hazardous waste from the DCL premises. This is accomplished through the services of a commercial broker. The Safety Manager is responsible for contacting and arranging for the proper transport, storage, and/or disposal of DCL hazardous waste. The Safety Manager shall ensure that the broker is licensed and registered with the EPA and that the ultimate disposal through the broker is according to State and Federal regulations.

4.51 *Effluent pH Monitoring* – Effluent from the acid neutralizing waste system is monitored in the following manner:

- The pH is continuously monitored by the automated system inline at the effluent. The pH monitoring is recorded into a computer file that can be viewed at any time.
- The pH monitoring record is examined daily for possible excursions (a pH of > 12 or < 5). Any excursion is noted, and a copy of the pH monitoring for that day is printed and placed on file.
- The Safety Manager investigates to determine the cause of any excursion and makes the proper changes to rectify the problem.
- Periodic grab samples of the effluent are taken and analyzed for pH. The date and time of the sample are noted so as to cross-check with the automated monitoring device and determine its accuracy.

4.5.2 The Effluent pH Monitoring apparatus is calibrated and documented in accordance with the procedure listed in Appendix B of this SOP.

4.5.3 Routine tasks of the Safety Manager include the following:

- Determine and maintain Hazardous Waste profiles as required in section 4.1 of this SOP.
- Maintain Hazardous Waste Drum log and electronic Chain-of-Custody as required by section 4.2 of this SOP.
- Instruct pertinent laboratory personnel concerning approved methods of disposal.
- Ensure that all laboratories generating waste are using acceptable containers and that labels are available and properly used.
- Monitor the bulk drums in the waste storage room to ensure proper labeling and timely removal.
- Maintain an adequate supply of bulk drums, regulatory labels, and shipping forms.
- Establish and maintain frequent contact with commercial brokers and arrange for the most expedient and cost-effective disposal.
- Maintain complete records of the status of all hazardous waste drums and maintain complete documentation of shipments.
- Monitor the effluent pH as described above.

4.5.4 The Safety Manager shall monitor the status of hazardous waste at DCL to ensure regulatory compliance with respect to all aspects of hazardous waste handling and disposal.

4.5.5 If the Safety Manager is unavailable, major duties listed in this section will be assigned to trained and qualified individuals.

APPENDIX A

Hazardous Waste Room

Weekly inspection

Inspected by: _____ Date: _____ Initials: _____

Description	OK	Deficient
Check all drums and containers for leakage or corrosion	☐	☐
Check all containers for proper labeling	☐	☐
Check all labels for complete information Be sure start date is present	☐	☐
Check to see that all containers are closed	☐	☐
Check for excess quantity being stored Limit storage to 8 full drums	☐	☐
Check for drums with dates older than 180 days	☐	☐
Check room for adequate housekeeping	☐	☐
Check for adequate exhaust ventilation	☐	☐

Describe any problems observed: _____

_____

_____

_____

_____

Appendix B
Quarterly pH Monitor Test and Calibration

Acid waste continuous pH monitor must be tested quarterly and calibrated if inaccurate by more than 20%.

Testing procedure:

1. Obtain a suitable, non-preserved sample container. Available in the Wet Chemistry lab.
2. Collect a water sample from the acid waste monitoring pit (northwest of building by picnic table area) using dip cup from hazardous waste room.
3. Record sample collection date and time on this form.
4. Print acid waste monitor graph from DCL network using Microsoft Excel.
5. Mark collection time on graph.
6. Deliver water sample to Wet Chemistry lab with this form and pH graph.
7. Ask lab personnel to determine sample pH and enter on this form.
8. Calculate percentage of error and enter on this form.
9. If error is greater than 20% proceed to calibration section.

Date	Time	Indicated pH	Actual pH	Error %

Calibration

The pH-monitoring instrument is located in an electrical box mounted on a post near the pH-monitoring pit. A building master key (GMK) is required. Calibration is accomplished by following the manufacturer's Easy Cal directions. 4.0 and 10.0 pH buffer solutions and a beaker of D.I. water for rinse will be needed (available in the Wet Chemistry Lab).

1. Open the round cover on the pH-monitoring pit.
2. Remove the pH sensor with its mounting pipe and attach to the clips on the side of the electrical box.
3. Follow manufacturers Easy Cal instructions (step 6) (attached). Be sure to rinse with D.I. water between buffers.
4. If calibration is difficult, the sensor may need replacement (a sensor information sheet is attached). pH Sensors typically last 6 to 12 months.
5. After calibration, replace sensor in pit and allow 10 minutes for stabilization.
6. Collect another water sample and repeat the test procedure above.

Quality Assurance Project Plan
Sampling Analysis Plan
for
Munitions Response Program
Site Inspections at
Ten Munitions Response Program
Ranges

VOLUME II OF II

Naval Support Facility
Indian Head-Stump Neck Annex
Indian Head, Maryland

Naval Facilities Engineering Command
Washington

Contract Number N62467-04-D-0055
Contract Task Order 423

September 2009

SAP Worksheet #1 -- Title and Approval Page
(UFP-QAPP Manual Section 2.1)

SAMPLING AND ANALYSIS PLAN
FOR
MUNITIONS RESPONSE PROGRAM
SITE INSPECTIONS AT 10 MUNTIONS RESPONSE PROGRAM RANGES
MEC (DETECTOR-AIDED SURFACE SWEEP / GEOPHYSICS) INVESTIGATION
NAVAL SUPPORT FACILITY INDIAN HEAD-STUMP NECK ANNEX
INDIAN HEAD, MARYLAND

September 2009

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Prepared under:
Comprehensive Long-Term Environmental Action Navy Contract
No. N62467-04-D-0055
Contract Task Order 423

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Appendix A: Standard Operating Procedures and Field Forms
Appendix B: Visual Sample Plan

ACRONYMS

AA&D	Advanced Access and Disablement
AOC	Area of Concern
AR	Administrative Record
bgs	Below Ground Surface
BTAG	Biological Technical Assistance Group
CA	Corrective Action
CD	Compact Diskette
CEC	Cation Exchange Capacity
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CHSO	Company Health and Safety Officer
CLEAN	Comprehensive Long-Term Environmental Action Navy
cm	Centimeter
COPC	Chemical of Potential Concern
CSM	Conceptual Site Model
CTO	Contract Task Order
CWM	Chemical warfare material
DDESB	Department of Defense Explosive Safety Board
DERP	Defense Environmental Restoration Program
DGM QC Guidance	Digital Geophysical Mapping Guidance – Operational Procedures and Quality Control Manual
DGM	Digital Geophysical Mapping
DID	Data Item Description
DMM	Discarded Military Munitions
DoD	Department of Defense
DOP	Dilution of Precision
DPT	Direct Push Technology
DQI	Data Quality Indicator
DQO	Data Quality Objective
EFT	Equipment Function Test
EM	Electromagnetic
EOD	Explosive Ordnance Disposal
EP	Engineering Pamphlet
ESS	Explosive Safety Submission

ESSL	Ecological Soil Screening Level
FOL	Field Operations Leader
FS	Feasibility Study
FTMR	Field Task Modification Request
GIS	Geographic Information System
GPS	Global Positioning System
HASP	Health and Safety Plan
HDOP	Horizontal Dilution of Precision
HE	High Explosives
HSM	Health and Safety Manager
HTRW	Hazardous, toxic, and radiological waste
IED	Improvised Explosive Device
IND	Improvised Nuclear Device
IR	Installation Restoration
IRCDQM	Installation Restoration Chemical Data Quality Manual
ITS	Instrument Test Strip
MC	Munitions constituents
MCB	Marine Corps Base
MD	Munitions Debris
MDE	Maryland Department of the Environment
MEC	Munitions and explosives of concern
MIS	Multi-Increment Samples
mm	Millimeter
MMCX	Munitions Mandatory Center of Expertise
MMRP	Military Munitions Response Program
MPPEH	Munitions Potentially Presenting an Explosive Hazard
MRA	Munitions Response Area
MRP	Munitions Response Program
MRS	Munitions Response Site
mS/m	MilliSiemens per meter
mV	Millivolt
NA	Not Applicable
NAD	North American Datum
NAVFAC	Naval Facilities Engineering Command
NDW	Naval District Washington
NFA	No Further Action

NIRIS	Naval Installation Restoration Information Solution
NOL	Naval Ordnance Laboratory
NOSSA	Naval Ordnance Safety and Security Activity
NQA	Normal Quality Assurance
NSF	Naval Support Facility
NSF-IH	Naval Support Facility - Indian Head
nT	nano Tesla
NTU	Nephelometric Turbidity Units
OE	Ordnance and Explosives
ORNL	Oak Ridge National Laboratory
PA	Preliminary Assessment
PAL	Project Action Limit
PM	Project Manager
POC	Point of Contact
ppt	Parts per thousand
PQO	Project Quality Objective
QA	Quality Assurance
QAM	Quality Assurance Manager
QAO	Quality Assurance Officer
QAPP	Quality Assurance Project Plan
QC	Quality Control
RI	Remedial Investigation
RPM	Remedial Project Manager
SAP	Sampling and Analysis Plan
SI	Site Inspection
SOP	Standard Operating Procedure
SSO	Site Safety Officer
SUXOS	Senior UXO Officer
SWMU	Solid Waste Management Unit
TBD	To be determined
Tetra Tech	Tetra Tech NUS, Inc.
TNT	Trinitrotoluene
TOC	Total Organic Carbon
U.S. EPA	United States Environmental Protection Agency
UFP	Uniform Federal Policy
USACE	United States Army Corps of Engineers

UXO	Unexploded Ordnance
UXOQC	UXO Quality Control
UXOSO	UXO Safety Officer
VI	Visual Inspection
VOA	Volatile Organic Analyte
VOC	Volatile Organic Compound
VSP	Visual Sample Plan
WMA	Wildlife Management Area
XRF	x-Ray Fluorescence

EXECUTIVE SUMMARY

Tetra Tech NUS, Inc. (Tetra Tech) has prepared this Quality Assurance Project Plan (QAPP) Sampling and Analysis Plan (SAP) under the Comprehensive Long-Term Environmental Action Navy (CLEAN) Contract No. N62467-04-D-0055 Contract Task Order (CTO) 423. This plan has been prepared for a Site Inspection (SI) at 10 Munitions Response Areas (MRAs) located at the Stump Neck Annex of the Naval Support Facility (NSF) located in Indian Head, Maryland. The general locations of NSF-Indian Head (IH) Main Installation and the NSF-IH-Stump Neck Annex are shown on Figure 1-1. The Stump Neck Annex covers approximately 1,100 acres on the Stump Neck peninsula at the confluence of the Potomac River and Chicamuxen Creek in Charles County, Maryland. The Main Installation is northeast of the Stump Neck Annex, across Mattawoman Creek. Much of Stump Neck peninsula lies within the Valley Impact Fan (Figure 1-2). General Smallwood State Park and private property are east of Stump Neck Annex.

The Navy has conducted various testing, training, and disposal activities related to military munitions at the Stump Neck Annex since NSF-IH was established in 1890 as a Naval Ordnance Station. As a result of these activities, munitions and explosives of concern (MEC) and munitions constituents (MC) may be present at various sites throughout the Stump Neck Annex. The term MEC includes Discarded Military Munitions (DMM), Unexploded Ordnance (UXO), and MC in high enough concentrations to pose an explosive hazard. The Department of Defense (DoD) has established the Military Munitions Response Program (MRP) to address MC and MEC at closed ranges. The DoD is following the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) process for the investigation and remediation of these sites. The Navy is responsible for implementing the MRP at the Stump Neck Annex.

The initial phase of the CERCLA process, the Preliminary Assessment (PA), was completed in September 2005 and identified for further investigation at the Stump Neck Annex 10 MEC sites or MRAs/Munitions Response Sites (MRSs). The 10 MRA/Ss described in the Stump Neck Annex PA Report and their locations are shown on Figure 1-3. The PA used five primary sources of information to support the facility data collection effort, including historical archives, personal interviews, installation data repositories (including the Administrative Record), visual surveys, and off-facility data sources and repositories such as local libraries and museums.

The primary objective of this SI is to determine whether further response actions, remedial investigations, or no further action are appropriate for any of the sites identified in the PA. The SI considers the background information provided in the PA and collects supplemental site-specific environmental data to

determine types and rough orders of magnitude quantities of MEC present and to refine site boundaries (footprint reduction).

The SI for the ten MEC sites consists of two distinctly different investigations, which will be conducted in two phases. The first phase will consist of the MEC investigations, which will include detector-aided surface sweeps for MEC followed by subsurface geophysics investigations. The second phase will consist of the MC investigations. The results of the geophysics investigation will be used to determine the locations where samples will be collected during the MC investigation.

This SAP describes the MEC investigation and is designed to be “stand alone” in regards to the technical details of the MEC investigation. The MC SAP has been prepared in accordance with DoD requirements for developing SAPs for the management of environmental data collection and use as described in the Uniform Federal Policy (UFP) for Quality Assurance Project Plans (UFP QAPP aka UFP SAP). DoD has issued a series of 37 worksheets, which are to be utilized in the development of UFP SAPs. The MC SAP consists of the 37 UFP SAP Worksheets with text, figures, maps, and appendices added as necessary to provide the required information.

The UFP SAP worksheets have been developed for the collection and evaluation of data on concentrations of chemical constituents in environmental media. These worksheets were not designed for the collection of geophysical data. The Navy MRP Workgroup has modified the UFP SAP worksheets to be applicable to MEC investigations. These modified worksheets have been used in the preparation of this MEC SAP.

The information provided in the worksheets was developed based on the results of three project scoping meetings among the planning team, which consists of representatives of the Navy, United States Environmental Protection Agency (U.S. EPA) Region 3, Maryland Department of the Environment (MDE), and Tetra Tech (see Worksheet #9 for attendees). Worksheet #10 contains summaries of the site-specific Conceptual Site Models (CSMs) for the 10 sites, CSMs are presented in detail in Appendix B of the MC SAP. The CSMs were used as the basis for the development of the project specific data quality objectives (DQOs), which are contained in Worksheet #11. The remainder of the worksheets describe the sampling, analytical, and data evaluation procedures including quality requirements specific to the detector-aided surface sweep and geophysics investigations.

SAP Worksheet #2 -- SAP Identifying Information

(UFP-QAPP Manual Section 2.2.4)

Site Name/Number: Naval Support Facility (NSF) Indian Head (NSF-IH) - Stump Neck Annex, Maryland
Operable Units: Unexploded Ordnance (UXO)-01, 02, 04, 05, 10, 12, 21, 23, 26, and 28
Contractor Name: Tetra Tech NUS, Inc. (Tetra Tech)
Contract Number: N62467-04-D-0055
Contract Title: Comprehensive Long-Term Environmental Action Navy (CLEAN)
Work Assignment Number (optional): Contract Task Order (CTO): 423

1. This SAP was prepared in general accordance with the requirements of the *Uniform Federal Policy for Quality Assurance Project Plans (UFP-QAPP)* (U.S. EPA, 2005) and *EPA Guidance for Quality Assurance Project Plans, EPA QA/G-5, QAMS (2002)*. However, because the UFP-SAP worksheets were not designed for MEC (geophysical) investigations, modifications were made to various worksheets to incorporate requirements applicable to geophysical investigations. Nine worksheets were not applicable.

2. Identify regulatory program: DoD Military Munitions Response Program (MMRP) using the general CERCLA process.

3. This SAP is a **project-specific SAP**.

4. The following scoping sessions were held:

Scoping Session	Date
Meeting No. 1 - Development of CSM and DQOs	November 7 to 9, 2007
Meeting No. 2 - Development of CSM and DQOs	December 18 and 19, 2007
Meeting No. 3 - Development of CSM and DQOs	January 28 and 29, 2008
Meeting No. 4 - Site Walk	February 11, 2008
Meeting No. 5 - DQO Discussion	May 14, 2008

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

Title	Date
Not applicable – This is the initial MRP SI	

6. List organizational partners (stakeholders) and connection with lead organization:

U.S. EPA Region 3 – Regulatory Oversight
MDE – Regulatory Oversight

7. Lead organization

Naval Facilities Engineering Command (NAVFAC) Washington

NSF-IH

8. 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:

UFP-QAPP Worksheet #	Required Information	Crosswalk to Related Information
A. Project Management		
Documentation		
1	Title and Approval Page	NA
2	Table of Contents SAP Identifying Information	NA
3	Distribution List	NA
4	Project Personnel Sign-Off Sheet	NA
Project Organization		
5	Project Organizational Chart	NA
6	Communication Pathways	NA
7	Personnel Responsibilities and Qualifications Table	NA
8	Special Personnel Training Requirements Table	NA
Project Planning/Problem Definition		
9	Project Planning Session Documentation (including Data Needs tables) Project Scoping Session Participants Sheet	NA
10	Problem Definition, Site History, and Background. Site Maps (historical and current)	NA
11	Site-Specific Project Quality Objectives	NA
12	Measurement Performance Criteria Table	NA
13	Sources of Secondary Data and Information, Secondary Data Criteria and Limitations Table	NA
14	Summary of Project Tasks	NA
15	Reference Limits and Evaluation Table	Not used – No samples proposed for collection/analysis during MEC geophysics survey/ investigation
16	Project Schedule/Timeline Table	NA
B. Measurement Data Acquisition		
Sampling Tasks		
17	Sampling Design and Rationale	NA
18	Sampling Locations and Methods/Standard Operating Procedure (SOP) Requirements Table Sample Location Map(s)	NA
19	Analytical Methods/SOP Requirements Table	Not used – No samples proposed for collection/analysis during MEC geophysics survey/ investigation
20	Field Quality Control Sample Summary Table	NA
21	Project Sampling SOP References Table, Sampling SOPs	NA
22	Field Equipment Calibration, Maintenance, Testing, and Inspection Table	NA

UFP-QAPP Worksheet #	Required Information	Crosswalk to Related Information
Analytical Tasks		
23	Analytical SOPs, Analytical SOP References Table	Not used – No samples proposed for collection/analysis during MEC geophysics survey /investigation
24	Analytical Instrument Calibration Table	Not used – No analytical instrument calibration data will be required to support MEC geophysics surveys/ investigations
25	Analytical Instrument and Equipment Maintenance, Testing, and Inspection Table	Not used – No analytical instrument equipment maintenance, testing, or inspections will be required to support MEC geophysics surveys/investigations
Sample Collection		
26	Sample Handling System, Documentation Collection, Tracking, Archiving, and Disposal Sample Handling Flow Diagram	Not used – No analytical sampling handling system will be required to support MEC geophysics surveys/ investigations
27	Sample Custody Requirements, Procedures/SOPs Sample Container Identification Example Chain-of-Custody Form and Seal	Not used – No samples are proposed for collection/analysis during the MEC geophysics survey/investigation
Quality Control (QC) Samples		
28	QC Samples Table, Screening/Confirmatory Analysis Decision Tree	Not used – No analytical laboratory QC sampling will be required to support MEC geophysics surveys/ investigations
Data Management Tasks		
29	Project Documents and Records Table	NA
30	Analytical Services Table Analytical and Data Management SOPs	Not used – No analytical services will be required to support MEC geophysics surveys/investigations.
C. Assessment Oversight		
31	Planned Project Assessments Table, Audit Checklists	NA
32	Assessment Findings and Corrective Action Responses Table	NA
33	QA Management Reports Table	NA
D. Data Review		
34	Verification (Step I) Process Table - Preparatory and Initial Inspections	NA
35	(Tier 2) QC Process Summary Table - Follow-Up Inspections	NA
36	Validation (Steps IIa and IIb) Summary Table	NA
37	Usability Assessment	NA

SAP Worksheet #3 -- Distribution List

(UFP-QAPP Manual Section 2.3.1)

Name of SAP Recipient	Title/Role	Organization	Telephone Number (Optional)	E-Mail or Mailing Address	Document Control Number (Optional)
Joseph Rail	Navy Remedial Project Manager (RPM)	NAVFAC Washington	202.685.3105	joseph.rail@navy.mil	NA
Nicholas.Carros	Environmental Director, NSF-IH	NSF-IH	301.744.2263	nicholas.carros@navy.mil	NA
Curtis DeTore	MDE RPM	MDE	410.537.3791	cdetore@mde.state.md.us	NA
Dennis Orenshaw	U.S. EPA Region 3 RPM	U.S. EPA Region 3	215.814.3361	orenshaw.dennis@epa.gov	NA
John Trepanowski	Program Manager	Tetra Tech	610.491.9688	john.trepanowski@tetratech.com	NA
Ralph Basinski	Project Manager (PM)	Tetra Tech	412.921.8308	ralph.basinski@tetratech.com	NA
Ralph Brooks	UXO Manager	Tetra Tech	706.224.4690	ralph.brooks@tetratech.com	NA
Jim Coffman	Project Geophysicist	Tetra Tech	412.921.8244	james.coffman@tetratech.com	NA
TBD	Geophysical Subcontractor	Subcontractor	***TBD***	***TBD***	NA

SAP Worksheet #4 -- Project Personnel Sign-Off Sheet

(UFP-QAPP Manual Section 2.3.2)

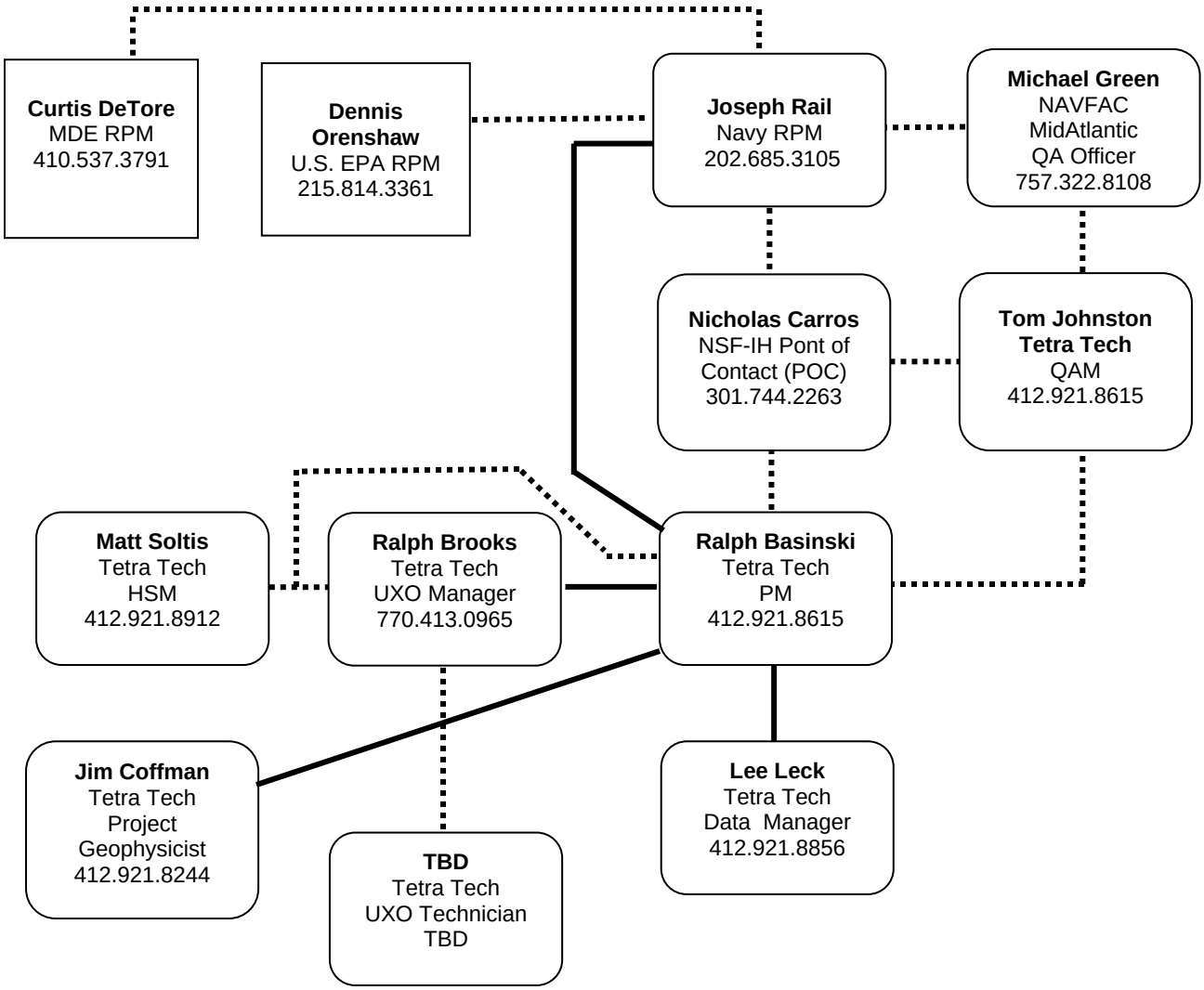
Name	Organization/Title/Role	Telephone Number (optional)	Signature/E-Mail Receipt	SAP Section Reviewed	Date SAP Read
Navy and Regulator Project Team Personnel					
Joseph Rail	Navy RPM	202.685.3105	joseph.rail@navy.mil	All	
Nicholas Carros	Environmental Division, NSF-IH	301.744.2263	nicholas.carros@navy.mil	All	
Curtis DeTore	MDE RPM	410.537.3791	cdetore@mde.state.md.us	All	
Dennis Orenshaw	U.S. EPA Region 3 RPM	215.814.3361	orenshaw.dennis@epa.gov	All	
Tetra Tech Project Team Personnel					
Ralph Basinski	PM	412.921.8308	ralph.basinski@tetratech.com	All	
Ralph Brooks	UXO/MEC Manager	706.224.4690	ralph.brooks@tetratech.com	All	
Dr. Tom Johnston	Quality Assurance Manager (QAM)	412.921.8615	tom.johnston@tetratech.com	All	
Jim Coffman	Project Geophysicist	412.921.8244	james.coffman@tetratech.com	All	
Matt Soltis	Health and Safety Manager (HSM)	412.921.8912	matt.soltis@tetratech.com	Health and Safety Plan (HASP)	
Subcontractor Personnel					
TBD	Geophysical Contractor (TBD) Supervisor	***TBD***	***TBD***		

TBD - To be determined

SAP Worksheet #5 -- Project Organizational Chart

(UFP-QAPP Manual Section 2.4.1)

Lines of Authority ——— Lines of Communication



SAP Worksheet #6 -- Communication Pathways

(UFP-QAPP Manual Section 2.4.2)

Communication Driver	Responsible Affiliation	Name	Phone Number and/or E-Mail	Procedure
MEC Find	Tetra Tech Field Staff Tetra Tech UXO Staff Tetra Tech UXO Manager Tetra Tech Project Manager Navy RPM Indian Head POC	TBD TBD Ralph Brooks Ralph Basinski Joe Rail Nicholas Carros	TBD TBD 770.413.0965 x231 412.921.8308 202.685.3105 301.744.2263	Field staff will immediately inform Tetra Tech UXO Manager and Base POC, and secure area. Tetra Tech UXO Manager will inform Tetra Tech PM on the same day. Base POC will immediately make Base Emergency notifications. Tetra Tech PM will inform Navy RPM on the same day. Navy RPM will inform Naval Ordnance Safety and Security Activity (NOSSA) on the same day.
Field issues that require change in field tasks	Tetra Tech Project Geophysicist Tetra Tech UXO Manager	Jim Coffman (Geophysical surveys) Ralph Brooks (UXO sweeps)	412.921.8244 770.413.0965 x231	The responsible person will verbally obtain approval from Tetra Tech PM on the day that the issue is discovered and document any change via Field Task Modification Request (FTMR) Form.
SAP/QAPP amendments	Navy RPM	Joseph Rail	202.685.3105	Send scope change to Tetra Tech Program Management Office.
Fieldwork schedule changes	Tetra Tech PM	Ralph Basinski	412.921.8308	Verbally inform Navy on the day that the schedule change is known and, if significant, document via schedule impact letter as soon as impact is realized.

Communication Driver	Responsible Affiliation	Name	Phone Number and/or E-Mail	Procedure
Field issues that require changes in the scope or implementation of field work	Tetra Tech PM Tetra Tech Project Geophysicist Tetra Tech UXO Manager	Ralph Basinski Jim Coffman Ralph Brooks	412.921.8308 412.921.8244 770.413.0965 x231	Project Geophysicist or UXO Manager will inform Tetra Tech PM, on the day that the issues is discovered. Tetra Tech PM will inform Navy RPM, Navy RPM will issue scope change, if warranted; the scope change will be implemented before further work is executed. Change will be documented on FTMR Form.
Stop-work recommendations, for example, to protect workers from unsafe conditions or situations or to prevent a degradation in quality of work	Tetra Tech PM Tetra Tech Project Geophysicist Tetra Tech QAM Tetra Tech HSM Navy RPM Tetra Tech UXO Manager	Ralph Basinski Jim Coffman Tom Johnston Matt Soltis Joseph Rail Ralph Brooks	412.921.8308 412.921.8244 412.921.8615 412.921.8912 202.685.3105 770.413.0965 x231	Responsible party will immediately inform subcontractors, Navy, and project team.
Field data issues	Tetra Tech Project Geophysicist SUXOS	Jim Coffman TBD	412.921.8244 TBD	Geophysical field team will immediately notify Tetra Tech Project Geophysicist who will inform Tetra Tech PM and QAM.
Corrective action for field program	Tetra Tech QAM	Tom Johnston	412.921.8615	Tetra Tech QAM will notify Tetra Tech PM within 1 day that the corrective action has been completed. The Tetra Tech PM will notify the Navy RPM within 1 day.

TBD – to be determined

SAP Worksheet #7 – Personnel Responsibilities and Qualifications Table
(UFP-QAPP Manual Section 2.4.3)

Name	Title/Role	Organizational Affiliation	Responsibilities	Education and/or Experience Qualifications (Optional)
John Trepanowski	Program Manager	Tetra Tech	Oversees CLEAN Program.	M.S. Mining Engineering, B.S. Mining Engineering, 27 years of engineering experience
Ralph Basinski	Project Manager	Tetra Tech	Oversees project, financial, schedule, and technical day-to-day management of the project. • Ensures timely resolution of project-related technical, quality, and safety questions associated with Tetra Tech operations. • Functions as the primary Tetra Tech interface with the Navy RPM, Indian Head POC, Tetra Tech field and office personnel, and laboratory POCs. • Ensures that Tetra Tech health and safety issues related to this project are communicated effectively to all personnel and off-site laboratories. • Monitors and evaluates all Tetra Tech subcontractor performance. • Coordinates and oversees work performed by Tetra Tech field and office technical staff (including data validation, data interpretation, and report preparation). • Coordinates and oversees maintenance of all Tetra Tech project records. • Coordinates and oversees review of Tetra Tech project deliverables. • Prepares and issues final Tetra Tech deliverables to the Navy.	B.S. Chemistry, 30 years of environmental experience

Name	Title/Role	Organizational Affiliation	Responsibilities	Education and/or Experience Qualifications (Optional)
Ralph Brooks	UXO Manager	Tetra Tech	Oversees selection of qualified UXO personnel, establishes overall quality control program for UXO activities, addresses UXO-related issues as identified by field personnel.	B.S. General Studies; Graduate, Navy Explosive Ordnance Disposal (EOD) School - Indian Head, 25 years of military EOD experience, 6 years commercial UXO experience.
TBD	UXO Technician III	Tetra Tech	Supervises the conduct of all on-site UXO-related operations. Prepare daily reports of field activities. Conduct daily site safety briefings. Escort non-UXO personnel in suspect MEC areas. Determine location and identification of suspect MEC. Conduct detector-aided surface sweep.	Minimum of 8 years prior military EOD and or commercial UXO experience in munitions response actions or range clearance activities. (DDESB TP 18)
TBD	UXO Safety Officer (UXOSO)	Tetra Tech	Ensure initial site-specific training is delivered for all field personnel before field activities begin and that all safety control measures have been established. Ensure all UXO-specific certifications are filed on site and are available for Navy inspection. Enforce personnel limits and safety exclusion zones. Conduct, document, and report safety inspections.	Minimum of 8 years prior military EOD and or commercial UXO experience in munitions response actions or range clearance activities and applicable safety standards. (DDESB TP 18)
TBD	UXO Quality Control (UXOQC) Specialist	Tetra Tech	Conduct quality control audits. Identify, document and report corrective actions.	Minimum of 8 years prior military EOD and or commercial UXO experience in munitions response actions or range clearance activities and the transportation, handling and storage of munitions and commercial explosives. (DDESB TP 18)

Name	Title/Role	Organizational Affiliation	Responsibilities	Education and/or Experience Qualifications (Optional)
Tom Johnston	QAM	Tetra Tech	Reviews QAPP, oversees preparation of lab scope, coordinates with lab, and conducts data quality review. Ensures quality aspects of the CLEAN program. • Develops, maintains, and monitors Quality Assurance (QA) policies and procedures. • Provides training to Tetra Tech staff in QA/Quality Control (QC) policies and procedures. • Conducts systems and performance audits to monitor compliance with environmental regulations, contractual requirements, QAPP requirements, and corporate policies and procedures. • Audits project records. • Monitors subcontractor quality controls and records. • Assists in the development of corrective action plans and ensuring correction of non-conformances reported in internal or external audits. • Ensures that this SAP meets Tetra Tech, Navy, and MDE requirements. • Oversees the responsibilities of the Tetra Tech Project Quality Assurance Officer (QAO). • Prepares QA reports for management.	Ph.D Analytical Chemistry, 30 years environmental experience
Jim Coffman	Project Geophysicist	Tetra Tech	• Overall responsibility for design, implementation, and management of all geophysical investigations required for the work effort, but may not necessarily be on site full time. • Project geophysicist-of-record.	B.S. Geology, M.S. Geophysics, 10 years geophysical experience

Name	Title/Role	Organizational Affiliation	Responsibilities	Education and/or Experience Qualifications (Optional)
Matt Soltis	HSM	Tetra Tech	Oversees CLEAN Program Health and Safety Program • Provides technical advice to the Tetra Tech PM on matters of health and safety. • Oversees the development and review of the HASP. • Conducts health and safety audits. • Prepares health and safety reports for management.	B.S. Industrial Safety Sciences, 24 years environmental experience
TBD	Site Safety Officer (SSO)	Tetra Tech	The SSO will be responsible for training and monitoring site conditions. The SSO reports to the Company Health and Safety Officer (CHSO) and indirectly to the Field Operations Leader (FOL) and Tetra Tech PM. Details of the SSO's responsibilities are presented in the HASP and include: • Controlling specific health and safety-related field operations such as personnel decontamination, monitoring of worker heat or cold stress, and distribution of safety equipment. • Conducting and documenting a daily health and safety briefing each day while on site. • Assuring that field personnel comply with all procedures established in the HASP. • Identifying assistant SSOs in his/her absence. • Terminating work if an imminent safety hazard, emergency situation, or other potentially dangerous situation is encountered. • Assuring the availability and condition of health and safety monitoring equipment. • Coordinating with the FOL and PM to institute and document any necessary HASP modifications. • Ensuring that facility personnel and subcontractors are adequately advised and kept clear of unexploded ordnance and potentially contaminated materials.	TBD

Name	Title/Role	Organizational Affiliation	Responsibilities	Education and/or Experience Qualifications (Optional)
TBD	Geophysical Contractor	Subcontractor	Conducts geophysical surveys	Minimum B.S. Geophysics or related field with UXO geophysical experience

In some cases one person may be designated responsibilities for more than one position. For example, the UXOSO may also be responsible for SSO duties. This action will be performed only as credentials, experience, and availability permits.

SAP Worksheet #8 -- Special Personnel Training Requirements Table

(UFP-QAPP Manual Section 2.4.4)

Project Function	Specialized Training by Title or Description of Course	Training Provider/ Verifier	Training Date	Personnel/ Groups Receiving Training	Personnel Titles/ Organizational Affiliation	Location of Training Records/Certificates
Project Operations	Site Orientation, Ethics Training, and UXO Avoidance	SUXOS	Upon arrival at NSF-IH	All personnel	Tetra Tech and Subcontractors	Documentation of special training requirements will be maintained on site. After the field investigation is complete, special training documentation will be maintained in the permanent project file.
	Accident Prevention and First Aid	SSO				
	Overview of Project Plans	Project Geophysicist, SUXOS				
	29CFR1910.120 Training	Vendor	Prior to arrival at NSF-IH	All field personnel		
Munitions Response	MEC Safety Training	UXOSO, SUXOS	Training will have been received prior to participation in field activities	Personnel entering exclusion zone		
Geophysical Survey	Use of DGPS equipment	Project Geophysicist		Geophysical Survey Team		
	Use of geophysical survey sensor	Project Geophysicist		Geophysical Survey Team		
	Geophysical Survey SOP	Project Geophysicist		Geophysical Survey Team		
	Geophysical Data Processing SOP	Project Geophysicist		Data Processors and Interpreters		

Project Function	Specialized Training by Title or Description of Course	Training Provider/ Verifier	Training Date	Personnel/ Groups Receiving Training	Personnel Titles/ Organizational Affiliation	Location of Training Records/Certificates
Grid Layout, Surface Sweep	Use of hand-held GPS	Project Geophysicist, SUXOS		Geophysical Survey Team and UXO Team		
MEC Data Collection	Surface Sweep and MEC Management and Accountability SOPs	SUXOS		UXO Team		

SAP Worksheet #9 -- Project Scoping Session Participants Sheet

(UFP-QAPP Manual Section 2.5.1)

Project Name: Stump Neck Annex SI Projected Date(s) of Sampling: May, 2009 Project Manager: Ralph Basinski	Site Name: Ten MEC MRP Sites at Stump Neck Annex SI Site Location: NSF-IH—Stump Neck Annex, Charles County, Maryland

Date of Session: November 7 to 9, 2007
Scoping Session Purpose: Develop CSM and DQOs

Name	Title	Affiliation	Phone Number	E-Mail Address	Project Role
Joseph Rail	Navy RPM	NAVFAC Washington	202. 685.3105	joseph.rail@ navy.mil	Navy NAVFAC project management
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Ralph Brooks	UXO Manager	Tetra Tech	706. 224.4690	ralph.brooks@ tetratech.com	UXO support
Jim Coffman	Geophysicist	Tetra Tech	412. 921.8244	jim.coffman@ tetratech.com	On-site geophysics measurements
Rick Barringer	Technical Lead	Tetra Tech	412. 921.8524	rick.barringer@ tetratech.com	Technical support
George Latulippe	Site Technical Lead	Tetra Tech	N/A	Retired from Tetra Tech	Technical/ coordination support

November 7-9, 2007 Meeting Notes

The November 7 – 9, 2007 scoping session addressed 16 sites at IH-Stump Neck Annex. Ten MEC sites (UXO-01, UXO-02, UXO-04, UXO-05, UXO-10, UXO-12, UXO-21, UXO-23, UXO-26, UXO-28) are addressed in this SAP. Information relevant to these sites is included in this worksheet. The full meeting minutes area available in the project file.

IH-Stump Neck Annex MRP Site Locations	General Notes
A. Advanced IED Area (UXO-5)	• Use UXO detector-aided survey to reconnoiter the site. Additionally, focus a UXO detector-aided survey near the concrete structure and MRP site berms with 100% coverage. • Use 100% geophysics survey coverage on the berms surrounding the cleared area (next to the concrete structure). • Need for vegetation removal (grass mowing and some limited underbrush removal in forested portions) to support geophysical survey and sample collection efforts. • Selected subsurface sampling for MECs with anomaly avoidance to supplement existing site data. • Munitions items observed at subgrade concrete structure suspected to be inert training items; however, an ESS may be required due to potential munitions hazards or scrap munitions, detonation cord, fuzes, igniters, etc. at this site. • Removal of non-MEC scrap materials? • Use of facility EOD to perform removals?
B. Basic IED Area (UXO-4)	• No recommended geophysics approach here. UXO detector-aided survey is recommended to reconnoiter the range. Focus survey with smaller transect spacing around the detonation area • Need for vegetation removal (grass mowing and some limited underbrush removal in forested portions) to support detector-aided survey actions and sample collection. • Selected subsurface sampling to supplement existing environmental data. • Uses a similar approach to that proposed for the Advanced Improvised Explosive Device (IED) Area.
C. EOD School Demolition Area (UXO-28)	• No recommended geophysics here. Use UXO detector-aided survey to focus small transect spacing around concrete structure and a coarser transect spacing to reconnoiter the rest of the site (5 acres). • Need for vegetation removal (grass mowing and limited underbrush removal-forest portions) to support surface sweep activities and soil sampling performance. • Selected subsurface sampling of munitions constituents (MCs) with anomaly avoidance to supplement existing environmental data.

IH-Stump Neck Annex MRP Site Locations	General Notes
D. Torpedo Burial Site (UXO-12)	• Use geophysics survey with 5 ft line spacing to allow coverage for large targets across the site (site grew from inventory to now being about 1.75 acres in area). • Need for vegetation (underbrush) removal to support geophysical grid performance. • Looking for shallow burial pits with metallic torpedoes at this site, so the geophysical signal should be very evident. • Selected subsurface sampling for MECs with anomaly avoidance.
E. Stump Neck Impact Area (UXO-10)	• Use geophysics survey on transects to reconnoiter the accessible land portions of the site while the ground is frozen (perhaps about 6-8 acres of survey area might be accessible). Investigation depth for individual targets is limited to about top 4 feet. • Historical records also indicate possible EOD training activities in this area. • Munitions impact penetration depths are 4 to 12 feet below ground surface (bgs). • Need for vegetation (underbrush) removal (or perhaps just stomping it down) to support geophysical grid performance. • There may be limitations on wetlands vegetation clearance within this MRP site. • Selected subsurface sampling for munitions and explosives of concern (MECs) with anomaly avoidance.
F. Air Blast Pond (UXO-1)	• Metallic debris is a problem at this site both inside and outside the Air Blast Pond. • A 57mm projectile (expended) was recovered at this site (on the berm). • Use of a geophysics survey to perform site footprint reduction will require extensive work to remove metallic interference. • Operations included testing and detonation of bulk explosives (TNT, PETN, HBX-1, HBX-2, H-6, C4, and Composition B). • Based on the materials observed outside, but adjacent to the Air Blast Pond, there may have been other training activities performed at this site. There are multiple drums, pipe sections, solid metallic training items, and other debris outside the berms of the Air Blast Pond. Items may remain on the pond bottom • Limited soil sampling during the Visual Inspection (VI) for soil (surface and subsurface) inside and outside the pond and sediment outside the Air Blast Pond confirmed no detectable explosives. • Selected surface/subsurface sampling (explosives) to supplement existing environmental data.

IH-Stump Neck Annex MRP Site Locations	General Notes
G. Area 8 (UXO-2)	• Need to supplement VI environmental data. Operations included Trinitrotoluene (TNT) blocks, detonation cord, fuzes, etc. Inert training items may remain on the pond bottom. • Perform detector-aided general surface sweep within 25 feet of inert training device locations (which were connected to shot points) to identify any remaining training materials at site. • Selected subsurface sampling for explosives with anomaly avoidance. • As a part of regular maintenance for water shot-points, the holes may have been periodically re-excavated and materials from the bottom of the hole and redeposited on the hole margins. • Three groundwater wells are located at this site. Is there a need for additional groundwater sampling points or is it adequate to use existing wells for groundwater sampling? • Groundwater samples to be evaluated for explosives/perchlorate (confirmatory sampling)? • Selected soil sampling to supplement existing environmental data (confirmatory sampling).
H. Test Area 1 (UXO-21)	• Selected subsurface sampling to supplement existing environmental data. Emphasis is to perform site footprint reduction. • Perform visual inspection of the antenna bowl. Geophysics sweep of bowl not possible due to iron mesh reinforcement in asphalt materials. • A 100-percent detector-aided surface sweep is recommended for the MRP Site area outside the bowl. • The southeastern corner of the site appears to have been the site of some explosive training activities. • Proposed sampling will include sampling for explosives and lead (lead linear-shaped charges) at selected locations in soil and sediment. • Soil samples/sediment samples to be field-screened using x-Ray Flourescence (XRF) instrumentation to identify lead concentrations. • Lead is the marker compound (due to linear shaped charges). Need to obtain a reference concentration–either health-based or risk-based for lead in soil to screen samples against. • Sampling points may be based on grid sampling or Multi-Increment Samples (MIS) techniques. • Sampling may include a sediment sample from the drainage grate at the base of the bowl antenna.

IH-Stump Neck Annex MRP Site Locations	General Notes
I. The Valley Impact Area (UXO-26)	• Subdivide The Valley Impact Fan Area into general categories √ Developed Areas (to be excluded) √ Undeveloped Areas √ Open Accessible Areas √ Inaccessible Areas (swamp/wetlands, also to be excluded) • Use geophysics surveys with variable transect spacings determined by the size of the survey areas (small sites – small transect spacing, larger sites – larger transect spacing) to reconnoiter the accessible undeveloped areas of the Valley Impact Area. Question raised as to whether Valley Impacts were ever discovered within the developed areas (Action Item – determine if there is a problem related to these old impacts?) • Historical records and observed munitions fragments and debris at Stump Neck Point (end of peninsula) also indicate EOD training activities (i.e., Range 6) within this area. • Munitions impact penetration depths may extend to a depth of 47 feet below ground surface for the largest munitions (16-inch projectiles). • Need for vegetation (underbrush) removal (or perhaps just stomping it down) to support geophysical grid performance. • There may be access limitations on wetlands vegetation clearance within this MRP site. • Selected subsurface sampling for MECs with anomaly avoidance.
J. Torpedo Casing Disposal Area (UXO-23)	• Use geophysics survey (10-foot line spacing) to search for disposal areas (areas with high metal content (torpedoes)). • Need for vegetation (underbrush) removal to support geophysical grid performance. • Looking for shallow burial pits with metallic torpedo casings at this site, so the geophysical signal should be very evident. • Subsurface anomalies (potential disposal pits) will be included in the selected subsurface soil sampling for munitions and explosives of concern (as residual MEC casing materials) with anomaly avoidance.

Date of Session: December 18 and 19, 2007
Scoping Session Purpose: Develop CSM and DQOs

Name	Title	Affiliation	Phone Number	E-Mail Address	Project Role
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December 18 and 19, 2007 Meeting Notes

The sixteen MRP sites were toured over the period of two days. The planning team agreed that, due to the number of sites (16) and complexity of the UFP SAP, additional meetings would be necessary. The agreement was made that the small arms ranges would be addressed separately from the MEC sites and that two UFP SAPs would be prepared.

The planning team approved the general approach for the five small arms/skeet ranges, which was described in the November 7-9, 2007 meeting notes.

Preparation of a technical memorandum for No Action at Test Area 2 (UXO-22) was approved on the basis that Test Area 2 was never used.

A planning meeting was scheduled for January 28 and 29 in the MDE headquarters in Baltimore, MD for the 10 MEC sites.

Date of Session: January 28 and 29, 2008
Scoping Session Purpose: Develop CSM and DQOs

Name	Title	Affiliation	Phone #	E-mail Address	Project Role
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January 28-29, 2008 Meeting Notes

Ten MEC MRP sites at IH-Stump Neck Annex, as listed below, were the principal focus of this scoping meeting.

- Air Blast Pond, UXO-01
- Area 8, UXO-02
- EOD School Demolition Area, UXO-28
- Basic IED Area, UXO-04
- Advanced IED Area, UXO-05
- Stump Neck Impact Area, UXO-10
- Test Area 1, UXO-21
- The Valley Impact Area, UXO-26

- Torpedo Burial Site, UXO-12
- Torpedo Casing Disposal Area, UXO-23

Ten MEC MRP sites are proposed for investigation in an SI. The goals of the SI Program for the MEC sites are:

- Evaluate if historical information supports whether site was an artillery impact range or whether explosives may have been used for training or demonstrational purposes (MEC).

- Perform area UXO surface sweep as site conditions require, and then execute geophysical survey to assess the area.

- Determine whether explosives or other contaminants MCs are present within the study area in quantities or concentrations that would require the Navy to proceed to an Remedial Investigation/Feasibility Study (RI/FS).

- Determine whether MC or other contaminants are present within the study area in quantities or concentrations that require an immediate response. If such quantities or concentration are present, then initiate an appropriate response. If no imminently hazardous MCs or other contaminants are present, then take no immediate action.

The 10 MEC MRP sites that will be investigated in the SI are addressed in this SAP. Site-specific background information was reviewed during the meeting and the general technical approach for the site investigations were developed as follows:

Air Blast Pond, UXO-01

<u>Background</u>

- Documented usage of bulk explosive testing during 1955-1975 using a circular aboveground impoundment filled with water.

- Air Blast Pond has been drained.

- There is evidence that other activities not related to the Air Blast Pond operations may have been conducted immediately outside the pond (based on site walks).

- Metallic debris is a problem at this site both inside and outside the Air Blast Pond.

- A 57mm projectile (expended) was recovered at this tie (on the berm).

- Based on the materials observed outside, but adjacent to the Air Blast Pond, there may have been other training activities performed at this site. There are multiple drums, pipe sections, solid metallic training items, and other debris outside the berms of the Air Blast Pond.

Technical Approach

- Use of a geophysics survey to perform site footprint reduction will require extensive work to remove metallic interference.

- Selected surface/subsurface sampling (explosives) to supplement existing environmental data.

- Determine the presence and concentrations of munitions constituents (MCs) in the environment (surface soils, subsurface soil, surface water, sediments).

- Limited soil sampling during the VI for soil (surface and subsurface) inside and outside the pond and sediment outside the Air Blast Pond confirmed no detectable explosives.

Area 8, UXO-02

Background

- The explosives used in Area 8 for training purposes may have included RDX, TNT, and PETN during 1957 - 1999.

- The design of the explosive shot locations (less than 0.5 pounds each) were configured to contain most of the detonation products; however the detonation shot operations may have produced a localized spray of detonated explosives (MC) in the immediate vicinity of the shot point during the training and resultant detonation activities.

Technical Approach

- Delineate suspect MEC on the surface, and qualify the amount of near surface suspect ferrous MEC across the accessible portions of selected water shot cluster areas. Locate subsurface anomalies that could possibly represent MEC at selected anomaly clusters detected by the UXO detector-aided sweep. Locate anomalies that could possibly represent MEC (if present) in the existing pond that was used for training exercises.

- The scope of geophysical activities at Area 8 is summarized as a UXO detector-aided surface sweep of the areas encompassing the water shot locations.

- Sonar survey of the pond to search for inert training devices discarded at the bottom of the pond.

- Possible geophysical survey across selected cluster anomalies detected by the UXO sweep (as deemed necessary).

- Use geophysics survey techniques (primarily transects) to reconnoiter the accessible land portions of the sites and confirm the presence of training devices to identify potential former training areas based on locations of subsurface anomalies.

- Determine the presence and concentrations of MCs in the environment (surface soils, subsurface soil, surface water, sediments) in the local environment.

EOD School Demolition Area, UXO-28

Background

- The explosives used at the EOD School Demo Area for training and demonstration purposes may have included RDX, TNT, Tetryl, and PETN during 1944 - 1949.

- After the basic demonstrations, EOD students completed exercises using cap blasters, blasting TNT blocks, shearing rails and trees, creating blow holes in the ground, and splitting live bombs by using shaped charges.

Technical Approach

- The plan for obtaining data at the EOD School Demolition Area is a UXO detector-aided surface sweep providing 100 percent coverage across a 100- by 200- foot grid surrounding the hut.

- A sweep with 50-foot spaced transects for the remainder of the 5 acres of the site [boundary as established in Preliminary Assessment (PA) Report].

- Use geophysics survey techniques (primarily transects) to reconnoiter the accessible land portions of the sites and confirm the presence of training devices to identify potential former training areas based on locations of subsurface anomalies.

- Determine the presence and concentrations of munitions constituents (MCs) in the environment (surface soils, subsurface soil, surface water, sediments) in the local environment.

Basic IED Area, UXO-04

Background

- The Basic IED Area was used for demonstration and testing purposes on a variety of explosive devices and chemicals for a period of approximately 40 years (1957 – 1996).

- Munitions used at this location included small arms, bulk high explosives, demolition charges, primers, detonators, fuzes, and squibs.

- The 1996 VI report indicated that explosives during that period were used at a rate of about 10 pounds net explosive weight (NEW) per year.

Technical Approach

- The plan for obtaining data at the Basic IED Area is a UXO detector-aided surface sweep providing 100 percent coverage across an 80 by 150 foot grid surrounding the demolition area.

- There will be a sweep with 30-foot spaced transects for the remainder of the 3.8 acres site (boundary as established in PA Report).

- Use geophysics survey techniques (primarily transects) to reconnoiter the accessible land portions of the sites and confirm the presence of training devices to identify potential former training areas based on locations of subsurface anomalies.

- Determine the presence and concentrations of MCs in the environment (surface soils, subsurface soil, surface water, sediments) in the local environment.

Advanced IED Area, UXO-05

Background

- Advanced IED Area includes SWMU # 27, which was used by the EOD School for training and to dispose of inert ordnance items and training aids (1953 -1995).

- Advanced IED Area activities included training on dropped munitions, fuze stripping, tools/methods, explosive analysis, X-ray (baltographic) Polaroid analysis, and evaluation of accidents related to dropped munitions.

- The PA report indicated that TNT (quarter- to half-pound) charges (most likely military dynamite – 75 percent RDX, 15 percent TNT, and 10 percent desensitizers and plasticizers) with detonation cord were used as training aids.

- At this time, SWMU #27 contains a subgrade concrete bunker that contained a variety of submunitions, practice rockets, snake eye fin tubes, bomb fuzes, and random munitions debris, all believed to be inert.

Technical Approach

- Delineate the surface and near surface (ferrous) distribution of suspect MEC across the accessible portions of a 200-foot grid surrounding the concrete foundation that contains visible suspect MEC. Locate suspect MEC on the surface, and qualify the amount of near surface suspect ferrous MEC in a reconnaissance level survey across the remainder of the site (about 10 acres). Delineate the subsurface distribution and extent of detectable suspect MEC across the accessible portions of the berm and open area surrounded by it.

- Determine whether MEC are present within the study area that require an immediate response. If so, initiate the appropriate response; otherwise, take no immediate action.

- UXO detector-aided surface sweep providing 100 percent coverage across a 200-foot grid surrounding the concrete foundation (SWMU #27) and a sweep with 50-foot spaced transects for the remainder of the 10-acre site (boundary as established in PA Report).

- Geophysical survey of cleared area and surrounding berm with no greater than a planned 5-foot survey line spacing

- Use geophysics survey techniques (primarily transects) to reconnoiter the accessible portion of the sites and confirm presence of training devices to identify former training areas based on locations of subsurface anomalies.

- Determine the presence and concentrations of munitions constituents (MCs) in the environment (surface soils, subsurface soil, surface water, sediments) in the local environment.

Stump Neck Impact Area, UXO-10

Background

- The Stump Neck Impact Area was used as a long-range Naval gunnery target from the early 1890s through early 1920s and was used for similar activities sporadically through the 1930s and 1940s. Certain sources indicate that rockets may have been fired into the Impact Area through 1947, and the range has been used for a variety of other training activities including land surface demolition testing and underwater testing prior to the construction of the Area 8 pond in 1957.

- There is no physical evidence of MEC/MC observed at the site, and no MCs were observed during the visual survey. However, based on information obtained during the data collection process, MEC is suspected for the Stump Neck Impact Area.

- Munitions constituents contained in the 75mm, 37mm, and 155mm projectiles include TNT, HMX, Composition B, Composition D, and perchlorate.

Technical Approach

- Determine surface and subsurface anomaly locations that could possibly represent MEC across the accessible portions of survey transects. The purpose of this SI approach will be to provide some reconnaissance level data as to the quantity of potential MEC within about the top 2 to 6 feet depending on the target metal mass and diameter which determine its maximum detection depth (larger items can be detected deeper than shallow ones). The survey area is marshy and aquatic, and MEC are not anticipated to be very near surface (expected maximum penetration depths range from 4 to 12 feet, thereby making some potential MEC too deep to detect by the survey).

- The scope of geophysical activities at the Stump Neck Impact Area includes UXO detector-aided surface sweep of the geophysical survey area.

- Geophysical survey across accessible portions of the site using a planned 50-foot transect spacing.

- Use geophysics survey techniques (primarily transects) to reconnoiter the accessible land portions of the sites and confirm the presence of training devices to identify potential former training areas based on locations of subsurface anomalies.

- Determine the presence and concentrations of MCs in the environment (surface soils, subsurface soil, surface water, sediments).

Test Area 1, UXO-21

Background

- Test Area 1 consists of approximately 4.5 acres of land in the middle of the Stump Neck Annex peninsula. This area was used in the 1950s for the construction of a 220-foot by 263-foot “hole-in-the-ground” antenna at the range used in pioneer moon relay communication experiments. The antenna portion of Test Area 1 is now wooded and overgrown with hardwood forest vegetation.

- Test Area 1 was used in the 1960s and 1970s for the Advances, Access, and Disablement, (AA&D) trainings, (including booby traps and trip wires). Subsequent training topics in the 1980s included IED and IND. As explained for other IED training activities, the actual training item devices were inert, but were connected to working components that would set off small (quarter pound blocks of TNT) located a short distance from the training item.

Technical Approach

- The plan for obtaining data at Test Area 1 is summarized as a UXO detector-aided surface sweep providing 100 percent coverage across the accessible portions of the 4.5 acre site (boundary as established in PA report) for those areas outside of the actual antenna “bowl” area.

- Use geophysics survey techniques (primarily transects) to reconnoiter the accessible land portions of the sites and confirm the presence of training devices to identify potential former training areas based on locations of subsurface anomalies.

- Determine the presence and concentrations of MCs in the environment (surface soils, subsurface soil, surface water, sediments).

The Valley Impact Area, UXO-26

Background

- The Valley Impact Area on Stump Neck Annex was used as a long-range Naval gunnery target by the Indian Head Main Installation (between the Potomac River and Mattawoman Creek to the northeast) from the early 1890s through early 1920s. The Valley is a 21-acre site located on the Indian Head main installation that was used for developing and testing numerous ordnance items from 1891 through 1921. According to historical documentation, practically all forms of Naval ordnance used from the 1890s until the 1920s (4-inch through 16-inch) were tested and/or developed at The Valley and fired onto The Valley Impact Area.

- The shells fired onto The Valley Impact Area contained different types of explosive fillers including black powder, smokeless powder, brown prismatic powders, emmensite, joveite, wet gun cotton, randite, and other high explosives, (e.g., Thorite). The explosives used at the EOD School Demo Area for training and demonstration purposes may have included RDX, TNT, Tetryl, and PETN during 1944 - 1949.

Technical Approach

- Use geophysics survey techniques (primarily transects) to reconnoiter the accessible land portions of the sites and confirm the presence of training devices to identify potential former training areas based on locations of subsurface anomalies.

- Determine presence/concentrations of MCs in the environment (surface soils, subsurface soil, surface water, sediments).

Torpedo Burial Site, UXO-12

Background

- The Torpedo Burial Site consists of a semi-circular shaped parcel, measuring approximately 1 acre in area, in the northern portion of Stump Neck Annex facility, although it is uncertain whether 15-foot long torpedoes were actually buried at this location.

- According to available reports, the site consists of at least one unlined earthen pit used to bury waste material, including torpedoes, primers, detonators, fuzes, squibs, and other associated hardware transported from a torpedo station near Washington, D.C. in the late 1940s or early 1950s. The entire Torpedo Burial Site is considered a suspect MEC area, with the 21-inch torpedo casing discovered during the visual survey as the only known MEC area.

- Potential MC at the site (based on the possible presence of torpedoes and their components) include TNT, RDX, Composition A, Composition B, Composition C, Torpex, PETN, dynamite, nitrocellulose, cordite, perchlorate.

Technical Approach

- UXO detector-aided surface sweep of the geophysical survey area.

- Geophysical survey across accessible portions of the site using a planned 5-foot survey line spacing.

- Use geophysics survey techniques (primarily transects) to reconnoiter the accessible land portions of the sites and confirm the presence of training devices to identify potential former training areas based on locations of subsurface anomalies.

- Determine presence/concentrations of MCs in the environment (surface soils, subsurface soil, surface water, sediments).

- Torpedo parts are visible at the surface, and additional torpedoes or parts of torpedoes may be present. Determine whether additional surface or subsurface anomalies that could possibly represent large MEC items are present across the accessible portions of the site (about 1.75 acres), and if present, locate them.

Torpedo Casing Disposal Area, UXO-23

Background

- The Torpedo Casing Disposal Area consists of a rectangular-shaped parcel, measuring approximately three-quarters of an acre in area, within the northern portion of the Stump Neck Annex facility. Navy personnel indicate that the area was used as a disposal site for torpedo casings during the 1950s, although the exact dates of use are unknown. A portion of the Torpedo Casing Disposal Area is within a designated wildlife area, while the rest of the site is located within a heavily forested area that is unused and not maintained.

- The entire Torpedo Casing Disposal Area is not suspected to contain MEC, since only torpedo casings with no explosive components were reportedly buried in the area.

- MC contamination derived from the Torpedo Casing Disposal Area may potentially migrate within the soil, surface water runoff, or groundwater.

Technical Approach

- Determine subsurface anomaly locations that could possibly represent large MEC disposal areas for torpedoes or other large MEC items across the accessible portions of the site (about 3/4 acres).

- The plan for obtaining data at the Torpedo Casing Disposal Area is a UXO detector-aided surface sweep of the geophysical survey area.

- Geophysical survey across accessible portions of the site using a planned 10-foot survey line spacing.

- Use geophysics survey techniques (primarily transects) to reconnoiter the accessible land portions of the sites and confirm the presence of training devices to identify potential former training areas based on locations of subsurface anomalies.

- Determine the presence and concentrations of MCs in the environment (surface soils, subsurface soil, surface water, sediments).

Date of Session: February 11, 2008
Scoping Session Purpose: Site Walk

Name	Title	Affiliation	Phone Number	E-Mail Address	Project Role
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February 11, 2008 Meeting Notes

A site walk, performed on February 11, 2008, was attended by the Tetra Tech Project Manager, the UXO Manager, and the FOL. The objectives of the site walk were as follows:

- Familiarize the FOL with the sites.
- Develop coordination activities between the UXO Manager and the FOL.

Participants also identified and reviewed logistical considerations of the field investigation including:

- Site access.
- Sequencing of surface clearance, geophysical investigation, and MC sampling activities.
- Navy restrictions on working.
- Vegetation clearing requirements.
- Coordination of MEC investigation and MC sampling activities.

Date of Session: May 14, 2008
Scoping Session Purpose: DQO Discussion

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May 14, 2008 Planning Meeting Minutes

The meeting started with a brief discussion of technical review comments provided by the Navy Chemist in the review of the SAP-QAPP for the small arms ranges at Indian Head-Stump Neck Annex. The rest of the meeting consisted of a general briefing and site-by-site discussion of problem statements, data quality objectives, and detailed technical approaches to collect, evaluate, and present the information necessary to support key site management decisions for individual MEC MRP sites. Tom Johnston (Tetra Tech QA Manager) also provided a brief discussion on technical approaches for UFP-QAPPs, recently received review comments, and the need to document team decisions and consensus decisions.

Comments/Decisions:

The SI is geared to provide the Navy some indication of what actions may be required for future land use at the various MRP sites. Land use controls may be required for certain MRP sites. Without a known or estimated impact to human health and the environment, there may be no compelling reason to do anything other than establish land use controls (institutional controls) for specific parcels or areas.

The term surface soil will refer to the 0- to 6-inch depth below the root zone. Subsurface soil, when collected, will be from depths of 2 to 4 feet and 4 to 6 feet, unless there are other depth-specific detected odors or visible staining that require modified soil depth sampling in the soil cores.

For groundwater samples, both total and dissolved metals will be analyzed for to determine the potential influence of suspended particulates on metals concentrations in groundwater.

Area 8—focus sampling on shot locations – surface soil from air-shot locations and sediment from about half the water-shot locations (both from the hole bottom and from the area around the hole perimeter).

Basic IED Area—consider evaluating groundwater and subsurface soil for Volatile Organic Compounds (VOCs) instead of limiting analyses to gasoline range organics. VOCs in surface soil have most likely volatilized since the site was last used.

Test Area 1—Multi-increment (MI) type surface soil sampling to be performed outside the “bowl” at the site.

Action Items:

Performance of MI sampling may use “wagon wheel” approach with a central “hub” sample and six or more “spoke” samples in a wheel-like pattern. There was some discussion on the length of the “spoke” segments from the hub, and Ralph Basinski stated that he would investigate the matter to develop a defensible and representative sampling protocol to address the size of the decision area.

Laboratory procurement must be completed to identify a laboratory that is qualified to perform SW-846 Method 8330B for explosives. Tetra Tech will sponsor a qualified laboratory to receive certification from the Navy.

Consensus Decisions:

Where appropriate, solid matrix environmental samples will be collected using a multi-increment sampling method. After drying, mixing, and sieving of the composited sample material to be analyzed, a sample aliquot will be removed for metals analysis (prior to grinding of the sample). This process will avoid the potential for biasing metals analyses with the reduced particle size and the increased total surface area that is available for leaching in metals analysis. The sample portion to be analyzed for explosives via SW-856 Method 8330B will be ground to the required size for this method.

SAP Worksheet #10 -- Problem Definition, Site History and Background

(UFP-QAPP Manual Section 2.5.2)

A detailed CSM is presented in Appendix B of Volume I for each of the 10 MEC sites located at the NSF-IH - Stump Neck Annex. A CSM is a description of a site and its environment that is based on existing knowledge. It describes the sources of MEC at a site; actual, potentially complete, and incomplete exposure pathways; current and proposed reasonable future uses of the property; and potential receptors. The source-receptor interaction is a descriptive output of a CSM.

The initial CSMs were developed as part of the PA Report (Malcolm Pirnie, 2005), which is one of the initial steps in the CERCLA process. The CSMs, which were presented in the PA Report, have been reviewed and modified as necessary based on additional information obtained during the Tetra Tech site visits and scoping meetings conducted during the preparation of this UFP SAP for the SI. The CSMs for each of the sites will be updated as additional information is obtained. Updated versions of the CSMs, which incorporate data obtained in the SI field effort, will be presented in the report prepared after all SI fieldwork is completed.

This introductory section includes general information on the site background and facility history. A brief summary of the Problem Definition for each of the 10 sites addressed in this UFP SAP has been prepared and is presented here (Worksheets 10.1 through 10.10). Appendix B of Volume I includes general descriptions of the geology, hydrology, endangered species, cultural settings, and natural resources on an installation-wide basis at the Stump Neck Annex as well as a detailed Problem Definition for each of the 10 MEC sites in terms of the site-specific CSM. The site–specific CSMs contain, in detail, the initial step (Step 1) of the DQO process, with site-specific maps for each site.

10-1 GENERAL INTRODUCTION FOR WORKSHEET #10

The Navy has conducted various testing, training, and disposal activities related to military munitions at the Stump Neck Annex, NSF-IH, Maryland, since it was established in 1890 as a Naval Ordnance Station. The general locations of the NSF-IH Main Installation and Stump Neck Annex are shown on Map 10-1 in Appendix B of Volume I. NSF-IH is located in northwestern Charles County, Maryland, approximately 25 miles southwest of Washington, D.C. The Stump Neck Annex covers approximately 1,100 acres on the Stump Neck peninsula at the confluence of the Potomac River and Chicamuxen Creek in Charles County, Maryland. Stump Neck Annex was acquired by the Navy in 1901 to support activities at the 2,300-acre Indian Head Main Installation. These two Navy properties are not contiguous; the Indian Head Main Installation is northeast of the Stump Neck Annex across Mattawoman Creek. General Smallwood State

Park and private property parcels are located east and southeast, respectively, of Stump Neck Annex, and the Chicamuxen Wildlife Management Area (WMA) is to the south across Chicamuxen Creek.

The Valley Impact Area and Stump Neck Impact Area are both located on the Stump Neck Annex (Map 10-2 in Appendix B of Volume I). These two areas received fire from the Valley Gun Proving Site located on the Main Installation of NSF-IH from 1891 through 1921. Various caliber guns (4-inch through 16-inch) were fired into these two areas. The projected firing fan from the Main Installation to the impact areas covers several of the sites discussed in this UFP SAP. In addition to fire from the gun proving site, the Stump Neck Impact Area received impacts from a firing range set up in the vicinity of Rum Point. Marine Corps Base (MCB) Quantico was also permitted to fire large artillery at the Stump Neck Annex for several years until 1934.

As a result of the Navy's explosives and munitions training activities, MEC may be present at various sties throughout the Stump Neck Annex. The term MEC includes DMM, UXO, and MC in high enough concentrations to pose an explosive hazard. This UFP SAP will cover the 10 sites presented in Table 10-1. A separate UFP SAP has been prepared to investigate five small arms ranges located on the Stump Neck Annex. The Navy is following the CERCLA process for the investigation of these sites.

The initial phase of the CERCLA process, the PA Report, was completed in September 2005 and identified 17 "other than operational range sites" or MRA/Ss at the Stump Neck Annex for further investigation (Malcolm Pirnie, 2005). Closed, transferred, and transferring military ranges and sites not located on an operational range are considered "other than operational." Two of the sites identified in the PA Report, the Old Demolition Area and Test Area 2, are considered to be currently active sites and are therefore not included in this UFP SAP.

The locations of the 10 sites presented in this UFP SAP are shown on Map 10-3 in Appendix B of Volume I. The Malcolm Pirnie (2005) PA Report used five primary sources of information to support the facility data collection effort, including historical archives, personal interviews, installation data repositories [including the Administrative Record (AR)], visual surveys, and off-facility data sources and repositories such as local libraries and museums. Table 10-1 summarizes the 10 sites at the Stump Neck Annex that are further discussed in this UFP SAP.

TABLE 10-1

**SUMMARY OF OTHER THAN OPERATIONAL RANGES
NAVAL SUPPORT FACILITY INDIAN HEAD
INDIAN HEAD, MARYLAND**

Site Name	Site No.	Size (acres)(1)	Purpose	Dates of Use
Air Blast Pond	UXO 01	3.72	Testing of bulk explosives	1955-1975
Area 8	UXO 02	22.61	Training on and defusing of explosive devices	1957-1999
EOD School Demolition Area	UXO 28	4.64	Demolition area	1944-1949
Basic IED Area	UXO 04	3.79	Training and demonstration of IEDs	1957-1996
Advanced IED Area	UXO 05	10.07	Training and demonstration of IEDs	1953-1995
Stump Neck Impact Area	UXO 10	32.88	Impact area	1891-1940s
Test Area 1	UXO 21	4.52	Communication experiments, AA&D training, IED/IND training, robotics training	1950s-1980s (robotics training 1990s - present)
Valley Impact Area	UXO 26	694	Safety danger zone	1891-1921 (Quantico fired in area 1931-1934)
Torpedo Burial Site	UXO 12	0.88	Burial of torpedoes	Late 1940s-Early 1950s
Torpedo Casing Disposal Area	UXO 23	0.74	Burial of torpedo casings	1950s

(1) Size as noted in the PA (Malcolm Pirnie, 2005)
AA&D - Advanced Access and Disablement
EOD - Explosive Ordnance Device
IED - Improvised Explosive Device
IND - Improvised Nuclear Device

INDIVIDUAL MRP SITE-SPECIFIC CHARACTERISTICS / PROBLEM DEFINITIONS

The following SAP worksheets (10.1 through 10.10) provide a brief summary of the Problem Definition for each of the "other than operational ranges" located on Stump Neck Annex, NSF-IH, Maryland. More detailed site specific information about each of the "other than operational ranges," including history and range description, land use, access controls and restrictions, visual survey observations and results, contaminant migration routes, and receptors is presented in Appendix B of Volume I.

SAP Worksheet #10.1 – Problem Definition Summary for the Air Blast Pond (UXO 01)

The Air Blast Pond is an earthen pit previously used to test the concussive factors of bulk explosives (including Pentolite, HBX-1, HBX-2, H-6, C-4, and Composition B). The unit hosted an estimated 1,500 shots (maximum charge weights were 8 pounds per shot) over 20 years of usage (1955 to 1975). The pit area has been drained of water and is overgrown with small trees. Rusted metal piping is present on the pit floor, and piping and wires are present in the pit berms. Steel cylinders, rusted drums, concrete and wooden platforms, and other razed structure debris are present in the wooded area immediately south of the pit. During the PA, a fired 57-mm projectile was observed on the northern side of the berm, and a C-4 end cap was observed on the southwestern portion of the berm. Therefore, the Air Blast Pond is regarded as a suspected MEC site.

The CSM (detailed in Appendix B of Volume I) indicates that potentially complete exposure pathways exist for both human and ecological receptors under current and hypothetical future land uses. Unacceptable levels of human health and ecological hazards from MEC may exist.

SAP Worksheet #10.2 – Problem Definition Summary for Area 8 (UXO 02)

Area 8, the Underwater Ordnance Training Area, consists of approximately 23 acres of wooded area and a small developed area (with a building and parking lot) with an explosives training pond to the south. Area 8 included 41 water shot and 30 air shot locations to train personnel to disarm inert training devices and to test demolition charges, primers, detonators, fuzes, and squibs. The water shot locations consisted of 6-to 9-foot holes filled with surface water to a depth of 4 to 5 feet. The explosive was placed 2 to 5 feet below the water surface, and students would work on an inert training item 30 feet away. The air shot locations had explosives suspended on a wire approximately 2 feet above the ground, and students would work on an inert training item 75 feet away from the air shot location. Explosives were limited to no more than 0.5 pound of explosives at shot locations in Area 8. Explosives included TNT block, PETN, military dynamite, blasting caps, detonation cords, and similar devices.

The pond at Area 8 was used for underwater EOD training with inert mines and torpedoes placed at the pond bottom. Students dove to the pond bottom and performed reconnaissance on the 10 to 15 inert items at that location. Additional EOD training was performed at the pond edge. The pond is now stocked and used for fishing.

From 1978 to 1999, a 100-foot-long portion of Chicamuxen Creek in Area 8 was used for training students with a half-buried inert mine on the creek bottom to simulate the conditions of reconnaissance and ordnance problem-solving in muddy waters.

The CSM (detailed in Appendix B of Volume I) indicates that potentially complete exposure pathways exist for both human and ecological receptors under current and hypothetical future land uses. Unacceptable levels of human health and ecological hazards from MEC may exist.

SAP Worksheet #10.3 – Problem Definition Summary for EOD School Demolition Area (UXO 28)

The EOD School Demolition Area consists of approximately 5 acres of mostly wooded and partly open field areas within the boundaries of the Marine Rifle Range (UXO 14), and partially within the Torpedo Burial Site (UXO 12). The EOD School Demolition Area is within the estimated firing fan of the Valley Impact Area; however, no MEC was observed during the visual site survey in 2003. The EOD School Demolition Area was used from 1944 to 1949 and supported the introduction of Indian Head EOD School graduates to live explosives. The introduced materials included blocks of TNT, tetryl packs, caps, primer cord, safety fuses, and shaped charges. Students would demonstrate the use of these explosives to shear rails and trees, blow holes in the ground, and split live bombs in situ using shaped charges. As a result of the training activities, MEC is suspected to be present over the entire area.

Investigations for MEC have not been conducted. MEC, if present, could present a physical hazard to human and ecological receptors. The CSM (detailed in Appendix B of Volume I) indicates that potentially complete exposure pathways exist for both human and ecological receptors under both current and hypothetical future land uses. Unacceptable human health and ecological hazards from MEC may exist.

SAP Worksheet #10.4 – Problem Definition Summary for Basic IED Area (UXO 04)

The Basic IED Area consists of approximately 4 acres of large wooded and open grassy fields. It was used from 1957 until approximately 1996 for the testing and demonstration of various explosive devices and chemicals. During the demonstrations, various chemicals and explosives were used.

The entire area has been identified as a suspected MEC site. MEC, if present, could present significant hazards to human and ecological receptors. The CSM (detailed in Appendix B of Volume I) indicates that potentially complete exposure pathways exist for both human and ecological receptors under both current and hypothetical future land uses. Unacceptable levels of human health and ecological hazards from MEC may exist.

SAP Worksheet #10.5 – Problem Definition Summary for the Advanced IED Area (UXO 05)

The Advanced IED Area was used by the EOD School for training and may have been used for the disposal of inert ordnance and training aids. An area of the site referred to as Solid Waste Management Unit (SWMU) 27 contains a concrete foundation in which a variety of submunitions and munitions debris are present. The site was reportedly active from 1953 to 1995 and is a part of the range fan of the Valley Impact Area. Currently, the site is defined as a mostly wooded 10-acre parcel. The Advanced IED Area is regarded as a suspected MEC site.

MEC, if present, could present a hazard to human and ecological receptors. The CSM (detailed in Appendix B of Volume I) indicates that potentially complete exposure pathways exist for both human and ecological receptors under both current and hypothetical future land uses. Unacceptable levels of human health and ecological hazards from MEC may exist.

SAP Worksheet #10.6 – Problem Definition Summary for the Stump Neck Impact Area (UXO 10)

The Stump Neck Impact Area was used as a long-range naval gunnery target from the early 1890s through the early 1920s and sporadically in the 1930s and 1940s. Sources indicate that rockets may also have been fired at the impact area as late as 1947, and a variety of other training activities occurred including land surface demolition testing and underwater testing prior to the construction of the Area 8 pond in 1957. The site encompasses about 33 acres of low-elevation wetlands, tidal pools, and marsh areas surrounded by Chicamuxen Creek in the central portion of Stump Neck Annex. The estimated ordnance penetration of the munitions fired on the Stump Neck Impact Area (1-inch to 14-inch projectiles) is between 4 and 12 feet bgs. Groundwater is present immediately below the ground surface within the boundaries of the Stump Neck Impact Area.

The Stump Neck Impact Area is regarded as a suspected MEC site. No previous environmental investigations have been conducted to determine whether MEC is present. The CSM (detailed in Appendix B of Volume I) indicates that potentially complete exposure pathways exist for both human and ecological receptors under current and hypothetical future land uses. Unacceptable levels of human health and ecological hazards from MEC may exist.

SAP Worksheet #10.7 – Problem Definition Summary for Test Area 1 (UXO 21)

Test Area 1 is an approximately 4.5-acre wooded site. In the 1950s the Naval Research Laboratory constructed a 220-foot by 263-foot "hole-in-the-ground" antenna (the bowl) to support moon relay communication experiments. During the 1960s and 1970s, Test Area 1 was used for AA&D training (such as booby traps and trip wires). In the 1980s, Test Area 1 was used for IED and IND training. All training items were inert; however, the devices were connected to small charges (a quarter-pound block of TNT) located a short distance from the training item. The charges were sized for total consumption, although small amounts of residue may remain. During the 1990s, Test Area 1 was used primarily for robotics testing.

Based on historical use of Test Area 1 for IED and IND training, all of the area is suspect for MEC. The CSM (detailed in Appendix B of Volume I) indicates that potentially complete exposure pathways exist for both human and ecological receptors under current and hypothetical future land uses. Unacceptable levels of human health and ecological hazards from MEC may exist.

SAP Worksheet #10.8 – Problem Definition Summary for the Valley Impact Area (UXO 26)

The Valley Impact Area is part of the firing fan for the Indian Head Valley gun proving site firing point, which was used from 1891 to 1921. Projectiles from a wide variety of ordnance fired from the Valley gun proving site may have impacted the Valley Impact Area. In addition, the Valley Impact Area also received ordnance from a firing range set up by units from the Quantico MCB (on Stump Neck Annex near Rum Point—the exact location is unknown) for 75-mm guns and howitzers. MCB Quantico was also permitted to fire large artillery at Stump Neck Annex for several years until 1934.

Based on historical use, the portion of the Stump Neck peninsula overlapped by the Valley Impact Area is suspect for MEC. The CSM (detailed in Appendix B of Volume I) indicates that potentially complete exposure pathways exist for both human and ecological receptors under current and hypothetical future land uses. Unacceptable levels of human health and ecological hazards from MEC may exist.

SAP Worksheet #10.9 – Problem Definition Summary for the Torpedo Burial Site (UXO 12)

The 1.75-acre Torpedo Burial Site may have been used for disposal of torpedoes during the 1940s and 1950s (before becoming inactive during the early 1950s). According to available reports, the site consists of at least one unlined earthen pit used to bury waste material including torpedoes, primers, detonators, fuzes, squibs, and other associated hardware transported from a torpedo station near Washington, D.C.,

in the late 1940s or early 1950s. The site area was expanded following the discovery of a 21-inch torpedo casing during the visual survey.

The entire Torpedo Burial Site is considered a suspected MEC area, although the 21-inch torpedo casing discovered during the visual survey is the only known MEC area. The CSM (detailed in Appendix B of Volume I) indicates that potentially complete exposure pathways exist for both human and ecological receptors under current and hypothetical future land uses. Unacceptable levels of human health and ecological hazards from MEC may exist.

SAP Worksheet #10.10 – Problem Definition Summary for the Torpedo Casing Disposal Area (UXO 23)

The Torpedo Casing Disposal Area is described as having been used in the 1950s to dispose of inert torpedoes, which may still remain. A previous geophysical survey of the general area suggests that magnetic anomalies greater than 3 feet deep may be indicative of large-item burial locations. The torpedo casings are presumed to be inert, although there is the potential that some explosive residue (torpex consisting principally of RDX and HMX) may remain. MEC are not suspected to be present in this area.

SAP Worksheet #11.1 - Data Quality Objectives for the Air Blast Pond (UXO 01)

STATE THE PROBLEM (STEP 1)

Worksheet 10.1 contains the problem definition for the Air Blast Pond.

IDENTIFY THE GOAL OF THE STUDY (STEP 2)

The primary goal of the SI for the Air Blast Pond is to obtain environmental data for use in making the following decisions:

1. Determine whether surface MEC are present within the study area in a condition or quantity that presents an immediate human health hazard and requires an immediate response. If such quantities are present, then initiate an appropriate remedial response. Otherwise, take no immediate action.

2. If surface MEC debris or subsurface anomalies indicate the presence of suspect MEC, then proceed with further investigation in the RI phase. If not, proceed to no further action (NFA) for MEC.

3. Determine the extent of MEC contamination for the purposes of delineation. If sufficient data have been collected for this purpose, then stop collecting data. If more data are required to delineate the extent of contamination, then conduct further investigation in the RI phase.

IDENTIFY INFORMATION INPUTS (STEP 3)

Data and information that will be required to achieve the goals include the following:

1. UXO Surface Sweeps:

   Surface: Data will be obtained from detector-aided surface sweeps conducted by UXO personnel using hand-held metal detectors, such as the Schonstedt GA-52Cx or White's Spectrum XLT or equivalent, and visual observations. UXO Technicians will use metal detectors to locate metallic items on the surface. Items located on the surface will be visually examined to determine if they are suspect MEC, munitions potentially presenting an explosive hazard (MPPEH), munitions debris (MD) or non-MD. If located, suspect MEC, MPPEH and/or MD will not be moved or disturbed during the SI.

   Subsurface: Metal detector anomalies (i.e., a response from the metal detector at a location where no surface materials are found) that result from the detector-aided surface sweeps will be used to locate

suspect metal objects in the shallow subsurface soil. Suspect MEC, MPPEH, MD and subsurface metals (if metals are MEC, MPPEH, or MD) could potentially result in the release of MC.

DEFINE THE BOUNDARIES OF THE STUDY (STEP 4)

The current MEC site investigation at the Air Blast Pond is limited to detector-aided surface investigations.

1. The initial horizontal boundary for the MEC investigation will include the Air Blast Pond and the area surrounding the pond identified in the PA as the suspect MEC area. See Figure 17.1-1.

2. The initial vertical boundary for the MEC investigation (detector-aided surface sweep) will be 1 foot bgs. The theoretical penetration depth for the 57 mm projectiles similar to the one observed during the site walks is up to 6.5 feet bgs. However, it is unlikely that the projectile's presence was the result of the Air Blast Pond being used as an impact area. It is most likely to be present as the result of operations occurring on the surface.

DEVELOP THE ANALYTIC APPROACH (STEP 5)

The decision rules for this MEC investigation are as follows:

1. The SI will use UXO detector-aided surface sweeps to locate surface and shallow subsurface anomalies. If the detector-aided surface sweep shows that suspect surface MEC and subsurface anomalies are not present, then proceed to NFA for MEC.

2. The SI will use UXO detector-aided surface sweeps to locate surface and shallow subsurface anomalies. If suspect MEC is observed on the surface or if shallow subsurface anomalies exist, then investigate the surface and/or subsurface soil in the location of the suspect MEC or shallow subsurface anomaly in order to determine if MC contamination is present in the soil.

Decision rules for delineation: MEC Approach

1. If suspect MEC and/or anomalies are found to be present in only a portion of the area surveyed then reduce the boundaries of the suspect MEC area to the outermost locations where suspect MEC or anomalies were found.

2. If suspect MEC and/or anomalies are found to be present at the boundaries of the surveyed area then consider extending the boundaries during the RI.

SPECIFY PERFORMANCE OR ACCEPTANCE CRITERIA (STEP 6)

1. The criterion for the detector-aided surface sweeps will be a go/no-go test performed by determining whether the instrument responds to metallic objects under a blanket (blanket test).

Details of the performance criterion for the blanket test are provided in Worksheet 12.

DEVELOP THE PLAN FOR OBTAINING DATA (STEP 7)

The proposed SI detector-aided surface field data collection program for the Air Blast Pond is described in detail in Worksheet 17. A brief summary of this approach is presented below.

Detector-Aided Surface Sweeps

1. Perform the blanket test. In this test, metal objects such as trailer hitches will be placed under a tarpaulin to verify that metal detectors are functioning.

2. Conduct detector-aided surface sweeps of the accessible area designated within the PA as suspect for MEC as shown on Figure 17.1-1. The sweep will be conducted by UXO technicians in 5-foot wide transects using hand-held all metals detectors (White) or magnetic locators (Schonstedt, GA-52CX). A grid (100-foot sides) will be pre-established. The grid nodes will be staked in the field using a global positioning system (GPS) instrument. Stakes will be placed at 5-foot intervals on opposite sides (north - south sides) of the grid. In clear areas (minimal tree canopy), stakes will be placed every 5-feet on the opposite intervals (east – west) and ropes will be stretched from one side to the other to establish 5-foot wide lanes. In heavily vegetated areas, where stretching of ropes is not feasible, technicians will walk side-by-side at 5–foot intervals. Locations where visual observations of suspect MEC, MPPEH, MD or subsurface anomalies are observed will be marked with a stake. Pictures will be taken of items observed on the surface. In clear areas the locations will be recorded using a GPS. In areas where tree canopy precludes use of a GPS locations will be established using a tape measure and compass measurements from a known location(s).

3. Utilize information from detector-aided surface sweep to identify surface and subsurface soil sampling locations areas within the footprint of the surface sweeps for collection of soil samples based on the presence of MD and shallow subsurface anomalies.

SAP Worksheet #11.2 - Data Quality Objectives for Area 8 (UXO 02)

STATE THE PROBLEM (STEP 1)

Worksheet 10.2 contains the problem definition for Area 8.

IDENTIFY THE GOAL OF THE STUDY (STEP 2)

The primary goal of the SI for Area 8 is to obtain environmental data for use in making the following decisions:

1. Determine whether surface MEC are present in a condition or quantity that presents an immediate human health hazard and requires an immediate response. If such quantities are present, then initiate an appropriate remedial response. Otherwise, take no immediate action.

2. If surface MEC debris or subsurface anomalies indicate the presence of suspect MEC, then proceed with further investigation in the RI phase. If not, proceed to NFA for MEC. In this case, MC may still be present, so continue to investigate for the presence of MC contamination in soil, sediment, and groundwater.

3. Determine the extent of MEC contamination for the purposes of delineation. If sufficient data have been collected for this purpose, then stop collecting data. If more data are required to delineate the extent of contamination, then conduct further investigation in the RI phase.

IDENTIFY INFORMATION INPUTS (STEP 3)

Data and information that will be required to achieve the goals include the following:

1. UXO Surface Sweeps and Geophysical Investigation:
   Surface: Data will be obtained from detector-aided surface sweeps conducted by UXO personnel using hand-held metal detectors such as the Schonstedt GA-52Cx or equivalent, and visual observations. UXO Technicians will use metal detectors to locate metallic items on the surface. Items located on the surface will be visually examined to determine if they are suspect MEC, MPPEH, MD or non-MD. If located, suspect MEC, MPPEH and/or MD will not be moved or disturbed during the SI.

Subsurface: Metal detector anomalies (i.e., a response from the metal detector at a location where no surface materials are found) that result from the detector-aided surface sweeps will be used, along with data from a subsurface geophysical investigation conducted by a geophysicist using an all metals detector (such as a Geometrics G858), to locate suspect metal objects in subsurface soil. Suspect MEC, MPPEH, MD and subsurface metals (if metals are MEC, MPPEH, or MD) could potentially result in the release of MC.

Water: Data from detector-aided (GPS located) sweeps will be used to locate training items, believed to be inert, that were possibly discarded in the pond.

DEFINE BOUNDARIES OF THE STUDY (STEP 4)

The current MEC site investigation at Area 8 is limited to detector-aided surface and subsurface geophysical investigations.

1. The initial horizontal boundary for the MEC investigation will include the area shown on Figure 17.2-1.

2. The initial vertical boundary for the MEC investigation (detector-aided surface sweeps and possible geophysical subsurface investigation) will be 6 feet bgs within the land area. It is reported that explosives at Area 8 were placed at 2 to 5 feet below the water surface in the 6 to 9 foot deep water shot locations.

DEVELOP THE ANALYTIC APPROACH (STEP 5)

The decision rules for this MEC investigation are as follows:

1. If the detector-aided surface sweep or geophysical investigation shows no suspect surface MEC, subsurface MEC, or anomalies in the land or pond area, then proceed to NFA for MEC. In this case, MC may still be present, so continue to investigate for the presence of MC contamination in surface soil, subsurface soil, sediment, and groundwater.

2. If suspect MEC is observed on the surface, or if subsurface anomalies exist, then investigate the surface and/or subsurface soil in the location of the suspect MEC or subsurface anomaly in order to determine if MC contamination is present in the soil.

3. If anomalies are present in the pond, they will be treated as suspect MEC until visual inspection certifies the item to be free of explosives. The sediment will then be investigated for the presence of MC contamination.

Decision rules for delineation: MEC Approach

1. If suspect MEC and/or anomalies are found to be present in only a portion of the area surveyed then reduce the boundaries of the suspect MEC area to the outermost locations where suspect MEC or anomalies were found.

2. If suspect MEC and/or anomalies are found to be present at the boundaries of the surveyed area then consider extending the boundaries during the RI.

SPECIFY PERFORMANCE OR ACCEPTANCE CRITERIA (STEP 6)

1. The criterion for the detector-aided surface sweeps will be a go/no-go test performed by determining whether the instrument responds to metallic objects under a blanket (blanket test).

2. The criteria for the geophysical equipment function test will be:
   a. Detection of all seed items buried within 11x depth;
   b. Horizontal positions of seeded items within 1 meter of known locations.

Details of the performance criteria for the blanket test and geophysical equipment function test are provided Worksheet 12.

DEVELOP THE PLAN FOR OBTAINING DATA (STEP 7)

The proposed SI detector-aided surface and subsurface geophysics field data collection program for Area 8 is described in detail in Worksheet 17. A brief summary of this approach is presented below.

<u>Detector-Aided Surface Sweeps</u>

1. Perform the blanket test. In this test metal objects such as trailer hitches, will be placed under a tarpaulin to verify that metal detectors are functioning.

2. Conduct detector-aided surface sweeps of the established survey areas as shown on Figure 17.2-1. The sweeps will be conducted by UXO Technicians, using hand held magnetic metal detectors

(Schonstedt GA-52Cx), in areas where water shots were located and at the Old Shot Hole. A sweep will be conducted at 4 parallel transects spaced 15 feet apart over numerous air shot locations. A 100 percent detector-aided surface sweep will also be conducted of accessible areas within 50 feet of any anomaly clusters identified along transects during detector-aided surface sweeps, or during the subsurface geophysical investigation.. Locations where visual observations of suspect MEC, MPPEH, MD or subsurface anomalies are observed will be marked with a stake. Pictures will be taken of items observed on the surface. In clear areas the locations will be recorded using a GPS. In areas where tree canopy precludes use of a GPS, locations will be established using a tape measure and compass measurements from a known location(s).

3. An underwater magnetic locator instrument will be used to search and locate anomalies on the bottom of the pond. Data will be collected along parallel survey lines spaced no greater than 5 feet apart using ropes anchored to the land or buoys placed across the pond. Anomaly locations will be reacquired and surveyed using GPS.

4. Utilize information from detector-aided sweeps to identify surface soil, subsurface soil and sediment sampling location areas within the footprint of the surface sweeps for collection of soil and sediment samples based on the presence of MD and subsurface anomalies.

Subsurface Geophysics

1. Determine whether it is necessary to conduct a subsurface geophysical investigation based on the number, the areal extent and the location of shallow subsurface anomalies identified during the detector-aided surface sweeps. If no shallow subsurface anomalies are present, then subsurface geophysics will not be considered.

2. Perform the geophysical equipment function test. In this test, metals items will be buried at various depths. Geophysical instrumentation will then be tested to verify that the operator, instrumentation and software are functioning properly. A Geometrics G858 is planned for use at this site.

3. Conduct the subsurface geophysical investigation at anomaly clusters. The geophysical survey will be conducted at selected anomaly clusters based on the number, areal extent and location.

4. Utilize information from the subsurface geophysical investigation to identify soil sampling locations for collection of soil based on the presence of subsurface anomalies.

SAP Worksheet #11.3 - Data Quality Objectives for EOD School Demolition Area (UXO 28)

STATE THE PROBLEM (STEP 1)

Worksheet 10.3 contains the problem definition for the EOD School Demolition Area.

IDENTIFY THE GOAL OF THE STUDY (STEP 2)

The primary goal of the SI for the EOD School Demolition Area is to obtain environmental data for use in making the following decisions:

1. Determine whether surface MEC are present in a condition or quantity that presents an immediate human health hazard and requires an immediate action. If such quantities are present, then initiate an appropriate remedial response. Otherwise, take no immediate action.

2. If surface MEC debris or anomalies indicate the presence of suspect MEC, then proceed with further investigation in the RI phase. If not, proceed to NFA for MEC. In this case, MC may still be present, so continue to investigate for the presence of MC contamination in surface soil.

3. Determine the extent of MEC contamination for the purposes of delineation. If sufficient data have been collected for this purpose, then stop collecting data. If more data are required to delineate the extent of contamination, then conduct further investigation in the RI phase.

IDENTIFY INFORMATION INPUTS (STEP 3)

Data and information that will be required to make the decisions include the following:

1. UXO Surface Sweeps and Geophysical Investigation:
   Surface: Data will be obtained from detector-aided surface sweeps conducted by UXO personnel using hand-held metal detectors such as the Schonstedt GA-52Cx, White's Spectrum XLT, or equivalent, and visual observations. UXO Technicians will use metal detectors to locate metallic items on the surface. Items located on the surface will be visually examined to determine if they are suspect MEC, MPPEH, MD or non-MD. If located, suspect MEC, MPPEH and/or MD will not be moved or disturbed during the SI.

   Subsurface: Locations of suspected metal objects in subsurface soil will be identified using metal detector anomalies (i.e., a response from the metal detector at a location where no surface materials

are found) that result from the detector-aided surface sweeps will be used, along with data from a subsurface geophysical investigation conducted by a geophysicist using an all metals detector (such as Geonics EM61-MK2 or Geometrics G858 magnetometer), to locate suspect metal objects in subsurface soil.. The choice of instrument will be based on the results of the Instrument Test Strip (ITS). Suspect MEC, MPPEH, MD and subsurface metals (if metals are MEC, MPPEH, or MD) could potentially result in the release of MC.

DEFINE THE BOUNDARIES OF THE STUDY (STEP 4)

The current MEC site investigation at the EOD School Demolition Area is limited to detector-aided surface and subsurface geophysical investigations.

1. The initial horizontal boundary for the MEC investigation is the boundary of the EOD School Demolition Area as shown on Figure 17.3-1.

2. The initial vertical boundary for the MEC investigation (detector-aided surface sweeps and geophysical data) will be 4 feet bgs within the land area. Site activities included usage of explosive charges which created blow holes which may have been 4 feet deep. The site is overlapped by the firing fan from the Valley located on the Main Installation; therefore, there is the potential for munitions associated with the Valley to be present in the soil. Information from this investigation will also be considered in the assessment of impacts from munitions fired from the Valley.

DEVELOP THE ANALYTIC APPROACH (STEP 5)

The decision rules for this MEC investigation are as follows:

1. If the detector-aided surface sweeps or geophysical investigation shows that suspect surface MEC and/or anomalies are not present, then proceed to NFA for MEC. In this case, MC may still be present, so continue to investigate for the presence of MC contamination in surface and subsurface soil.

2. If suspect MEC is observed on the surface or anomalies are present, then investigate the surface soil in the location of the suspect MEC or subsurface anomalies in order to determine if MC contamination is present in the soil.

Decision rules for delineation: MEC Approach

1. If suspect MEC and/or anomalies are found to be present in only a portion of the area surveyed then reduce the boundaries of the suspect MEC area to the outermost locations where suspect MEC or anomalies were found.

2. If suspect MEC and/or anomalies are found to be present at the boundaries of the surveyed area then consider extending the boundaries during the RI.

SPECIFY PERFORMANCE OR ACCEPTANCE CRITERIA (STEP 6)

1. The criterion for the detector-aided surface sweeps will be a go/no-go test performed by determining whether the instrument responds to metallic objects under a blanket (blanket test).

2. The criteria for the geophysical equipment function test will be:
   a. Detection of all seed items buried within the 11x depth;
   b. Horizontal positions of seeded items within 1 meter of known locations.

Details of the performance criteria for the blanket test and geophysical equipment function test are provided in Worksheet 12.

DEVELOP THE PLAN FOR OBTAINING DATA (STEP 7)

The proposed SI detector-aided surface and subsurface geophysics field data collection program for the EOD School Demolition Area is described in detail in Worksheet 17. A brief summary of the approach is presented below.

<u>Detector-Aided Surface Sweeps</u>

1. Perform the blanket test. In this test metal objects such as trailer hitches, will be placed under a tarpaulin to verify that metal detectors are functioning.

2. Conduct detector-aided surface sweeps of the established survey areas as shown on Figure 17.3-1. A grid, 100 by 200 foot, surrounding the former ready bunker area, will be established and will receive 100-percent survey coverage. Sweeps, at 5-foot spaced transects will be conducted for the remainder of the area. A 100 percent detector-aided surface sweep will also be conducted of accessible areas within 50 feet of any anomaly clusters identified along transects during detector-aided surface sweeps, or during the subsurface geophysics investigation. The sweeps will be

conducted by UXO technicians using hand-held metal detectors (White). Grid nodes will be staked in the field using a GPS unit. Stakes will be placed at 5-foot intervals on opposite sides (north - south sides) of the grid. In clear areas (minimal tree canopy) stakes will be placed every 5-foot on the opposite intervals (east – west) and ropes will be stretched from one side to the other to establish 5-foot wide lanes. In heavily vegetated areas, where stretching of ropes is not feasible, technicians will walk side-by-side at 5–foot intervals. Locations where visual observations of suspect MEC, MPPEH, MD or subsurface anomalies are observed will be marked with a stake. Pictures will be taken of items observed on the surface. In clear areas the locations will be recorded using a GPS unit. In areas where tree canopy precludes use of a GPS unit, locations will be established using a tape measure and compass measurements from a known location(s).

3. Utilize information from detector-aided sweeps to identify surface soil sampling location areas within the footprint of the surface sweeps for collection of soil samples based on the presence of MD and subsurface anomalies.

Subsurface Geophysics

1. Perform the geophysical equipment function test. In this test, metals items will be buried at various depths. Geophysical instrumentation will then be tested to verify that the operator, instrumentation and software are functioning properly. A Geonics EM61-MK2 or Geometrics G858 is planned for use at this site.

2. Conduct 100-percent survey of the 100- by 200-foot grid surrounding the former ready bunker area. Use survey line spacing no greater than 5 feet. Field conditions (i.e., brush) will further determine survey line spacing.

3. Conduct survey at 50-foot spaced transects for the remainder of the site.

4. Conduct 100-percent survey of accessible areas within 50 feet of any anomaly clusters identified along transects during the detector-aided surface sweeps or during the subsurface geophysical investigation.

SAP Worksheet #11.4 - Data Quality Objectives for Basic IED Area (UXO 04)

STATE THE PROBLEM (STEP 1)

Worksheet 10.4 contains the problem definition for the Basic IED Area.

IDENTIFY THE GOAL OF THE STUDY (STEP 2)

The primary goal of the SI for the Basic IED Area is to obtain environmental data for use in making the following decisions:

1. Determine whether surface MEC are present in a condition or quantity that presents an immediate human health hazard and requires an immediate response. If such quantities are present, then initiate an appropriate remedial response. Otherwise, take no immediate action.

2. If surface MEC debris or subsurface anomalies indicate the presence of suspect MEC, then proceed with further investigation in the RI phase. If not, proceed to NFA for MEC. In this case, MC may still be present, so continue to investigate for the presence of MC contamination in surface soil, subsurface soil, and groundwater.

3. Determine the extent of MEC contamination for the purposes of delineation. If sufficient data have been collected for this purpose, then stop collecting data. If more data are required to delineate the extent of contamination, then conduct further investigation in the RI phase.

IDENTIFY INFORMATION INPUTS (STEP 3)

Data and information that will be required to make the decisions include the following:

1. UXO Surface Sweeps:
   Surface: Data will be obtained from detector-aided surface sweeps conducted by UXO personnel using hand-held metal detectors, such as the Schonstedt GA-52Cx, White's Spectrum XLT, or equivalent, and visual observations. UXO Technicians will use metal detectors to locate metallic items on the surface. Items located on the surface will be visually examined to determine if they are suspect MEC, MPPEH, MD or non-MD. If located, suspect MEC, MPPEH and/or MD will not be moved or disturbed during the SI.

Subsurface: Metal detector anomalies (i.e., a response from the metal detector at a location where no surface materials are found) that result from the detector-aided surface sweeps will be used to locate suspect metal objects in subsurface soil. Suspect MEC, MPPEH, munitions debris and subsurface metals (if metals are MEC, MPPEH, or MD) could potentially result in the release of MC.

DEFINE THE BOUNDARIES OF THE STUDY (STEP 4)

The current MEC site investigation at the Basic IED Area is limited to detector-aided surface investigations.

1. The initial horizontal boundary for the MEC investigation is defined as the Basic IED Area as presented on Figure 17.4-1.

2. The initial vertical boundary for the MEC investigation (detector-aided surface sweeps) will be 1 foot bgs within the land area. Explosives were used at this site only on the surface for testing and demonstration purposes. This site is overlapped by the firing fan from the Valley located on the Main Installation; therefore, there is the potential for munitions associated with the Valley to be present in the soil. Data from this investigation will also be used in the assessment of impacts from munitions fired from the Valley.

DEVELOP THE ANALYTIC APPROACH (STEP 5)

The decision rules for this MEC investigation are as follows:

1. The SI will use UXO detector-aided surface sweeps to locate surface and shallow subsurface anomalies. If the detector-aided surface sweeps shows that suspect surface MEC and subsurface anomalies are not present, then proceed to NFA for MEC. In this case, MC may still be present, so continue to investigate for the presence of MC contamination in surface soil, subsurface soil, and groundwater.

2. The SI will use UXO detector-aided surface sweeps to locate surface and shallow subsurface anomalies. If suspect MEC is observed on the surface or subsurface anomalies exist, then investigate the surface and/or subsurface soil in the location of the suspect MEC or subsurface anomaly in order to determine if MC contamination is present in the soils. .

Decision rules for delineation: MEC Approach

1. If suspect MEC and/or anomalies are found to be present in only a portion of the area surveyed then reduce the boundaries of the suspect MEC area to the outermost locations where suspect MEC or anomalies were found.

2. If suspect MEC and/or anomalies are found to be present at the boundaries of the surveyed area then consider extending the boundaries during the RI.

SPECIFY PERFORMANCE OR ACCEPTANCE CRITERIA (STEP 6)

1. The criterion for the detector-aided surface sweeps will be a go/no-go test performed by determining whether the instrument responds to metallic objects under a blanket (blanket test).

Details of the performance criteria for the blanket test are provided in Worksheet 12.

DEVELOP THE PLAN FOR OBTAINING DATA (STEP 7)

The proposed SI detector-aided surface field data collection program for the Basic IED Area is detailed in Worksheet 17. A brief summary of this approach is presented below.

<u>Detector-Aided Surface Sweeps</u>

1. Perform the blanket test. In this test, metal objects such as trailer hitches will be placed under a tarpaulin to verify that metal detectors are functioning.

2. Conduct detector-aided surface sweeps of the established survey areas as shown on Figure 17.4-1. A 90- by 150-foot grid around the former detonation area will be established and will receive 100-percent coverage. Sweeps, at 50-foot spaced transects will be conducted for the remainder of the area. A 100 percent detector-aided surface sweep will also be conducted of accessible areas within 50 feet of any anomaly clusters identified along transects during detector-aided surface sweeps,. The sweeps will be conducted by UXO Technicians using hand held metal detectors (Schonstedt or White's). Grid nodes will be staked in the field using a GPS unit. Stakes will be placed at 5-foot intervals on opposite sides (north - south sides) of the grid. In clear areas (minimal tree canopy) stakes will be placed every 5 feet on the opposite intervals (east – west) and ropes will be stretched from one side to the other to establish 5-foot wide lanes. In heavily vegetated areas, where stretching of ropes is not feasible, technicians will walk side-by-side at 5–foot intervals. Locations where visual

observations of suspect MEC, MPPEH, MD or subsurface anomalies are observed will be marked with a stake. Pictures will be taken of items observed on the surface. In clear areas, the locations will be recorded using a GPS unit. In areas where tree canopy precludes use of a GPS unit, locations will be established using a tape measure and compass measurements from a known location(s).

3. Utilize information from detector-aided sweeps to identify soil sampling location areas within the footprint of the surface sweeps for collection of soil samples based on the presence of MD and subsurface anomalies.

SAP Worksheet #11.5 - Data Quality Objectives for the Advanced IED Area (UXO 05)

STATE THE PROBLEM (STEP 1)

Worksheet 10.5 contains the problem definition for the Advanced IED Area.

IDENTIFY THE GOAL OF THE STUDY (STEP 2)

The primary goal of the SI for the Advanced IED Area is to obtain environmental data for use in making the following decisions:

1. Determine whether surface MEC are present in a condition or quantity that presents an immediate human health hazard and requires an immediate action. If such quantities are present, then initiate an appropriate remedial response. Otherwise, take no immediate action.

2. If surface MEC debris or subsurface anomalies indicate the presence of suspect MEC, then proceed with further investigation in the RI phase. If not, proceed to NFA for MEC. In this case, MC may still be present, so continue to investigate for the presence of MC contamination is surface and subsurface soil.

3. Determine the extent of MEC contamination for the purposes of delineation. If sufficient data have been collected for this purpose, then stop collecting data. If more data are required to delineate the extent of contamination, then conduct further investigation in the RI phase.

IDENTIFY INFORMATION INPUTS (STEP 3)

Data and information that will be required to make the decisions include the following:

1. UXO Surface Sweeps and Geophysical Investigation:
   Surface: Data will be obtained from detector-aided surface sweeps conducted by UXO personnel using hand-held metal detectors such as Schonstedt GA-52Cx, White's Spectrum XLT, or equivalent, and visual observations. UXO Technicians will use metal detectors to locate metallic items on the surface. Items located on the surface will be visually examined to determine if they are suspect MEC, MPPEH, MD or non-MD. If located, suspect MEC, MPPEH and/or MD will not be moved or disturbed during the SI.

Subsurface: Metal detector anomalies (i.e., a response from the metal detector at locations where no surface materials are found) that result from the detector-aided surface sweeps will be used, along with data from a subsurface geophysical investigation conducted by a geophysicist using a Geonics EM61 or Geometrics G858, to locate suspect metal objects in subsurface soil. The choice of instrument will be based on the results of the ITS. Suspect MEC, MPPEH, MD and subsurface metals (if metals are MEC, MPPEH, or MD) could potentially result in the release of MC.

DEFINE THE BOUNDARIES OF THE STUDY (STEP 4)

The current MEC site investigation at the Advanced IED Area is limited to detector-aided surface and subsurface geophysical investigations.

1. The initial horizontal boundary for the MEC is the boundary of the Advanced IED Area as defined in the PA and shown on Figure 17.5-1.

2. The initial vertical boundary for the MEC investigation (detector-aided surface sweeps and geophysical data) will be 1 foot bgs within the land area as shown on Figure 17.5-1. This area was used for training which did not involve firing projectile-type ordnance items; therefore, ordnance items are not suspected to be found below the 1 foot interval. The Advanced IED Area is overlapped by the firing fan from the Valley located at the Main Installation; therefore, there is the potential for munitions associated with the Valley to be present in this area. Data from this investigation will also be used in the assessment of impacts from munitions fired from the Valley.

DEVELOP THE ANALYTIC APPROACH (STEP 5)

The decision rules for this MEC investigation are as follows:

1. If the detector-aided surface sweeps or geophysical investigation shows that suspect surface MEC and subsurface anomalies are not present, then proceed to NFA for MEC. In this case, MC may still be present, so continue to investigate for the presence of MC contamination in surface and subsurface soil.

2. If suspect MEC is observed on the surface or if subsurface anomalies exist, then investigate the surface and/or subsurface soil in the location of the suspect MEC or subsurface anomalies in order to determine if MC contamination is present in the soil.

Decision rules for delineation: MEC Approach

1. If suspect MEC and/or anomalies are found to be present in only a portion of the area surveyed then reduce the boundaries of the suspect MEC area to the outermost locations where suspect MEC or anomalies were found.

2. If suspect MEC and/or anomalies are found to be present at the boundaries of the surveyed area then consider extending the boundaries during the RI.

SPECIFY PERFORMANCE OR ACCEPTANCE CRITERIA (STEP 6)

1. The criterion for the detector-aided surface sweeps will be a go/no-go test performed by determining whether the instrument responds to metallic objects under a blanket (blanket test).

2. The criteria for the geophysical equipment function test will be:
   a) Detection of all seed items buried within the 11x depth;
   b) Horizontal positions of seeded items within 1 meter of known locations.

Details of the performance criteria for the blanket test and geophysical equipment function test are provided in Worksheet 12.

DEVELOP THE PLAN FOR OBTAINING DATA (STEP 7)

The proposed SI detector-aided surface and subsurface geophysics field data collection program for the Advanced IED Area is described in detail in Worksheet 17 . A brief summary of this approach is presented below.

<u>Detector-Aided Surface Sweeps</u>

1. Perform the blanket test. In this test, metal objects such as trailer hitches will be placed under a tarpaulin to verify that metal detectors are functioning.

2. Conduct a 100-percent detector-aided surface sweep around SWMU 27 at the location as shown on Figure 17.5-1. Sweeps, at 50-foot spaced transects, will be conducted for the remainder of the area. A 100-percent detector-aided surface sweep will also be conducted of accessible areas within 50 feet of any anomaly clusters identified along transects during detector-aided surface sweeps, or during the

subsurface geophysical investigation. The sweeps will be conducted by UXO Technicians using hand held metal detectors (Schonstedt or White's). Locations where visual observations of suspect MEC, MPPEH, MD or subsurface anomalies are observed will be marked with a stake. Pictures will be taken of items observed on the surface. In clear areas, the locations will be recorded using a GPS unit. In areas where tree canopy precludes use of a GPS unit, locations will be established using a tape measure and compass measurements from a known location(s).

3. Utilize information from detector-aided sweeps to identify soil sampling location areas within the footprint of the surface sweeps for collection of soil samples based on the presence of MD and subsurface anomalies.

Subsurface Geophysics

1. Perform the geophysical equipment function test. In this test, metals items will be buried at various depths. Geophysical instrumentation will then be tested to verify that the operator, instrumentation and software are functioning properly. A Geonics EM61-MK2 or Geometrics G858 is planned for use at this site. .

2. Test the survey equipment.

3. Conduct survey on 5-foot spaced parallel survey lines on the berm and with 2.5-foot spacing in the open (cleared) area surrounded by the berm.

4. Conduct 100-percent survey of accessible areas within 50 feet of any anomaly clusters identified along transects during the detector-aided surface sweeps or subsurface geophysical investigation.

5. Utilize information from subsurface geophysical investigation to identify soil sampling locations based on the presence of subsurface anomalies.

SAP Worksheet #11.6 - Data Quality Objectives for the Stump Neck Impact Area (UXO 10)

STATE THE PROBLEM (STEP 1)

Worksheet 10.6 contains the problem definition for the Stump Neck Impact Area.

IDENTIFY THE GOAL OF THE STUDY (STEP 2)

The primary goal of the SI for the Stump Neck Impact Area is to obtain environmental data for use in making the following decisions:

1. Determine whether surface MEC are present in a condition or quantity that presents an immediate human health hazard and requires an immediate action. If such quantities are present, then initiate an appropriate remedial response. Otherwise, take no immediate action.

2. If surface MEC debris or subsurface anomalies indicate the presence of suspect MEC, then proceed with further investigation in the RI phase. If not, proceed to NFA for MEC. In this case, MC may still be present, so continue to investigate for the presence of MC contamination in surface and subsurface soil.

3. Determine the extent of MEC contamination for the purposes of delineation. If sufficient data have been collected for this purpose, then stop collecting data. If more data are required to delineate the extent of contamination, then conduct further investigation in the RI phase.

IDENTIFY INFORMATION INPUTS (STEP 3)

1. UXO Surface Sweeps and Geophysical Investigation:

   Surface: Data will be obtained from detector-aided surface sweeps conducted by UXO personnel using hand-held metal detectors such as the Schonstedt GA-52Cx, White's Spectrum XLT, or equivalent, and visual observations. UXO Technicians will use metal detectors to locate metallic items on the surface. Items located on the surface will be visually examined to determine if they are suspect MEC, MPPEH, MD or non-MD. If located, suspect MEC, MPPEH and/or MD will not be moved or disturbed during the SI.

   Subsurface: Metal detector anomalies (i.e., a response from the metal detector at a location where no surface materials are found) that result from the detector-aided surface sweeps will be used, along with the data from a subsurface geophysical investigation conducted by a geophysicist using a

Geometrics G858, to locate metals in subsurface soil. The choice of instrument may change based on the results of the ITS. Suspect MEC, MPPEH, MD and subsurface metals (if metals are MEC, MPPEH, or MD) could potentially result in the release of MC.

DEFINE THE BOUNDARIES OF THE STUDY (STEP 4)

The current MEC site investigation at the Stump Neck Impact Area is limited to detector-aided surface and subsurface geophysical investigations.

1. The initial horizontal boundary for the MEC investigation will be the portions of the MRP boundary identified on Figure 17.6-1 that are accessible by foot and survey instrument. The wetland portion will not be investigated.

2. The initial vertical boundary for the MEC investigation (detector-aided surface sweeps and geophysical investigation) will be 1 foot bgs within the accessible land area. The vertical boundary for the geophysical investigation will be 0 to 5 feet bgs. The PA indicated that estimated penetration depths for munitions believed to have been fired into this area are between 4 and 12 feet bgs. The Stump Neck Impact Area is overlapped by the firing fan from the Valley located at the Main Installation; therefore, there is the potential for munitions associated with the Valley to be present in this area. Data from this investigation will also be used in the assessment of impacts from munitions fired from the Valley.

DEVELOP THE ANALYTIC APPROACH (STEP 5)

The decision rules for this MEC investigation are as follows:

1. If the detector-aided surface sweeps or geophysical investigation shows that suspect surface MEC and subsurface anomalies are not present, then proceed to NFA for MEC. In this case, MC may still be present, so continue to investigate for the presence of MC contamination in surface and subsurface soil.

2. If suspect MEC is observed on the surface or if subsurface anomalies exist, then investigate the surface and/or subsurface soil in the location of the suspect MEC or subsurface anomaly in order to determine if MC contamination is present in the soil.

Decision rules for delineation: MEC Approach

1. If suspect MEC and/or anomalies are found to be present in only a portion of the area surveyed then reduce the boundaries of the suspect MEC area to the outermost locations where suspect MEC or anomalies are found.

2. If suspect MEC and/or anomalies are found to be present at the boundaries of the surveyed area then consider extending the boundaries during the RI.

SPECIFY PERFORMANCE OR ACCEPTANCE CRITERIA (STEP 6)

1. The criterion for the detector-aided surface sweeps will be a go/no-go test performed by determining whether the instrument responds to metallic objects under a blanket (blanket test).

2. The criteria for the geophysical equipment function test will be:
   a. Detection of seed items buried within the 11x depth;
   b. Horizontal positions of seeded items within 1 meter of known locations.

Details of the performance criteria for the blanket test and geophysical equipment function test are provided in Worksheet 12.

DEVELOP THE PLAN FOR OBTAINING DATA (STEP 7)

The proposed SI detector-aided surface and subsurface geophysics field data collection program for the Stump Neck Impact Area is described in detail in Worksheet 17. A brief summary of this approach is presented below.

<u>Detector-Aided Surface Sweeps</u>

1. Perform the blanket test. In this test, metal objects such as trailer hitches will be placed under a tarpaulin to verify that metal detectors are functioning.

2. Conduct detector-aided surface sweeps of the established survey areas as shown on Figure 17.6-1. Sweeps, at 40-foot spaced transects along accessible portions of the site, will be conducted. A 100-percent detector-aided surface sweep will also be conducted of accessible areas within 50 feet of any anomaly clusters identified along transects during detector-aided surface sweeps, or during the subsurface geophysical investigation. The sweeps will be conducted by UXO Technicians using

hand held metal detectors (Schonstedt or White's). Locations where visual observations of suspect MEC, MPPEH, MD or subsurface anomalies are observed will be marked with a stake. Pictures will be taken of items observed on the surface. In clear areas the locations will be recorded using a GPS unit. In areas where tree canopy precludes use of a GPS unit, locations will be established using a tape measure and compass measurements from a known location(s).

3. Utilize information from detector-aided sweeps to identify soil sampling location areas within the footprint of the surface sweeps for collection of soil samples based on the presence of MD and subsurface anomalies.

Geophysical Survey

1. Perform the geophysical equipment function test. In this test, metals items will be buried at various depths. Geophysical instrumentation will then be tested to verify that the operator, instrumentation and software are functioning properly. A Geometrics G858 is planned for use at this site.

2. Test the survey equipment.

3. Conduct survey on 40-foot spaced parallel survey transects across accessible portions of the designated site.

4. Utilize information from subsurface geophysical investigation to identify soil sampling locations based on the presence of subsurface anomalies.

SAP Worksheet #11.7 - Data Quality Objectives for Test Area 1 (UXO 21)

STATE THE PROBLEM (STEP 1)

Worksheet 10.7 contains the problem definition for the Test Area 1.

IDENTIFY THE GOAL OF THE STUDY (STEP 2)

The primary goal of the SI for Test Area 1 is to obtain environmental data for use in making the following decisions:

1. Determine whether surface MEC are present in a condition or quantity that presents an immediate human health hazard and requires an immediate action. If such quantities are present, then initiate an appropriate remedial response. Otherwise, take no immediate action.

2. If surface MEC debris or subsurface anomalies indicate the presence of suspect MEC, then proceed with further investigation in the RI phase. If not, proceed to NFA for MEC. In this case, MC may still be present, so continue to investigate for the presence of MC contamination in surface soil.

3. Determine the extent of MEC contamination for the purposes of delineation. If sufficient data have been collected for this purpose, then stop collecting data. If more data are required to delineate the extent of contamination, then conduct further investigation in the RI phase.

IDENTIFY INFORMATION INPUTS (STEP 3)

Data and information that will be required to make the decisions include the following:

1. UXO Surface Sweeps:
   Surface: Data will be obtained from detector-aided surface sweeps conducted by UXO personnel using hand-held metal detectors such as the Schonstedt GA-52Cx, White's Spectrum XLT, or equivalent, and visual observations. UXO Technicians will use metal detectors to locate metallic items on the surface. Items located on the surface will be visually examined to determine if they are suspect MEC, MPPEH, MD or non-MD. If located, suspect MEC, MPPEH and/or MD will not be moved or disturbed during the SI.

Subsurface: Metal detector anomalies (i.e., a response from the metal detector at a location where no surface materials are found) that result from the detector-aided surface sweeps will be used to locate suspect metal objects in subsurface soil. Suspect MEC, MPPEH, MD and subsurface metals (if metals are MEC, MPPEH, or MD) could potentially result in the release of MC.

DEFINE THE BOUNDARIES OF THE STUDY (STEP 4)

The current MEC site investigation at Test Area 1 is limited to visual and detector-aided surface investigations.

1. The initial horizontal boundary for the MEC investigation will be the MRP boundary identified on Figure 17.7-1.

2. Within the bowl, only visual observations of the surface will be conducted.

3. The initial vertical boundary for the MEC investigation (detector-aided surface sweeps) will be 1 foot bgs. The site was initially developed for moon relay communication experiments and was subsequently used for IED and IND training. Small TNT charges were used during training at this site, but are not expected to have penetrated the ground surface.

DEVELOP THE ANALYTIC APPROACH (STEP 5)

The decision rules for this MEC investigation are as follows:

1. The SI will use UXO detector-aided surface sweeps to locate surface and shallow subsurface anomalies. If the detector-aided surface sweep shows that suspect surface MEC and anomalies are not present, then proceed to NFA for MEC. In this case, MC may still be present, so continue to investigate for the presence of MC contamination in soil.

2. The SI will use UXO detector-aided surface sweeps to locate surface and shallow subsurface anomalies. If suspect MEC is observed on the surface or if subsurface anomalies exist, then investigate the soil in the location of the suspect MEC or subsurface anomaly in order to determine if MC contamination is present in the soil.

Decision rules for delineation: MEC Approach

1. If suspect MEC and/or anomalies are found to be present in only a portion of the area surveyed then reduce the boundaries of the suspect MEC area to the outermost locations where suspect MEC or anomalies were found.

2. If suspect MEC and/or anomalies are found to be present at the boundaries of the surveyed area then consider extending the boundaries during the RI.

SPECIFY PERFORMANCE OR ACCEPTANCE CRITERIA (STEP 6)

1. The criterion for the detector-aided surface sweeps will be a go/no-go test performed by determining whether the instrument responds to metallic objects under a blanket (blanket test).

Details of the performance criteria for the blanket test are provided in Worksheet 12.

DEVELOP THE PLAN FOR OBTAINING DATA (STEP 7)

The proposed SI detector-aided surface field data collection program for Test Area 1 is detailed in Worksheet 17. A brief summary of this approach is presented below.

Visual Survey (Inside the Bowl)

1. Conduct a thorough visual inspection of the metal-reinforced bowl area for the presence of suspect MEC.

Detector-Aided Surface Sweep (Outside the Bowl)

1. Perform the blanket test. In this test, metal objects such as trailer hitches will be placed under a tarpaulin to verify that metal detectors are functioning.

2. Conduct a 100-percent detector-aided surface survey outside the bowl area as shown on Figure 17.7-1. The survey will be conducted by UXO Technicians using hand held metal detectors (Schonstedt or White's). Locations where visual observations of suspect MEC, MPPEH, MD or subsurface anomalies are observed will be marked with a stake. Pictures will be taken of items observed on the surface. In clear areas the locations will be recorded using a GPS unit. In areas where tree canopy precludes use of a GPS unit, locations will be established using a tape measure and compass measurements from a known location(s).

3. Utilize information from detector-aided sweeps to identify surface soil sampling location areas within the footprint of the surface sweeps for collection of soil samples based on the presence of MD and subsurface anomalies.

SAP Worksheet #11.8 - Data Quality Objectives for the Valley Impact Area (UXO 26)

STATE THE PROBLEM (STEP 1)

Worksheet 10.8 contains the problem definition for the Valley Impact Area.

IDENTIFY THE GOAL OF THE STUDY (STEP 2)

The primary goal of the SI for the Valley Impact Area is to obtain environmental data for use in making the following decisions:

1. Determine whether surface MEC are present in a condition or quantity that presents an immediate human health hazard and requires an immediate action. If such quantities are present, then initiate an appropriate remedial response. Otherwise, take no immediate action.

2. If surface MEC debris or subsurface anomalies indicate the presence of suspect MEC, then proceed with further investigation in the RI phase. If not, then evaluate the need to conduct further investigation, based on a review of the data from investigations at co-located MRP sites.

IDENTIFY INFORMATION INPUTS (STEP 3)

Data and information that will be required to make the decisions include the following:

1. UXO Surface Sweeps and Geophysical Investigation:
   Surface: Data will be obtained from detector-aided surface sweeps conducted by UXO personnel using hand-held metal detectors such as the Schonstedt GA-52Cx or equivalent and visual observations. UXO Technicians will use metal detectors to locate metallic items on the surface. Items located on the surface will be visually examined to determine if they are suspect MEC, MPPEH, MD or non-MD. If located, suspect MEC, MPPEH and/or MD will not be moved or disturbed during the SI.

   Subsurface: Metal detector anomalies (i.e., a response from the metal detector at a location where no surface materials are found) that result from the detector-aided surface sweeps will be used, along with data from a subsurface geophysical investigation conducted by a geophysicist using an instrument such as a Geometrics G858, to locate suspect metal objects in subsurface soil. The choice of instrument may change and will be based on the results of the ITS. Suspect MEC, MPPEH,

MD and subsurface metals (if metals are MEC, MPPEH, or MD) could potentially result in the release of MC.

DEFINE THE BOUNDARIES OF THE STUDY (STEP 4)

The current MEC site investigation at the Valley Impact Area is limited to UXO detector-aided surface and subsurface geophysical investigations.

1. The initial horizontal boundary for the MEC investigation will be the portions of the Valley Impact Area identified in the PA that are accessible by foot and survey instrument. The horizontal boundary does not include areas where development has occurred.

2. The initial vertical boundary for the MEC investigation (detector-aided surface sweeps and geophysical investigation) will be 5 feet bgs within the accessible land area.

DEVELOP THE ANALYTIC APPROACH (STEP 5)

The decision rules for this MEC investigation are as follows:

1. If the detector-aided surface sweeps or geophysical investigation shows that suspect surface MEC and subsurface anomalies are not present, then consider NFA for MEC.

2. If suspect MEC is observed on the surface or if subsurface anomalies are observed, then return for further investigation in the RI phase.

Decision Rules for Delineation: MEC Approach

1. If suspect MEC and/or anomalies are found to be present in only a portion of the area surveyed then reduce the boundaries of the suspect MEC area to the outermost locations where suspect MEC or anomalies were found.

2. If suspect MEC and/or anomalies are found to be present at the boundaries of the surveyed area then consider extending the boundaries during the RI.

SPECIFY PERFORMANCE OR ACCEPTANCE CRITERIA (STEP 6)

1. The criterion for the detector-aided surface sweeps will be a go/no-go test performed by determining whether the instrument responds to metallic objects under a blanket (blanket test).

2. The criteria for the geophysical equipment function test will be:
   a. Detection of all seed items buried within the 11x depth;
   b. Horizontal positions of seeded items within 1 meter of known locations.

Details of the performance criteria for the blanket test and geophysical equipment function test are provided in Worksheet 12.

DEVELOP THE PLAN FOR OBTAINING DATA (STEP 7)

The proposed detector-aided surface and subsurface geophysical field data collection program for the Valley Impact Area is detailed in Worksheet 17. A brief summary of the investigation approach is presented below.

Detector-Aided Surface Sweep

1. Perform the blanket test. In this test, metal objects such as trailer hitches will be placed under a tarpaulin to verify that metal detectors are functioning.

2. Conduct detector-aided surface sweeps of 19 (400-foot spaced) parallel survey transects across the accessible and non-developed portions of the site (as shown on Figure 17.8-1). The survey will be conducted by UXO Technicians using hand held metal detectors (Schonstedt). Locations where visual observations of suspect MEC, MPPEH, MD or subsurface anomalies are observed will be marked with a stake. Pictures will be taken of items observed on the surface. In clear areas the locations will be recorded using a GPS unit. In areas where tree canopy precludes use of a GPS unit, locations will be established using a tape measure and compass measurements from a known location(s).

3. Utilize information from detector-aided sweeps to identify potential soil sampling location areas within the footprint of the surface sweeps for collection of soil samples based on the presence of MD and subsurface anomalies if the site proceeds to the RI phase.

Geophysical Survey

1. Perform the geophysical equipment function test. In this test, metals items will be buried at various depths. Geophysical instrumentation will then be tested to verify that the operator, instrumentation and software are functioning properly. A Geometrics G858 is planned for use at this site. .

2. Test the survey equipment.

3. Conduct survey on 19 (400-foot spaced) parallel survey transects across the accessible and non-developed portions of the site where the detector-aided surface sweeps were conducted.

SAP Worksheet #11.9 - Data Quality Objectives for the Torpedo Burial Site (UXO 12)

STATE THE PROBLEM (STEP 1)

Worksheet 10.9 contains the problem definition for the Torpedo Burial Site.

IDENTIFY THE GOAL OF THE STUDY (STEP 2)

The primary goal of the SI for the Torpedo Burial Site is to obtain environmental data for use in making the following decisions:

1. Determine whether surface MEC are present in a condition or quantity that presents an immediate human health hazard and requires an immediate response. If such quantities are present, then initiate an appropriate remedial response. Otherwise, take no immediate action.

2. If surface MEC debris or subsurface anomalies indicate the presence of suspect MEC, then proceed with further investigation in the RI phase. If not, proceed to NFA for MEC. In this case, MC may still be present, so continue to investigate for the presence of MC contamination in subsurface soil, surface water and sediment.

3. Determine the extent of MEC contamination for the purposes of delineation. If sufficient data have been collected for this purpose, then stop collecting data. If more data are required to delineate the extent of contamination, then conduct further investigation in the RI phase.

IDENTIFY INFORMATION INPUTS (STEP 3)

Data and information that will be required to make the decisions include the following:

1. UXO Surface Sweeps and Geophysical Investigation:
   Surface: Data will be obtained from detector-aided surface sweeps conducted by UXO personnel using hand-held metal detectors such as the Schonstedt GA-52Cx, White's Spectrum XLT, or equivalent and visual observations. UXO Technicians will use metal detectors to locate metallic items on the surface. Items located on the surface will be visually examined to determine if they are suspect MEC, MPPEH, MD or non-MD. If located, suspect MEC, MPPEH and/or MD will not be moved or disturbed during the SI.

Subsurface: Metal detector anomalies (i.e., a response from the metal detector at a location where no surface materials were found) that result from the detector-aided surface sweeps will be used, along with data from a subsurface geophysical investigation conducted by a geophysicist using a Geometrics G858, to locate suspect metal objects in subsurface soil. Suspect MEC, MPPEH, MD and subsurface metals (if metals are MEC, MPPEH, or MD) could potentially result in the release of MC.

DEFINE THE BOUNDARIES OF THE STUDY (STEP 4)

The current site investigation at the Torpedo Burial Site is limited to detector-aided surface and subsurface geophysical investigations.

1. The initial horizontal boundary is defined as the suspect MEC area as shown in the PA and on Figure 17.9-1.

2. The initial vertical boundary for the MEC investigation (detector-aided surface sweeps and geophysical investigation) will be 6 feet bgs within the land area.

DEVELOP THE ANALYTIC APPROACH (STEP 5)

The decision rules for this MEC investigation are as follows:

1. If the detector-aided surface sweeps or geophysical investigation shows that suspect surface MEC and subsurface anomalies are not present, then proceed to NFA for MEC. In this case, MC may still be present, so continue to investigate for the presence of MC contamination in subsurface soil, surface water, and sediment.

2. If suspect MEC are observed on the surface or in the drainage channel, or if subsurface anomalies exist, then investigate the subsurface soil, surface water and sediment in the location of the suspect MEC or subsurface anomaly in order to determine if MC contamination is present in these media. If the collected data are sufficient to determine the presence of MC contamination associated with the suspect MEC, then stop collecting data. If the data are not sufficient to determine the presence of MC contamination, then return for further investigation in the RI phase.

Decision rules for delineation: MEC Approach

1. If suspect MEC and/or anomalies are found to be present in only a portion of the area surveyed then reduce the boundaries of the suspect MEC area to the outermost locations where suspect MEC or anomalies were found.

2. If suspect MEC and/or anomalies are found to be present at the boundaries of the surveyed area then consider extending the boundaries during the RI.

SPECIFY PERFORMANCE OR ACCEPTANCE CRITERIA (STEP 6)

1) The criterion for the detector-aided surface sweeps will be a go/no-go test performed by determining whether the instrument responds to metallic objects under a blanket (blanket test).

2) The criteria for the geophysical equipment function test will be:
   a. Detection of all seed items buried within the 11x depth;
   b. Horizontal positions of seeded items within 1 meter of known locations.

Details of the performance criteria for the blanket test and geophysical equipment function test are provided in Worksheet 12.

DEVELOP THE PLAN FOR OBTAINING DATA (STEP 7)

The proposed SI detector-aided surface and subsurface geophysical field data collection program for the Torpedo Burial Site is presented in detail in Worksheet 17. A brief summary of this approach is presented below.

<u>Detector-Aided Surface Sweep</u>

1. Perform the blanket test. In this test, metal objects such as trailer hitches will be placed under a tarpaulin to verify that metal detectors are functioning.

2. Conduct a 100 percent detector-aided surface sweep of the site within the area shown on Figure 17.9-1. The sweep will be conducted by UXO technicians using hand held metal detectors (Schonstedt or White's). Locations where visual observations of suspect MEC, MPPEH, MD or subsurface anomalies are observed will be marked with a stake. Pictures will be taken of items observed on the surface. In clear areas the locations will be recorded using a GPS unit. In areas

where tree canopy precludes use of a GPS unit, locations will be established using a tape measure and compass measurements from a known location(s).

3. Utilize information from detector-aided sweeps to identify potential soil sampling location areas within the footprint of the surface sweeps for collection of soil samples based on the presence of MD and subsurface anomalies if site proceeds to RI phase.

Geophysical Survey

1. Perform the geophysical equipment function test. In this test, metals items will be buried at various depths. Geophysical instrumentation will then be tested to verify that the operator, instrumentation and software are functioning properly. A Geometrics G858 is planned for use at this site.

2. Test the survey equipment.

3. Conduct survey on 5-foot spaced parallel survey lines across the accessible portions of the site. The area is shown on Figure 17.9-1.

SAP Worksheet #11.10 - Data Quality Objectives for the Torpedo Casing Disposal Area (UXO 23)

STATE THE PROBLEM (STEP 1)

Worksheet 10.10 contains the problem definition for the Torpedo Casing Disposal Area.

IDENTIFY THE GOAL OF THE STUDY (STEP 2)

The primary goal of the SI for the Torpedo Casing Disposal Area is to obtain environmental data for use in making the following decisions:

1. Determine whether surface MEC are present in a condition or quantity that presents an immediate human health hazard and requires an immediate response. If such quantities are present, then initiate an appropriate remedial response. Otherwise, take no immediate action.

2. If surface MEC debris or subsurface anomalies indicate the presence of suspect MEC, then proceed with further investigation in the RI phase. If not, proceed to NFA for MEC. In this case, MC may still be present, so continue to investigate for the presence of MC contamination in subsurface soil.

3. Determine the extent of MEC contamination for the purposes of delineation. If sufficient data have been collected for this purpose, then stop collecting data. If more data are required to delineate the extent of contamination, then conduct further investigation in the RI phase.

IDENTIFY INFORMATION INPUTS (STEP 3)

Data and information that will be required to make the decisions include the following:

1. UXO Surface Sweeps and Geophysical Investigation:
   Surface: Data will be obtained from detector-aided surface sweeps conducted by UXO personnel using hand-held metal detectors such as the Schonstedt GA-52Cx or equivalent and visual observations. UXO Technicians will use metal detectors to locate metallic items on the surface. Items located on the surface will be visually examined to determine if they are suspect MEC, MPPEH, MD or non-MD. If located, suspect MEC, MPPEH and/or MD will not be moved or disturbed during the SI.

Subsurface: Metal detector anomalies (i.e., a response from the metal detector at locations where no surface materials are found) that result from the detector-aided surface sweeps will be used, along with data from a subsurface geophysical investigation conducted by a geophysicist using a Geometrics G858, to locate suspect metal objects in subsurface soil. Suspect MEC, MPPEH, MD and subsurface metals (if metals are MEC, MPPEH, or MD) could potentially result in the release of MC.

DEFINE THE BOUNDARIES OF THE STUDY (STEP 4)

The current site investigation at the Torpedo Casing Disposal Area is limited to detector-aided surface and subsurface geophysical investigations.

1. The initial horizontal boundary for the MEC investigation is defined as the suspect torpedo casing disposal area as shown in the PA and on Figure 17.10-1.

2. The initial vertical boundary for the MEC investigation (detector-aided surface sweeps and potential geophysical investigation) will be 6 feet bgs within the land area. Previous geophysical investigations suggested anomalies at greater than 3 feet bgs.

DEVELOP THE ANALYTIC APPROACH (STEP 5)

The decision rules for this MEC investigation are as follows:

1. If the detector-aided surface sweeps or geophysical investigation shows suspect surface MEC and subsurface anomalies are not present, then proceed to NFA for MEC. In this case, MC may still be present, so continue to investigate for the presence of MC contamination in subsurface soil.

2. If suspect MEC is observed on the surface or if subsurface anomalies exist, then investigate the soil in the location of the suspect MEC or subsurface anomaly in order to determine if MC contamination is present in the soil. If the collected data are sufficient to determine the presence of MC contamination associated with the suspect MEC, then stop collecting data. If the data are not sufficient to determine the presence, then return for further investigation in the RI phase.

Decision rules for delineation: MEC Approach

1. If suspect MEC and/or anomalies are found to be present in only a portion of the area surveyed them reduce the boundaries of the suspect MEC area to the outermost locations where suspect MEC or anomalies were found.

2. If suspect MEC and/or anomalies are found to be present at the boundaries of the surveyed area then consider extending the boundaries during the RI.

SPECIFY PERFORMANCE OR ACCEPTANCE CRITERIA (STEP 6)

1. The criterion for the detector-aided surface sweeps will be a go/no-go test performed by determining whether the instrument responds to metallic objects under a blanket (blanket test).

2. The criteria for the geophysical equipment function test will be:
   a. Detection of all seed items buried within the 11x depth;
   b. Horizontal positions of seeded items within 1 meter of known locations.

Details of the performance criteria for the blanket test and geophysical equipment function test are provided in Worksheet 12.

DEVELOP THE PLAN FOR OBTAINING DATA (STEP 7)

The proposed SI detector-aided surface and subsurface geophysical field data collection program for this location is presented Worksheet 17 A brief summary of this approach is presented below.

<u>Detector-Aided Surface Sweep</u>

1. Perform the blanket test. In this test, metal objects such as trailer hitches will be placed under a tarpaulin to verify that metal detectors are functioning.

2. Conduct a 100 percent detector-aided surface sweep of the site as shown on Figure 17.10-1. The sweep will be conducted by UXO Technicians using hand held metal detectors (Schonstedt). Locations where visual observations of suspect MEC, MPPEH, MD or subsurface anomalies are observed will be marked with a stake. Pictures will be taken of items observed on the surface. In clear areas the locations will be recorded using a GPS unit. In areas where tree canopy precludes

use of a GPS unit, locations will be established using a tape measure and compass measurements from a known location(s).

3. Utilize information from detector-aided sweeps to identify potential soil sampling location areas within the footprint of the surface sweeps for collection of soil samples based on the presence of MD and subsurface anomalies if the site proceeds to the RI phase.

Geophysical Survey

1. Perform the geophysical equipment function test. In this test, metals items will be buried at various depths. Geophysical instrumentation will then be tested to verify that the operator, instrumentation and software are functioning properly. A Geometrics G858 is planned for use at this site.

2. Perform the blanket test.

3. Conduct survey on 10-foot spaced parallel survey lines across the accessible portions of the site.

4. Utilize data regarding subsurface anomalies to determine locations for collection of subsurface soil samples.

SAP Worksheet #12 -- Measurement Performance Criteria Table
(UFP-QAPP Manual Section 2.6.2)

Measurement Performance Criteria Table – Field QC Samples

Data Type	Data Quality Indicator	QC Sample and/or Activity to Assess Measurement Performance	Measurement Performance Criteria	Frequency
Transect	Precision	Resurvey transects to perform a direct comparison to field data collected during detector-aided surface sweep.	Detect all metallic 20mm or larger on surface; non-detection of metallic objects would result in failure of QC.	Resurvey 25% of first four transects and after any failure, then 10% of remaining transects after four transects in a row pass QC. If any transect does not pass QC, UXO team will resurvey entire transect and another QC check will be performed.
Grid	Precision	Resurvey grids to perform a direct comparison to field data collected during detector-aided surface sweep.	Detect all metallic 20mm or larger on surface; non-detection of metallic objects would result in failure of QC.	Resurvey 25% of first four grids and after any failure, then 10% of remaining grids after four grids in a row pass QC. If any grid does not pass QC, UXO team will resurvey entire grid and another QC check will be performed.
GPS Positional Data	Real-Time Accuracy	HDOP and number of satellites	HDOP <3, number of satellites at least six	On-Going
	Accuracy	GPS positioning - comparison with two known locations	Sub-foot for 100% coverage of grids, Sub-meter for other areas	Daily

Data Type	Data Quality Indicator	QC Sample and/or Activity to Assess Measurement Performance	Measurement Performance Criteria	Frequency
Instrument Test Strip (ITS)	Sensitivity	Detection capabilities test of representative seed items	Vertical detection of individual inert munitions seeds or surrogates (20mm diameter and larger) within 11x rule (USACE) Horizontal detection positioning between 0 and 2 feet horizontal accuracy from known location for systems operating in 100% coverage areas, and 0 to 3 feet horizontal accuracy for systems operating in other areas (e.g., wooded areas)	Daily
Equipment Function Test (EFT)	Sensitivity	Instrument response to metallic targets	Anomalous response to all test targets within 20% standard deviation response for each given work site	Daily
Geophysical Data	Completeness	Data capture	Minimize data dropouts and unusable data. 90% minimum of usable data per survey line	Daily

Explanations for criteria listed above explained in Worksheet #22.

An ITS will be performed to evaluate geophysical surveying techniques and personnel that will be used at MEC MRP sites and Areas of Concern (AOCs).

GPS Global Positioning System
HDOP Horizontal Dilution of Precision
USACE United States Army Corps of Engineers

12.1 INSTRUMENT TEST STRIP (ITS)

One ITS will be developed and utilized to evaluate geophysical surveying techniques and personnel with the EM61 and G-858 to represent all of the subject sites. The ITS will be used to evaluate the geophysical surveying techniques and personnel over several buried metallic objects laid out in a straight line. The ITS will only be surveyed once if operator(s) and equipment are approved. If new equipment or new operators are necessary, then both operator and equipment will need to be tested on the ITS. The ITS will be seeded with inert munitions or surrogate items that represent the expected range of MEC items used on the sites. Site-specific technical approaches and survey designs have been developed for each MEC area.

12.1.1 Objectives and Scope

The specific objectives of the ITS are as follows:

- Demonstrate that the geophysical investigation systems and navigational equipment are operating properly.

- Provide a safe area with a known set of isolated objects (for example, a single inert UXO or UXO surrogate) for testing detection with the EM61and G-858 equipment.

- Assess the operators' performance and update related procedures to assist in the development of operator measurement techniques.

- Evaluate average speed, minimum along track sampling, and line separation distance in detecting target items.

- Evaluate detection of seed items (20mm diameter and larger) buried within the maximum detection depth determined from United States Army Corps of Engineers (USACE's) 11x rule (maximum detection depth = 11 times the diameter of the munition). Seed items will be broken into two categories. The first will be items that will be scored or 100 percent detected, and the others will be deeper items that will be used for evaluation purposes only. Evaluation items will be used to provide information about detection depth capabilities. The Project Geophysicist and PM will determine whether the ITS performance is acceptable, and consequently when survey work may begin.

12.1.2 Rationale for Selection of Geophysical and Surveying Equipment

The Geonics EM61and G-858 instruments will be tested in the ITS because they are industry-standard instruments capable of detecting ferrous targets (containing iron or steel), and in the EM's case, non-ferrous (e.g., aluminum or brass) targets as well. The results of the ITS could help determine appropriate equipment for use at each site. It is anticipated that a single man-portable array will be employed for the surveys. A sub-meter GPS unit is planned for use with the geophysical surveys at the sites (where an adequate satellite signal can be received), which provides high accuracy at a reasonable cost. GPS will be used where possible, given the wooded nature of the sites.

12.1.3 Personnel Qualifications

The ITS and geophysical investigation will be managed and performed by a qualified Project Geophysicist and Site Geophysicist who meet the requirements stated in USACE Data Item Description (DID) OE-025.01 (USACE, 2002). At least one UXO Technician II or higher will be present throughout the ITS and geophysical investigation to provide UXO avoidance support. Worksheet #7 describes the personnel qualifications and experience for these positions.

12.1.4 ITS Survey Procedure

A test strip will be established in a clear (unvegetated) area. The test area will be chosen in cooperation with the Navy RPM to avoid cultural areas potentially containing clutter, utilities, or landfill materials that might interfere with the ability of the geophysical instrument to definitively detect the seed items. A suitable location would be in an area that can be left seeded for the duration of the project in the event that different equipment or operators need to be tested. The operators and equipment used for geophysical survey work must be tested and approved first in the ITS. The test strip location will be identified by Tetra Tech and approved by the Navy prior to the ITS mobilization. Test Area 2, which is located on the Stump Neck Annex, is recommended for the ITS to provide the desired conditions aforementioned. A utility clearance and/or Dig Permit will be requested from the Navy prior to conducting ITS operations.

The UXO team will start with a detector-aided surface sweep of the selected test strip location. A geophysical survey will be conducted prior to seeding the test area with inert or simulated test items to evaluate the instrument response of the site background. Afterwards, geophysical data will be collected along several survey lines across the seeded test strip. An initial survey line will be conducted directly overtop of the seed items (that will be arranged in a straight line), and two more parallel survey lines will be surveyed at 18 inches and 30 inches from the initial survey line on both sides of the initial survey line.

The initial survey line will be used to evaluate the ITS for approval (detections), and the subsequent survey lines will be used for informational purposes on the lateral detection capabilities of the geophysical methods. The ITS surveying is planned with GPS; however, if conditions do not permit adequate satellite signal reception, then surveying with fiducials is planned. Based on visual inspection during site walks, Tetra Tech believes that nearly all wooded sites in the project are both too densely covered with vegetation and large to allow total stationing as an efficient data positioning tool; therefore, fiducials are planned for these sites.

The locations of the test strip, survey data stations, and test seed items will be accurately documented. Depths, orientations, and physical descriptions of each of the test seed items will also be noted and provided to the Site Geophysicist after the targets are selected by the geophysical team to provide understanding of the seed items in relation to their resultant anomaly signatures. Photographs of the seed items will also be taken and made available to the survey team.

12.1.5 Test Strip Seeding

The test strip will be seeded by Tetra Tech. Tetra Tech will have at least one UXO Technician II (or higher) on site during the intrusive seeding to perform anomaly avoidance. The UXO Technician(s) will utilize a Schonstedt GA-52 Cx or similar equipment to provide MEC avoidance. See Worksheet 17 for additional details on UXO support. Each seed item will be labeled with a unique identifier, photographed (open hole), and located in relation to the ITS survey plot corners ends that will also be located.

Eight items are planned to be buried blind to the geophysical team in the ITS. Inert munitions and surrogate seed items expected for the sites will be buried in various orientations at depths within the typical maximum detection depth of 11 times the diameter (11x D) of the munition (following the USACE 11x rule from the USACE Engineering Manual EM 1110-1-4009). The eight seed items will be buried at least six feet apart to distinguish each item's anomaly signature to aid in later interpretation of survey data, and at the following depths below ground surface (bgs):

Item and Burial Depth	11x depth	Scored/Unscored
One 3-inch/50 projectile at 22 inches bgs	(11x D = 33 inches)	Scored ferrous object
One aluminum projectile fuze at 6 inches bgs		Unscored non-ferrous object
One 30mm projectile at 8 inches bgs	(11x D = 13 inches)	Scored ferrous object
Ten brass cartridge cases at 18 inches bgs		Unscored non-ferrous object
One 40mm projectile at 10 inches bgs	(11x D = 17.3 inches)	Scored ferrous object
One 40mm projectile at 16 inches bgs	(11x D = 17.3 inches)	Unscored ferrous object

Item and Burial Depth	11x depth	Scored/Unscored
One 20mm projectile at 4 inches bgs	(11x D = 8.7 inches)	Scored ferrous object
One 30mm projectile at 12 inches bgs	(11x D = 13 inches)	Unscored ferrous object

Notes: mm – millimeter, 11x D is 11 times the diameter (USACE rule)

12.1.6 Data Analysis and Interpretation

The ITS activities will generate geophysical contour and profile maps depicting the area surveyed and the anomalies detected. The geophysical maps will be transmitted electronically and will be compatible with ArcView Version 8 or the specific GIS platform in use. Tetra Tech will perform data file QC review and correction as necessary. ITS results will be summarized in a brief report (e-mail or fax) submitted to the Project Geophysicist for approval and authorization before site work begins and to continue work. The SI report will also document the ITS and will include an as-built drawing of the ITS plot geophysical data and a summary of ITS results including techniques and equipment used.

12.1.7 Equipment Standardization

Geophysical sensors and support equipment, navigation equipment, and operator performance will be tested at specific intervals and must meet the appropriate acceptance criteria. One of these tests will be a daily EFT. The Worksheet 12 table (above) lists additional tests or checks, their required frequencies, and acceptance criteria. Additionally, calibrations and other equipment setup information are detailed in Worksheet 22. Initially, before the ITS is performed, out-of-box tests are planned and detailed below in Section 12.1.7.2.

12.1.7.1 Equipment Function Test (EFT)

The EFT will be implemented on a daily basis once the ITS is completed. The EFT will provide a simple everyday test of equipment functionality over a few metallic targets representing suspected MEC items for the project. The primary objective is to demonstrate that the survey equipment is responding normally to a controlled set of objects (equipment is functioning property); the objective is not to duplicate the ITS. To make the test practical three targets will be placed on the ground, each spaced 10 feet apart and in the same orientation for each test. This will allow the objects to easily be laid out and transported between subject sites. Site conditions (i.e., soils) may differ between sites, and this could create differences in response; however, responses should be similar when tests are conducted at the same site, as care should be taken to lay out the same objects in the same locations and orientations (i.e., use field marks to help with object placement). All tests should be conducted in an area free of metal. Pre-screening with

the geophysical instrument will be necessary to find such an area when work begins at a new site. Field notes will be kept on each test, and all data will be included in the SI report.

12.1.7.2 Out-of-Box Tests

The following out-of-box tests will be conducted before the pre-seed geophysical survey of the ITS area begins and at the start of each day of surveying.

- Inventory and inspect all equipment to confirm that all components are present and in good condition.
- Assemble the equipment and power up.

12.1.8 Anomaly Avoidance

Anomaly avoidance will be performed by UXO Technicians for site workers by locating potentially hazardous anomalies (whether identified by visual means or through detector-aided surface sweeps).

12.1.9 ITS Disassembly

The ITS will be seeded for the project duration to allow additional testing of a new operator or new pieces of equipment if necessary for the project geophysical work. After the project field work is complete, the ITS items will be removed from the test plot, and the holes will be backfilled and restored.

SAP Worksheet #13 -- Secondary Data Criteria and Limitations Table
(UFP-QAPP Manual Section 2.7)

Secondary Data	Data Source (originating organization, report title and date)	Data Generator(s) (originating organization, data types, data generation / collection dates)	How Data Will Be Used	Limitations on Data Use
Site Histories, Initial CSM	Naval District Washington, Preliminary Assessment, Stump Neck Annex, Indian Head, Maryland, April 2006	Malcolm Pirnie, Inc	Basis for UFP SAP, Site Histories, and CSMs	The information is qualitative and no quantitative (site-specific nature and extent of contamination) information is available. The information was used to establish the field work program and identify areas most likely to be contaminated.

SAP Worksheet #14 -- Summary of Project Tasks
(UFP-QAPP Manual Section 2.8.1)

The implementation of the MEC investigation has been divided into definable features of work and the tasks required to complete each definable feature of work have been identified. Procedures for these tasks, including recording data, forms and checklists, data generation, QC checks, data management, and information management, are defined in the SOPs for the projected indexed in Worksheet 21.

Definable Feature of Work	Tasks
Mobilization/Site Preparation	• Project Plan Preparation • Verify Personnel Qualifications • Setup Administrative Offices • Equipment Setup and Checkout • Installation of ITS • Grid Survey and Layout • Vegetation Management • Surface Removal of Non-Munitions Related Debris, as applicable
Site-specific Training/ITS Certification	• Initial Orientation and Training • ITS Review and Approval
Detector-Aided Surface Sweep	• Surface Sweep • Record Location (GPS and Photograph)
Geophysical Survey	• Geophysical Survey • Data Download • Data Upload
Geophysical Data Processing and Interpretation	• Data Processing • Initial Target Selection • Peer QC • Final Target Selection • Provide Anomaly Mapping to Stakeholders to aid in MC Sampling Location Selection
Demobilization	• Remove ITS • Remove Temporary Survey Markers • Complete all Field Forms • Close-Out Field Log Books • Return Equipment • Provide all Field Documentation to PM

SAP Worksheet #15 -- Reference Limits and Evaluation Table

(UFP-QAPP Manual Section 2.8.1)

☑ **Worksheet Not Applicable (State Reason)**

No samples are proposed for collection/analysis during this MEC geophysics survey/investigation.

SAP Worksheet #16 -- Project Schedule / Timeline Table (optional format)
(UFP-QAPP Manual Section 2.8.2)

Activities	Organization	Dates (MM/YY)	
		Anticipated Date(s) of Initiation	Anticipated Date of Completion
Prepare Rough Draft SI Work Plan & Appendices	Tetra Tech	10/07	10/08
Submit Rough Draft SI Work Plan & Appendices	Tetra Tech	10/08	10/08
Navy Review	Navy	11/08	12/08
Prepare Draft SI Work Plan & Appendices	Tetra Tech	1/09	3/09
Submit Draft SI Work Plan & Appendices	Tetra Tech	3/09	3/09
Regulator Review	U.S. EPA & MDE	4/09	8/09
Receive Comments/Comment Resolution	Tetra Tech	8/09	9/09
Prepare Final SI Work Plan & Appendices	Tetra Tech	8/09	9/09
Submit Final SI Work Plan & Appendices	Tetra Tech	9/09	9/09
Mobilization and Field Investigation	Tetra Tech	10/09	10/09
Complete Field Investigation and Demobilization	Tetra Tech	10/09	12/09
Prepare Rough Draft SI Report	Tetra Tech	12/09	3/10
Submit Rough Draft SI Report	Tetra Tech	3/10	3/10
Navy Review	Navy	3/10	4/10
Prepare Draft SI Report	Tetra Tech	4/10	5/10
Submit Draft SI Report	Tetra Tech	5/10	5/10
Regulator Review	U.S. EPA & MDE	5/10	7/10
Receive Comments/Comment Resolution	Tetra Tech	7/10	8/10
Prepare Final SI Report	Tetra Tech	8/10	9/10
Submit Final SI Report	Tetra Tech	9/10	9/10

SAP Worksheet #17 -- Project Design and Rationale

(UFP-QAPP Manual Section 3.1.1)

SAMPLING DESIGN AND RATIONALE

This section describes in detail the approach, methods, and operational procedures Tetra Tech will use to collect geophysical data to identify anomalies potentially related to MEC. The geophysical data collected will be used to evaluate suspected anomalies in the accessible portions of the survey area. Specifically, this UFP SAP documents the site-specific application of geophysical sensors, navigation equipment, data analysis, data management, and associated equipment and personnel in a manner capable of meeting the site-specific project goals as presented in Worksheet #11 of MC UFP-SAP.

The MC UFP SAP for the MEC areas is being addressed under separate cover, and the associated MC field work will not be initiated until the MEC investigation is completed.

GENERAL PROCEDURE

The following general items will apply to all sites. Site-specific items are presented in numbered sections of this worksheet.

Site Accessibility and Traffic Control

The installation is a controlled area accessible only through an access gate. Safety requires that an active exclusion zone be established and maintained before any MEC activities occur due to the potential of encountering live explosively configured/fuzed munitions. For this project, the exclusion zone will be established at 200 feet for each site. If non-site personnel or non-essential non-UXO personnel enter the exclusion zone, all MEC operations will cease until the exclusion zone is re-established.

Both routine and emergency response actions require prevention of unauthorized site access and the protection of vital records and equipment. All equipment will be brought to a designated secure location each day.

Site Security

Site security will be maintained to ensure that non-essential personnel do not access the exclusion zone during the UXO detector-aided surface sweeps or other UXO avoidance operations at the sites. Barricades will be positioned on access routes a minimum of 200 feet from the edge of the sites.

Notification procedures will be posted on the barricades to ensure that non-essential personnel notify the team working in each area prior to entering the area during active operations. Barricades will be removed when operations stop for the day.

Site Preparation

At a minimum, pre-survey brush clearing (3-foot-wide paths) to allow for data collection on transects will be required at most of the subject sites. Brush clearing for the UXO detector-aided sweeps will only be needed when a large gap or deviation off line would otherwise occur on a brushy section of a survey line or transect.

Brush cutting and mowing of grass will be required at most locations to prepare the sites for the detector-aided surface sweeps and subsurface geophysics investigations. Brush cutting and vegetation clearance will be conducted according to SOP-06. Brush and grass can present impediments to positioning the metal detectors and geophysics detectors in close proximity to the ground surface. The degree of brush cutting/vegetation clearance will be site specific and based on the conditions at the time that the investigations are conducted. The following are the types of equipment/techniques that will be used.

- Weed wackers will be used to clear light vegetation and small grassy areas.
- Mechanized lawn mowers will be used to mow larger grassy areas.
- Chain saws will be used in heavier brush areas and to cut small trees up to 2 inches in diameter.
- Tractor-mounted brush hogs will be used in larger areas and heavier brush areas.
- Brush/vegetation cutting will be left at the site of the edge of the area cleared. If this is impractical or if the base requires, brush may be disposed of or a wood chipper will be utilized.

Brush cutting/vegetation clearance operations will be conducted by the UXO staff. If it is necessary to utilize subcontractors, a UXO escort will be provided during subcontractor brush/vegetation clearance operations.

UXO Escort Operations

All activities involving work in areas potentially containing MEC hazards will be conducted in full compliance with this UFP SAP regarding personnel, equipment, and procedures as follows:

1. If any complete munitions- or ordnance-related material is encountered (including suspect MEC, MPPEH, MD, and frag), the item will be avoided during this phase of the project. The UXO

Technician will not attempt to identify the type or condition of the ordnance. Its location will be reported to the UXO team leader. MEC avoidance procedures will be practiced at all times. Potential exposure to chemical warfare material (CWM) at the sites is not anticipated. In the event that hazardous, toxic, and radiological waste (HTRW) is encountered on site, the work site will be evacuated until the Project Health and Safety Officer, with the concurrence of the NSF-IH Installation Restoration (IR) Coordinator, identifies and implements appropriate protective measures.

2. The UXO escort will clearly mark any area with visible ordnance or MEC, and the area will be avoided. The visible ordnance or MEC will be noted on the field log sheets or in the field logbook. The UXO escort will report the MEC to the UXO team leader.

3. No ordnance, munitions, explosives, or ordnance-related materials will be moved, removed, or disposed of during UXO escort duties.

4. The UXO escort will conduct a UXO avoidance sweep for all proposed survey stake locations using a metal detector to check for possible ordnance or ordnance-related material. If an anomaly is encountered or if the UXO Technician suspects the presence of MEC, the proposed stake location will be relocated to an area free of concerns/anomalies.

UXO Detector-Aided Sweeps, Geophysical Surveys, and Positioning

Data will be collected in the accessible portions of the established survey areas. Detector-aided and geophysical survey data collected along transects will be from a single operator using one survey instrument, unless otherwise noted. Using a single operator and survey instrument, a survey width of 3 to 5 feet is expected for the detector-aided sweeps, which involve moving the sensor back and forth along the transect. Approximately the same survey width may apply to the geophysical surveys, except that the sensor will not move in a back-and-forth motion along the survey line, and the lateral detection capability will be generally dependent on the size, orientation, and depth of the buried item. Larger shallower items can be detected further to the side of a survey line than smaller deeper items. Data station intervals will be determined with the expected target sizes in mind to provide adequate sampling for the smallest expected target sizes. These intervals are normally controlled by survey speed and acquisition rate (readings per second) but may also be controlled by a survey wheel in certain cases.

Data will be collected when the ground surface is exposed (not during snow cover), and a UXO detector-aided sweep will precede geophysical surveying. Non-MEC items and surface debris may be removed by the UXO Technicians to aid in the geophysical surveying effort. This will avoid mapping of anomalies that

are not of concern (if needed). No MEC or material potentially presenting an explosive hazard (MPPEH) will be moved during this SI.

The detector-aided sweeps will be used to locate surface items of concern (munition items or debris), and will generally provide a qualitative assessment of the amount of shallow buried metal (small, moderate, or large). Locations of surface items will be collected using a GPS and/or compass/tape measure from a known location. The location information will be stored in the GPS or entered into the field log. Geophysical data (anomalies and relative or absolute locations) will be stored automatically. If GPS accuracy is not sub-meter for the geophysical surveys and the detector-aided sweeps, data will not be collected until more satellites are available and the accuracy criteria are met, or an alternative positioning technique will be employed (e.g., tape-measured grid). If necessary, due to wooded conditions that do not allow GPS or a satisfactory alternative positioning technique to be used, a professional survey firm may be employed to provide at a minimum absolute coordinate points as needed. Gaps in the geophysical data from unusable data or data that could not be positioned will be evaluated to determine whether they are sufficiently large to warrant data recollection in those areas. The UXO or geophysical team will record location data and possibly photograph other cultural features at the sites that might affect geophysical data interpretation (to include culverts, power lines, fencing, etc.).

Data will be provided in an SI report and will consist of tables reporting the UXO sweep and geophysical anomaly results (anomaly locations) and data contour and profile maps depicting the geophysical results in North American Datum (NAD)83 Maryland State Plane coordinates in US survey feet on plan or aerial maps for each of the MRP areas. A summary of methods used and discussion of the survey results will also be included in the report. Descriptive data will be recorded in the UXO team log book, and a copy of these data will be provided in the report.

UXO Detector-Aided Surface Sweep Instrumentation

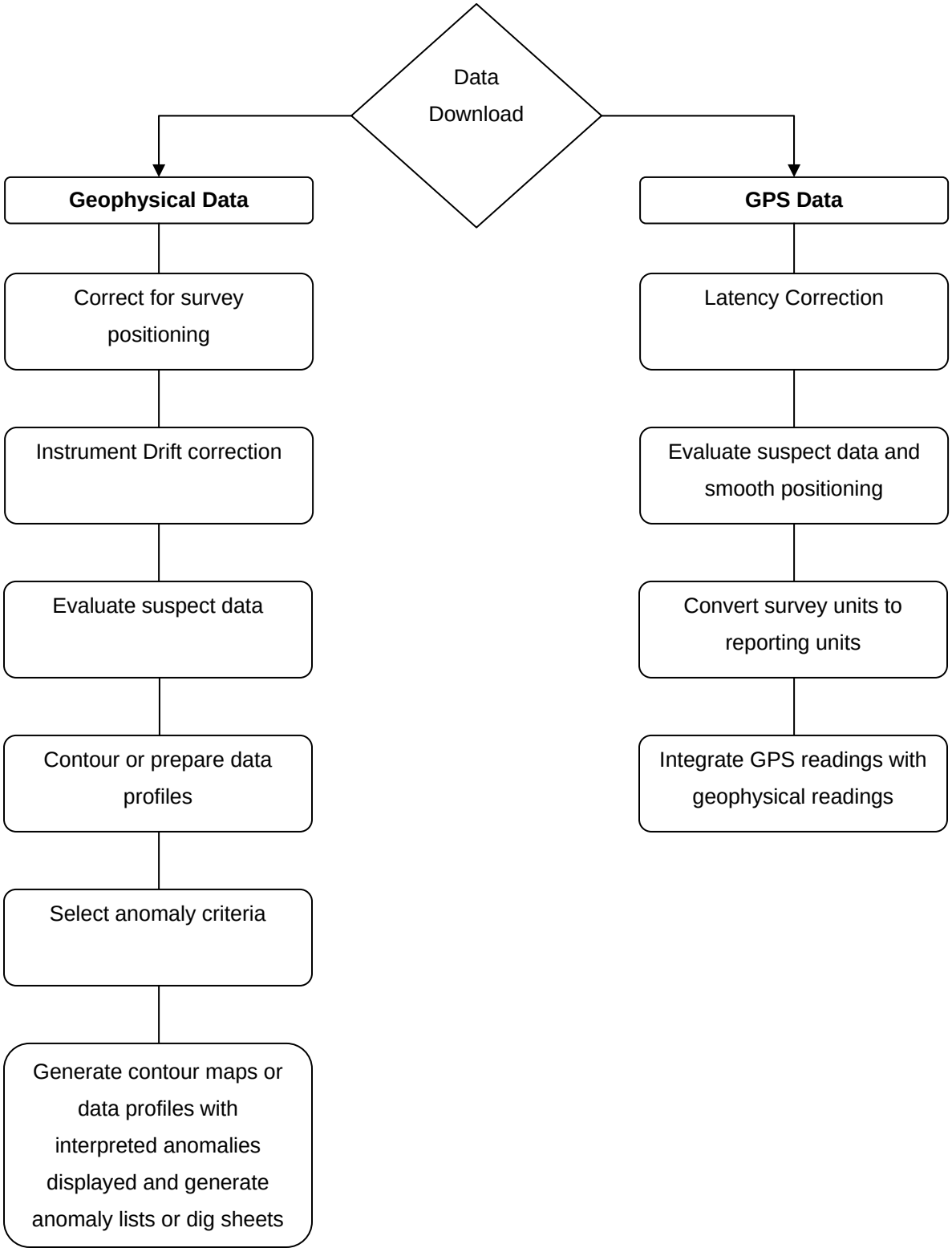
The metal detectors to be used by the UXO team during detector-aided visual sweeps have a detection depth limited by size and orientation of the target and soil characteristics of the work area. These instruments provide an audio signal for response but do not store data. The magnetic locator (magnetic gradiometer) does not need to be calibrated, but the all-metal detector does require field calibration. To ensure that each detector is operating properly, the operator turns on the instrument and slowly moves the locator towards metal. As the probe advances toward the target, the audio signal will increase. Failure to detect the object is reason to reject the instrument. Each detector will be checked daily before starting MEC activities and after any battery change. UXO Technicians will also conduct three random checks each day during daily operations.

The calibration setting for the Schonstedt magnetic locator instrument is 2; setting the instrument to 3 or 4 will make it more sensitive, and setting the instrument to 1 will make it less sensitive. The Schonstedt instrument will not detect non-ferrous munitions such as those made of copper, brass, or aluminum. The normal settings for the White's all-metal detector are presented in Appendix A (OPS01).

Software

All geophysical data will be processed within twenty four hours after data collection has been finished each day for preliminary data quality review. After the geophysical data have been backed up, the data will be copied to the processing computer and imported into geophysical data processing and mapping software (Geosoft's Oasis montaj). This software will be used to process, analyze, and present the findings of the geophysical surveys. The processing and analysis will consist of applying standard corrections to the data, producing data profiles to interpret the data, and identifying responses that could be associated with individual anomalies that represent MEC, and this process is depicted in the flowchart below. The geophysical team will prepare a detailed map and anomaly target list that depicts the northings and eastings of all anomalies that meet the identification criteria of potential ordnance items for each site. Each anomaly will be assigned a unique reference number for tracking and reporting.

GEOPHYSICAL DATA PROCESSING FLOWCHART



Governing Regulations/Guidance and ESS Determination

The work planned for the SI at each site does not require an Explosive Safety Submission (ESS) because MEC avoidance measures will be practiced during the investigation. No MEC or MPPEH will be moved or disturbed during this phase of the project. An ESS Determination Request has been prepared describing the general operations planned at each site. NOSSA has reviewed and approved the ESS Determination.

MEC activities will be performed in accordance with all local, state, and federal regulations and all applicable DoD requirements including those in Engineer Pamphlet EP-75-1-2 (USACE, 2004) and DID OE 005 (USACE, 2002). Activities involving work in areas potentially containing MEC hazards will be conducted in full compliance with NSF-IH, Munitions Mandatory Center of Expertise (MMCX), Department of the Navy, NOSSA, and DoD requirements regarding personnel, equipment, and procedures. Navy requirements include OP-5 and NOSSAINST.8020.15B

This work falls under the Defense Environmental Restoration Program (DERP). The SI will be performed in accordance with CERCLA Sections 104 and 121.

The sites where geophysical surveys will be conducted may contain live munitions, and caution should always be exercised while working on these sites.

Anomaly Reacquisition

No anomaly reacquisition is planned for this SI.

Team Decision Points

The detector-aided surface sweep and geophysical survey will be used to establish specific locations for MC sampling (documented under separate cover). The MC UFP SAP is written to allow flexibility in establishing locations after the detector-aided surface sweep and/or geophysical surveying are completed and allows for input from the Project Team.

The decision points are defined as follows:

- Any MEC, suspect MEC, MPPEH, or MD discovered on site will be brought to the attention of the Navy (NSF-IH) and Tetra Tech (UXO Manager, PM and Program Management).

- Any unanticipated findings that warrant modification of the UFP SAP will be brought to the attention of the Project Team.

The decision point with the Project Team to determine MC locations is important to the overall project schedule for the MRP sites. When the detector-aided surface sweeps and/or geophysical surveys are completed and data are evaluated, Tetra Tech will prepare recommendations and supporting documentation that will be provided to the stakeholders (via mail or e-mail), Navy, and Project Team. A conference call (or meeting) will then be arranged to achieve Navy and regulator consensus. Quick resolution will be needed to facilitate initiation of MC field work.

17.1 PLANNED MEC FIELD PROGRAM FOR AIR BLAST POND

17.1.1 Rationale

17.1.1.1 Rationale for Selection of Grids

At a minimum, limited pre-survey clearing to allow detector-aided surface sweeps may be necessary.

The Naval Ordnance Laboratory (NOL) used the Air Blast Pond for bulk high explosives (HE) testing from 1955 to 1975. The Air Blast Pond is an unlined earthen pit approximately 100 feet in diameter with a capacity of approximately 1.3 million gallons. The pit is surrounded by a man-made earthen berm approximately 10 feet tall. The Air Blast Pond area is currently undeveloped and wooded. To test the bulk HE, wire was strung across the pond to measure the concussion factors of various explosives. Test explosives were detonated above and in water and the tests were observed on range and recorded by the NOL. According to the PA, three to four detonation events (shots) were conducted per day, with an estimated 1,500 shots over the unit's active life.

According to the PA, a 57mm projectile was discovered during the 2003 and 2004 visual surveys. The source of the 57mm projectile is unknown, and its presence is inconsistent with bulk explosives testing. The Air Blast Pond is overlapped by the firing fan from the Valley Impact Area Firing Point located at NSF-IH, Main Installation; thus, there is a potential for munitions associated with the Valley Impact Area firing fan to be present at the Air Blast Pond. Also, an end cap for a C-4 block was found during the visual surveys on the southwestern portion of the berm. The PA reports that wooden debris, metal drums, and several steel cylinders were observed around the berm of the pond. There are several rusted

metal pipes standing upright on the earthen floor of the pit, and metal pipes are also exposed in the berm. The PA Report also notes other concrete and wooden structures and stairs throughout the site.

The area immediately surrounding the 57mm projectile's location is a known MEC area, and the remainder of the Air Blast Pond is considered a suspect MEC area. Geophysical surveying is not considered an option due to the excessive amount of metal debris scattered throughout the area. Therefore, a UXO detector-aided surface sweep will be conducted over 100 percent of the accessible portions of the 3.72-acre site.

17.1.1.2 Rationale for UXO Surveying Instrumentation

Recommended Instrumentation

The detector-aided surface sweep will be initially conducted using a magnetic locator (magnetic gradiometer) such as the Schonstedt GA-52Cx instrument or equivalent. During the surface sweep, if visual observations or other information show that non-ferrous metals from suspect MEC may be present, an all metals detector such as the White's Spectrum XLT or equivalent will be used. The all metals detector will either be used in place of, or in conjunction with, the magnetic locator. The decision as to whether one or both detectors will be used will be based on the ability to place the sensor of the all metals detector within 1 foot of the ground surface, the relative proportion of ferrous items to non-ferrous items, and the types of items visually observed and their relative potential to be MEC or MPPEH.

17.1.2 Scope

The scope of survey activities at the Air Blast Pond is summarized as follows (see Figure 17.1-1):

- Brush cutting as necessary to support the detector-aided surface sweeps.
- UXO detector-aided surface sweeps covering 100 percent of all accessible areas.
- Consultation with the Navy and stakeholders to discuss results and establish SI sampling locations for MC (in accordance with separate UFP SAP).

The UXO team leader will report all suspect MEC items to the NSF-IH IR Coordinator and then to the Tetra Tech UXO Manager. Suspect MEC items left in place will be avoided during subsequent operations at the site. No MEC items will be moved or disturbed during this phase of the project.

17.1.3 Site Preparation

Brush cutting and vegetation removal to support the detector-aided surface sweeps will be conducted to the degree necessary to allow the metal detector to get within a few inches of the ground surface. The magnetic detector is approximately 1 inch in diameter and is durable; therefore, it is possible to push the detector through brush and vegetation, and as a result, less brush cutting and vegetation removal is required. The all metals detector has a detection head of approximately 8 inches and is more fragile than the magnetometer. Therefore, brush and vegetation must be cleared to within a few inches of the ground surface.

17.1.4 UXO Detector-Aided Surface Sweep

The UXO team will establish transects for the detector-aided sweeps across 100 percent of the established survey areas. Metal detectors will be used to locate surface metal and debris. If suspect MEC, MPPEH, or MD are encountered, the location of each item will be recorded and/or marked using a GPS, tape measure, or other grid coordinate location system. The UXO team will attempt to determine its condition without moving or disturbing the item prior to proceeding with the surface sweep. Each item will be marked with flagging tape, and assigned a unique number starting with the transect ID label followed by the item number (e.g., ABP-1-1). All available information about the item will be recorded in the logbook, including location, identification, item number, and whether or not the item is suspect MEC or MPPEH. A digital photograph will be taken of each item. The UXO team will not move or otherwise disturb the item in an attempt to collect information. After all available information is recorded, the UXO team will resume the detector-aided surface sweep.

Every effort will be made to identify each suspect MEC/MPPEH item; however under no circumstances will any suspect MEC be moved in an attempt to make a definitive identification. Munition items will be visually examined for markings and other external features such as shape, size, and external fittings. If unknown military munitions are encountered, the NSF-IH IR Coordinator and Tetra Tech UXO Manager will be notified. Prior to any action being performed on an ordnance item, all fuzing will be definitively identified if it is possible to safely do so without disturbing the ordnance item. This identification will consist of fuze type by function and condition (armed or unarmed) and physical state/condition of the fuze (i.e., burned, broken, parts exposed/sheared, etc.).

Only UXO-qualified personnel will perform MEC identification procedures. As an exception, a UXO Technician I may assist in the performance of MEC identification procedures when under the supervision of a UXO Technician III or higher. All personnel engaged in field operations will be thoroughly trained and

capable of recognizing the specific hazards of the procedures being performed. To ensure that these procedures are performed to standards, all field personnel will be under the direct supervision of a UXO Technician III or higher. All suspect MEC items will be recorded following the requirements of this UFP SAP, the project site-specific HASP, applicable ordnance operations procedural safety guidelines, and industry-accepted safe work practices and procedures.

17.2. PLANNED MEC FIELD PROGRAM FOR AREA 8

17.2.1 Rationale

17.2.1.1 Rationale for Selection of Grids

At a minimum, limited pre-survey clearing to allow for geophysical data collection may be necessary.

Area 8 is a 22.61-acre mostly wooded site. Training activities were conducted at the site using inert devices coupled to small charges (1/2 pound TNT connected via wire) and were conducted underwater in the existing pond and creek (Chicamuxen). Charges connected to training devices are referred to as air shots if they were detonated aboveground or water shots if they were detonated underwater in pits or holes. The charges are the only expected MEC items because the training items connected to the shots were reportedly inert. Water-shot charges (excavations or pits), the Old Shot Hole and the existing pond and creek represent locations where the possibility for inert training device dumping would be higher (if such activities occurred) because they would have had existing holes that were covered or could easily be covered to keep items out of sight. Tetra Tech will conduct a UXO detector-aided sweeps of areas where water shots were located to search for possible caches of items to depths dependent on the quantity and volume of the metal that could be present. Furthermore, UXO detector-aided sweeps of the pond and creek are planned to search for caches of inert training items possibly discarded there. A geophysical survey may be used as part of the TRIAD approach at selected cluster anomaly locations detected by the UXO sweep. The training items are the focus of the detector-aided surface sweeps and the geophysical survey investigations not the MEC explosive shots, because the MEC explosive shots (or small charges) themselves are not expected to have physical properties that would allow them to be detected by the UXO sweep or geophysics survey. Any munitions training item discovered on site will be treated as suspect MEC and will not be moved or disturbed during this phase of the project.

17.2.1.2 Rationale for UXO Detector-Aided Surface Sweep Instrumentation

Recommended Instrumentation

A magnetic locator such as the Schonstedt GA-52Cx instrument will be used for detector-aided surface sweep operations.

17.2.2 Scope

The scope of survey activities at Area 8 is summarized as follows (see Figure 17.2-1):

- Brush and vegetation clearing will be necessary to support the detector-aided surface sweeps and geophysical investigation.

- 100-Percent UXO detector-aided surface sweeping of the accessible areas encompassing the water-shot locations and Old Shot Hole.

- UXO detector-aided sweeping of the pond and section of Chicamuxen Creek within the MRP site boundary from the PA Report to search for possible inert training devices using a 5-foot survey line spacing.

- UXO detector-aided surface sweeping of four parallel transects spaced 15 feet apart to provide reconnaissance coverage over numerous air-shot locations (shown on Figure 17.2-1).

- Possible geophysical surveying across selected anomaly clusters identified by the UXO sweep (as determined by the field team and PM).

- Consultation with the Navy and stakeholders to discuss results and establish SI sampling locations for MC (in accordance with separate MC UFP SAP).

The UXO team leader will report all suspect MEC items to the NSF-IH IR Coordinator and then to the Tetra Tech UXO Manager. Suspect MEC items will be avoided during subsequent geophysical surveying. No MEC items will be moved or disturbed during this phase of the project. Surface MD will be reported on the log sheet or in the logbook for the site.

The geophysical crew will be accompanied by a UXO Technician II or higher during all fieldwork and geophysical mapping. Before the geophysical crew enters an area potentially containing MEC, the UXO

Technician will conduct a detector-aided surface sweep and visual survey for surface ordnance and mark each surface MEC anomaly. Before the crew sets monuments or drives stakes, the UXO Technician will conduct a detector-aided surface sweep and visual survey for surface ordnance and a magnetometer or electromagnetic survey of the site to ensure that it is free of anomalies. The UXO Technician will not be required on a full-time basis for non-intrusive activities after the site has been cleared.

17.2.3 Site Preparation

Brush cutting and vegetation removal to support the detector-aided surface sweep will be conducted to the degree necessary to allow the metal detector to get within a few inches of the ground surface. The magnetic detector is approximately 1 inch in diameter and is durable; therefore, it is possible to push the detector through brush and vegetation; as a result, less brush cutting and vegetation removal is required. The all metals detector has a detection head of approximately 8 inches and is more fragile than the magnetometer. Therefore, brush and vegetation must be cleared to within a few inches of the ground surface.

The site is mostly wooded, and will require brush and vegetation cutting in the abovementioned geophysical survey areas. These areas will need to be clear-cut of brush smaller than 2 inches in diameter and other vegetation to a level no greater than 12 inches above the ground surface to permit the passage of the survey equipment. Trees and brush 2 inches and larger will not be cut. The survey crew will work around these obstacles.

17.2.4 UXO Detector-Aided Surface Sweeps

The UXO team will establish a coordinate system for the detector-aided surface sweeps by creating a labeled system of survey stakes. The UXO team will establish 5-foot lanes to survey the established areas with 100 percent coverage. Metal detectors will be used to locate surface metal and debris. The 50-foot-spaced transects will be swept perpendicular to an established baseline using a compass or GPS unit to guide the team on a meandering path (avoiding obstacles, heavy brush, wetlands, etc.). If suspect MEC, MPPEH, or MD are encountered, the location of each will be recorded and/or marked using a GPS, tape measure, or other grid coordinate location system. The UXO team will attempt to determine its condition without moving or disturbing the item prior to proceeding with the surface sweep. Each item will be marked with flagging tape and assigned a unique number starting with the survey area/transect ID label followed by the item number (e.g., A8-A-1-1 for the first area, and A8-T-1-1 for the first transect). All available information about the item will be recorded in the logbook, including suspect MEC/MPPEH or MD, location, identification, item number, and whether or not the item is suspect MEC or MPPEH. A

digital photograph will be taken of each item. The UXO team will not move or otherwise disturb the item in an attempt to collect information. After all available information is recorded, the UXO team will resume the detector-aided surface sweep.

Every effort will be made to identify each suspect MEC item. Under no circumstances will any suspect MEC/MPPEH be moved in an attempt to make a definitive identification. Munitions will be visually examined for markings and other external features such as shape, size, and external fittings. If unknown military munitions are encountered, the NSF-IH IR Coordinator and Tetra Tech UXO Manager will be notified. Prior to any action being performed on an ordnance item, all fuzing will be definitively identified if it is possible to safely do so without disturbing the ordnance item. This identification will consist of fuze type by function and condition (armed or unarmed) and physical state/condition of the fuze (i.e., burned, broken, parts exposed/sheared, etc.).

Only UXO-qualified personnel will perform MEC identification procedures. As an exception, a UXO Technician I may assist in the performance of MEC identification procedures when under the supervision of a UXO Technician III or higher. All personnel engaged in field operations will be thoroughly trained and capable of recognizing the specific hazards of the procedures being performed. To ensure that these procedures are performed to standards, all field personnel will be under the direct supervision of a UXO Technician III or higher. All suspect MEC items will be recorded following the requirements of this UFP SAP, the project site-specific HASP, applicable ordnance operations procedural safety guidelines, and industry-accepted safe work practices and procedures.

All MEC/MPPEH items discovered during the detector-aided surface sweep of the areas/transects will be left in place. No MEC or MPPEH will be moved during this part of the project.

17.2.5 UXO Detector-Aided Sweep of the Pond and Chicamuxen Creek

An underwater magnetic locator instrument operated from a boat will be used to search, and if detected, locate possible large anomalies on the bottom of the pond and along the edge of Chicamuxen Creek. The data will be collected along parallel survey lines spaced no greater than 5 feet apart using ropes anchored to the land or buoys placed across the pond to provide navigation. Anomaly locations will be reacquired and surveyed using GPS. Survey line spacing was chosen to provide sufficient coverage for detecting large items or caches of items.

17.2.6 Geophysical Surveying

A Geometrics G858 magnetometer is planned for use if a geophysics survey is conducted (determined by field team and PM) because the types of training devices that are the expected site targets (e.g., bomb, torpedo, and mine casings) are expected to be ferrous metal objects, and more brush clearance would be required to access the site with an all metals detector. Geophysics may also be utilized at selected anomaly clusters identified during the detector-aided sweep. Any suspect MEC found during the surface sweep will have been flagged by the UXO team and reported, and the geophysical survey team will avoid these areas. If, during the geophysical survey additional MEC items are observed, these will be marked with engineering flagging tape and given a unique I.D. number by the UXO technician. Targets of a geophysical investigation may include small to large object sizes at this site, and therefore it is estimated that survey depths might range from 0 to 6 feet based on a range of target sizes that may include items as large as bomb or torpedo casings (training items). In general, the larger buried metallic objects can be detected at greater depths.

17.3 PLANNED MEC FIELD PROGRAM FOR EOD SCHOOL DEMOLITION AREA

17.3.1 Rationale

17.3.1.1 Rationale for Selection of Grids

The EOD School Demolition Area was used from 1944 to 1949 as a training area to introduce graduating students to live explosives. The site is located on Stump Neck Annex, within the boundaries of the Marine Rifle Range and Torpedo Burial Site, and is mostly wooded. MEC may remain at the EOD School Demolition Area. Potential MEC include TNT, Tetryl packs, shape charges, caps, primer cords, safety fuses, 100-pound bombs, other live bombs. Therefore, Tetra Tech will conduct a focused UXO detector-aided sweep (100-percent survey coverage) within an 100- by 200-foot grid around the former ready bunker area (only range structure present) and will conduct a geophysical investigation of this former ready bunker area using no greater than 5-foot line spacing. The PA indicated that the site consists of 4.64 acres (based on historical review), and hence a UXO detector-aided sweep on 50-foot-spaced transects will be conducted to reconnoiter the remainder of the site.

17.3.1.2 Rationale for UXO Detector-Aided Surface Sweep Instrumentation

Recommended Instrumentation

The detector-aided surface sweeps will be initially conducted using a magnetic locator (magnetic gradiometer) such as the Schonstedt GA-52Cx instrument or equivalent. During the surface sweep, if visual observations or other information show that non-ferrous metals from suspect MEC may be present, then an all metals detector such as the White's Spectrum XLT or equivalent will be used. The all metals detector will either be used in place of, or in conjunction with, the magnetic locator. The decision as to whether one or both detectors will be used will be based on the ability to place the sensor of the all metals detector within 1 foot of the ground surface, the relative proportion of ferrous MEC items to non-ferrous MEC items, and the types of items visually observed and their relative potential to be MEC or MPPEH.

17.3.2 Scope

The scope of survey activities at the EOD School Demolition Area is summarized as follows (see Figure 17.3-1):

- Brush and vegetation clearing will be necessary to support the detector-aided surface sweeps and geophysical investigation.

- UXO detector-aided surface sweeping providing 100-percent coverage across a 100- by 200-foot grid surrounding the former ready bunker area, and sweeping with 50-foot-spaced transects for the remainder of the 5-acre site (boundary established based on PA).

- Geophysical surveying with no greater than a planned 5-foot survey line spacing across a 100- by 200-foot grid surrounding the ready bunker area, and with 50-foot-spaced transects for the remainder of the 5-acre site (boundary established on PA).

- If suspect MEC or subsurface anomaly clusters are detected along the 50-foot-spaced transects, additional detector-aided or geophysical investigation of these areas will be conducted to further determine the extent of possible MEC. Investigation will be limited to no greater than 100 feet beyond the planned survey boundary and will be determined by a field decision involving the UXO team leader and geophysics team. Notification will be given to the UXO Manager and PM prior to starting the abovementioned additional investigation.

- Consultation with the Navy and stakeholders to discuss results and establish SI sampling locations for MC (in accordance with separate MC UFP SAP).

The UXO team leader will report all suspect MEC items to the NSF-IH IR Coordinator and then to the Tetra Tech UXO Manager. Suspect MEC items left in place will be avoided during subsequent geophysical surveying. No MEC items will be moved or disturbed during this phase of the project. Surface MD will be reported on the log sheets or in the logbook for the site.

The geophysical crew will be accompanied by a UXO Technician II or higher during all fieldwork and geophysical mapping. Before the geophysical crew enters an area potentially containing MEC, the UXO Technician will conduct a detector-aided surface sweep and visual survey for surface ordnance and will mark each surface MEC anomaly. Before the crew sets monuments or drives stakes, the UXO Technician will conduct a detector-aided surface sweep and visual survey for surface ordnance and a magnetometer or electronic survey of the site to ensure that it is free of anomalies. The UXO Technician will not be required on a full-time basis for non-intrusive activities after the site has been cleared.

17.3.3 Site Preparation

Brush cutting and vegetation removal to support the detector-aided surface sweep will be conducted to the degree necessary to allow the metal detector to get within a few inches of the ground surface. The magnetic detector is approximately 1 inch in diameter and is durable; therefore, it is possible to push the detector through brush and vegetation and as a result, less brush cutting and vegetation removal is required. The all metals detector has a detection head of approximately 8 inches and is more fragile than the magnetometer. Therefore, brush and vegetation must be cleared to within a few inches of the ground surface.

The site is mostly wooded and will require brush cutting in the abovementioned geophysical survey areas. The areas will need to be clear-cut of brush smaller than 2 inches in diameter and other vegetation to a level no greater than 6 inches above the ground surface to permit the passage of survey equipment. The transects will need to be cut to no greater than 12 inches above ground surface, and cutting should be limited to 3-foot-wide along each transect. A grassy survey area is expected to be present, and mowing may be required depending on whether the grass area continues to be maintained by the base at the time of the survey. Trees and brush 2 inches and larger will not be cut. The survey crew will work around these obstacles.

17.3.4 UXO Detector-Aided Surface Sweep

The UXO team will establish a coordinate system for the detector-aided sweeps by creating a labeled system of survey stakes. Metal detectors will be used to locate surface metal and debris. The UXO team will establish 5-foot lanes to survey the 100- by 200-foot grid with 100-percent coverage. The 50-foot-spaced transects will be established perpendicular to an established baseline using a compass or GPS unit to guide the team on a meandering path (avoiding obstacles, heavy brush, wetlands etc.) from one end of the site to the other. If suspect MEC, MPPEH, or MD are encountered, the location of each item will be recorded and/or marked using a GPS, tape measure, or other grid coordinate location system. The UXO team will attempt to determine its condition without moving or disturbing the item prior to proceeding with the surface sweep. Each item will be marked with flagging tape and assigned a unique number starting with the transect ID label followed by the item number (e.g., EOD-T-1-1 for the first transect). All available information about the item will be recorded in the logbook, including suspect MEC/MPPEH or MD, location, identification, item number, and whether or not the item is suspect MEC or MPPEH. A digital photograph will be taken of each item. The UXO team will not move or otherwise disturb the item in an attempt to collect information. After all available information is recorded, the UXO team will resume the detector-aided surface sweep.

Every effort will be made to identify each suspect MEC item; however, under no circumstances will any suspect MEC be moved in an attempt to make a definitive identification. Munitions will be visually examined for markings and other external features such as shape, size, and external fittings. If unknown military munitions are encountered, the NSF-IH IR Coordinator and Tetra Tech UXO Manager will be notified. Prior to any action being performed on an ordnance item, all fuzing will be definitively identified if it is possible to safely do so without disturbing the ordnance item. This identification will consist of fuze type by function and condition (armed or unarmed) and physical state/condition of the fuze (i.e., burned, broken, parts exposed/sheared, etc.).

Only UXO-qualified personnel will perform MEC identification procedures. As an exception, a UXO Technician I may assist in the performance of MEC identification procedures when under the supervision of a UXO Technician III or higher. All personnel engaged in field operations will be thoroughly trained and capable of recognizing the specific hazards of the procedures being performed. To ensure that these procedures are performed to standards, all field personnel will be under the direct supervision of a UXO Technician III or higher. All suspect MEC items will be recorded following the requirements of this UFP SAP, the project site-specific HASP, applicable ordnance operations procedural safety guidelines, and industry-accepted safe work practices and procedures.

All items discovered during the detector-aided surface sweep of the transects/grid will be left in place. No MEC or MPPEH will be moved during this part of the project.

17.3.5 Detector-Aided Surface Sweep for Geophysical Survey

A 100-percent coverage detector-aided surface sweep is planned across a 100- by 200-foot grid surrounding the former ready bunker area, and a 50-foot-spaced transect survey is planned for the remainder of the site. Additional surveying may also be conducted at selected anomaly clusters following the survey of the 50-foot-spaced transects. The UXO Technician will conduct a detector-aided surface sweep of the grid and record the location of each MEC item discovered, if any. Each item will be marked with engineer flagging/tape and will be given a unique number starting with the grid number followed by the item number (e.g., EOD-A1-1). All available information about the MEC item will be recorded in the logbook including location, identification, item number, and whether the item is suspect MEC or MPPEH. A digital photograph will be taken of any MEC item. In addition to the MEC records stated above, the record will include general information on MPPEH, MD, and other items warranting attention for decision making during follow-up work. Flagging for items discovered during the detector-aided surface sweep will be checked and replaced if need to ensure the safety of the geophysical survey crew.

17.3.6 Geophysical Surveying

A Geonics EM61-MK2 and a Geometrics G858 magnetometer are planned for use in the grassy portions of the former ready bunker area., The Geometrics G858 magnetometer is planned for use in the wooded survey areas because the expected targets, given the age of the site, are expected to be ferrous metal objects, and more brush clearance would be required to access the site with an all-metals detector. The geophysical team will conduct the geophysical survey along parallel survey lines spaced no greater than 5 feet apart in one trend around the ready bunker area. A field decision based on site conditions (i.e., brush) will further determine this survey line spacing. A geophysical survey using 50-foot-spaced transects over the remainder of the site will also be conducted. Additional geophysical surveying may also be conducted at selected anomaly clusters following the survey of the 50-foot-spaced transects. Based on former site usage, it is anticipated that potential target anomalies are shallow (no more than 2 feet bgs). Targets of a geophysical investigation may include small to large object sizes at this site, and therefore survey depths are estimated to range from 0 to 4 feet based on a range of target sizes that may include items as large as large artillery rounds or bomb casings. The larger the buried metallic object, the deeper it can be detected.

Before the geophysical surveys begin, the UXO team will conduct a visual and detector-aided surface sweep of the survey area. Any suspect MEC found during the surface sweep will be flagged by the UXO team and reported, and the geophysical survey team will avoid these areas. If, during the geophysical survey additional MEC items are observed, these will be marked with engineering flagging tape and given a unique I.D. number by the UXO technician.

17.4 PLANNED MEC FIELD PROGRAM FOR BASIC IMPROVISED EXPLOSIVE DEVICE (IED) AREA

17.4.1 Rationale

17.4.1.1 Rationale for Selection of Grids

The Basic IED Area was used from November 1957 until approximately 1996 for the testing and demonstration of various explosive devices. Munitions used on range include small arms, bulk HE, demolition charges, primers, detonators, fuzes, and squibs. Law enforcement officers were trained here to disarm explosive devices, foreign explosives were brought to the range for anti-terrorism training, and newly developed ordnance was also tested and evaluated here by EOD technicians before being used by the Navy. Practical exercises were set up using letters, parcels, and pipe bombs with chlorates and thorates as part of the EOD School. Also, there were simulated real-life situations in which EOD technicians would be required to disarm explosive devices set up within car carcasses, helicopters, and other structures. Fragment-producing devices with TNT were used in such exercises. Although no MEC were observed during a visual survey performed for the PA, historical evidence suggests that MEC may still be present at the site. Therefore, a UXO detector-aided sweeps (100-percent survey coverage) will be conducted within a 90- by 150- foot grid around the former detonation area. The PA indicated that the site consists of 3.79 acres (based on historical review), and hence a UXO detector-aided sweep on 50-foot-spaced transects will be conducted for the remainder of the site to determine if other suspect metal is present outside the former detonation area.

17.4.1.2 Rationale for UXO Surveying Instrumentation

Recommended Instrumentation

The detector-aided surface sweeps will be initially conducted using a magnetic locator (magnetic gradiometer) such as the Schonstedt GA-52Cx instrument or equivalent. During the surface sweep, if visual observations or other information show that non-ferrous metals from suspect MEC may be present, then an all metals detector such as the White's Spectrum XLT or equivalent will be used. The all metals

detector will either be used in place of, or in conjunction with, the magnetic locator. The decision as to whether one or both detectors should be used will be based on the ability to place the sensor of the all metals detector within one foot of the ground surface, the relative proportion of ferrous MEC items to non-ferrous MEC items, and the types of items visually observed and their relative potential to be MEC or MPPEH.

17.4.2 Scope

The scope of survey activities at the Basic IED Area is summarized as follows (see Figure 17.4-1):

- Brush cutting as necessary to support the detector-aided surface sweeps.

- UXO detector-aided surface sweeping (providing 100-percent coverage) across a 90- by 150-foot grid around the former detonation area, and a sweep with 50-foot-spaced transects for the remainder of the 3.79-acre site (boundary established based on PA).

- If suspect MEC or subsurface anomaly clusters are detected along the 50-foot-spaced transects, additional detector-aided investigation of these areas will be conducted to determine their nature and extent. Investigation will be limited to no greater than 100 feet beyond the planned survey boundary, and the distance will be determined in the field by the UXO team leader. Notification will be given to the UXO Manager and PM prior to starting the abovementioned additional investigation.

- Consultation with the Navy and stakeholders to discuss results and establish SI sampling locations for MC (in accordance with separate MC UFP SAP).

The UXO team leader will report all suspect MEC items to the NSF-IH IR Coordinator and then to the Tetra Tech UXO Manager. Suspect MEC items left in place will be avoided during subsequent site work. No MEC items will be moved or disturbed during this phase of the project. Surface MD will be reported on the log sheets or in the logbook for the site.

Before the crew sets monuments or drives stakes, the UXO Technician will conduct a detector-aided surface sweep and visual survey for surface ordnance and a magnetometer or electronic survey of the site to ensure that it is free of anomalies.

17.4.3 Site Preparation

Brush cutting and vegetation removal to support the detector-aided surface sweep will be conducted to the degree necessary to allow the metal detector to get within a few inches of the ground surface. The magnetic detector is approximately 1 inch in diameter and is durable; therefore, it is possible to push the detector through brush and vegetation, as a result, less brush cutting and vegetation removal is required. The all metals detector has a detection head of approximately 8 inches and is more fragile than the magnetometer. Therefore, brush and vegetation must be cleared to within a few inches of the ground surface.

17.4.4 UXO Detector-Aided Surface Sweeps

The UXO team will establish a coordinate system for the detector-aided sweeps by creating a labeled system of survey stakes. Metal detectors will be used to locate surface metal and debris. The UXO team will establish 5-foot lanes to survey the 90- by 150-foot grid with 100-percent coverage. The 50-foot-spaced transects will be established perpendicular to the established baseline using a compass or GPS unit to guide the team on a meandering path (avoiding obstacles, heavy brush, wetlands etc.) from one end of the site to the other. If suspect MEC, MPPEH, or MD are encountered, the location of each item will be recorded and/or marked using a GPS, tape measure, or other grid coordinate location system. The UXO team will attempt to determine its condition without moving or disturbing the item prior to proceeding with the surface sweep. Each item will be marked with flagging tape and assigned a unique number starting with the transect ID label followed by the item number (e.g., BIED-T-1-1 for the first transect). All available information about the item will be recorded in the logbook, including suspect MEC/MPPEH or MD, location, identification, item number, and whether the item is suspect MEC or MPPEH. A digital photograph will be taken of each item. The UXO team will not move or otherwise disturb the item in an attempt to collect information. After all available information is recorded, the UXO team will resume the detector-aided surface sweep.

Every effort will be made to identify each suspect MEC item; however, under no circumstances will any suspect MEC be moved in an attempt to make a definitive identification. Munitions will be visually examined for markings and other external features such as shape, size, and external fittings. If unknown military munitions are encountered, the NSF-IH IR Coordinator and Tetra Tech UXO Manager will be notified. Prior to any action being performed on an ordnance item, all fuzing will be definitively identified if it is possible to safely do so without disturbing the ordnance item. This identification will consist of fuze type by function and condition (armed or unarmed) and physical state/condition of the fuze (i.e., burned, broken, parts exposed/sheared, etc.).

Only UXO-qualified personnel will perform MEC identification procedures. As an exception, a UXO Technician I may assist in the performance of MEC identification procedures when under the supervision of a UXO Technician III or higher. All personnel engaged in field operations will be thoroughly trained and capable of recognizing the specific hazards of the procedures being performed. To ensure that these procedures are performed to standards, all field personnel will be under the direct supervision of a UXO Technician III or higher. All suspect MEC items will be recorded following the requirements of this UFP SAP, the project site-specific HASP, applicable ordnance operations procedural safety guidelines, and industry-accepted safe work practices and procedures.

All items discovered during the detector-aided surface sweep of the transects/grid will be left in place. No MEC or MPPEH will be moved during this part of the project.

17.5 PLANNED MEC FIELD PROGRAM FOR ADVANCED IED AREA

17.5.1 Rationale

17.5.1.1 Rationale for Selection of Grids

The concrete foundation located in the southeastern portion of the site (SWMU 27) was discovered during the PA to contain visible suspect MEC (e.g., submunitions, practice rockets, snake eye fin tubes, smoke canisters, bomb fuzes, and random MD). The area immediately surrounding the foundation may have been used for training with inert explosive devices based on the visible suspect MEC, historical documents indicating that such activity took place at the site, and the characteristics of the landscape features (flat cleared area surrounded by a berm). Based on this information, it is possible that disposal of training items may also have occurred in this area. Therefore, a UXO detector-aided sweep (100-percent survey coverage) will be conducted within a 200-foot grid surrounding the concrete foundation, and a geophysical investigation will be conducted using no greater than a 5-foot line spacing across the berm and the cleared area enclosed by it. The PA indicated that the site consists of about 10 acres (based on historical review), and hence a UXO detector-aided sweep on 50-foot-spaced transects will be conducted for the remainder of the site to determine if other suspect metal is present outside the foundation area.

17.5.1.2 Rationale for UXO Detector-Aided Surface Survey Instrumentation

Recommended Instrumentation

The detector-aided surface sweeps will be initially conducted using a magnetic locator (magnetic gradiometer) such as the Schonstedt GA-52Cx instrument or equivalent. During the surface sweep, if visual observations or other information show that non-ferrous metals from suspect MEC may be present, then an all metals detector such as the White's Spectrum XLT or equivalent will be used. The all metals detector will either be used in place of, or in conjunction with, the magnetic locator. The decision as to whether one or both detectors should be used will be based on the ability to place the sensor of the all metals detector within 1 foot of the ground surface, the relative proportion of ferrous MEC items to non-ferrous MEC items, and the types of items visually observed and their relative potential to be MEC or MPPEH.

17.5.2 Scope

The scope of survey activities at the Advanced IED Area is summarized as follows (see Figure 17.5-1):

- Brush and vegetation clearing will be necessary to support the detector-aided surface sweeps and geophysical investigation.

- UXO detector-aided surface sweeping providing 100-percent coverage across a 200-foot grid surrounding the concrete foundation (SWMU 27), and a sweep with 50-foot-spaced transects for the remainder of the 10-acre site (boundary established based on PA).

- Geophysical surveying of the cleared area (2.5-foot survey line spacing) and surrounding berm (5-foot survey line spacing).

- If suspect MEC or subsurface anomaly clusters are detected along the 50-foot-spaced transects, additional detector-aided or geophysical investigation of these areas will be conducted to better determine the extent of possible MEC. Investigation will be limited to no greater than 100 feet beyond the planned survey boundary, and the distance will be determined in the field by the UXO team leader and geophysics team. Notification will be given to the UXO Manager and PM prior to starting the abovementioned additional investigation.

- Consultation with the Navy and stakeholders to discuss results and establish SI sampling locations for MC (in accordance with separate MC UFP SAP).

The UXO team leader will report all suspect MEC items to the NSF-IH IR Coordinator and then to the Tetra Tech UXO Manager. Suspect MEC items left in place will be avoided during subsequent geophysical surveying. No MEC items will be moved or disturbed during this phase of the project. Surface MD will be reported on the log sheets or in the logbook for the site.

The geophysical crew will be accompanied by a UXO Technician II or higher during all fieldwork and geophysical mapping. Before the geophysical crew enters an area potentially containing MEC, the UXO Technician will conduct a detector-aided surface sweep and visual survey for surface ordnance and mark each surface MEC anomaly. Before the crew sets monuments or drives stakes, the UXO Technician will conduct a detector-aided surface sweep and visual survey for surface ordnance and a magnetometer or electronic survey of the site to ensure that it is free of anomalies. The UXO Technician will not be required on a full-time basis for non-intrusive activities after the site has been cleared.

17.5.3 Site Preparation

Brush cutting and vegetation removal to support the detector-aided surface sweep will be conducted to the degree necessary to allow the metal detector to get within a few inches of the ground surface. The magnetic detector is approximately 1 inch in diameter and is durable; therefore, it is possible to push the detector through brush and vegetation, as a result, less brush cutting and vegetation removal is required. The all metals detector has a detection head of approximately 8 inches and is more fragile than the magnetometer. Therefore, brush and vegetation must be cleared to within a few inches of the ground surface.

The site is mostly wooded and will require brush cutting in the abovementioned geophysical survey areas. These areas will need to be clear-cut of brush smaller than 2 inches in diameter and other vegetation to a level no greater than 12 inches above the ground surface to permit passage of the survey equipment. A grassy survey area is expected to be present, and mowing may be required depending on whether the grass area continues to be maintained by the base at the time of the survey. Trees and brush 2 inches and larger will not be cut. The survey crew will work around these obstacles.

17.5.4 UXO Detector-Aided Surface Sweeps

The UXO team will establish a coordinate system for the detector-aided sweeps by creating a labeled system of survey stakes. Metal detectors will be used to locate surface metal and debris. The UXO team will establish 5-foot lanes to survey the 200-foot grid with 100-percent coverage. The 50-foot-spaced transects will be established perpendicular to the established baseline using a compass or GPS unit to guide the team on a meandering path (avoiding obstacles, heavy brush, wetlands etc.) from one end of the site to the other. If suspect MEC, MPPEH, or MD are encountered, the location of each item will be recorded and/or marked using a GPS, tape measure, or other grid coordinate location system. The UXO team will attempt to determine its condition without moving or disturbing the item prior to proceeding with the surface sweep. Each item will be marked with flagging tape and assigned a unique number starting with the transect ID label followed by the item number (e.g., AIED-T-1-1 for the first transect). All available information about the item will be recorded in the logbook, including location, identification, item number, and whether the item is suspect MEC or MPPEH. A digital photograph will be taken of each item. The UXO team will not move or otherwise disturb the item in an attempt to collect information. After all available information is recorded, the UXO team will resume the detector-aided surface sweep.

Every effort will be made to identify each suspect MEC item observed. Under no circumstances will any suspect MEC be moved in an attempt to make a definitive identification. Munitions will be visually examined for markings and other external features such as shape, size, and external fittings. If unknown military munitions are encountered, the NSF-IH IR Coordinator and Tetra Tech UXO Manager will be notified. Prior to any action being performed on an ordnance item, all fuzing will be definitively identified if it is possible to safely do so without disturbing the ordnance item. This identification will consist of fuze type by function and condition (armed or unarmed) and physical state/condition of the fuze (i.e., burned, broken, parts exposed/sheared, etc.).

Only UXO-qualified personnel will perform MEC identification procedures. As an exception, a UXO Technician I may assist in the performance of MEC identification procedures when under the supervision of a UXO Technician III or higher. All personnel engaged in field operations will be thoroughly trained and capable of recognizing the specific hazards of the procedures being performed. To ensure that these procedures are performed to standards, all field personnel will be under the direct supervision of a UXO Technician III or higher. All suspect MEC items will be recorded following the requirements of this UFP SAP, the project site-specific HASP, applicable ordnance operations procedural safety guidelines, and industry-accepted safe work practices and procedures.

All items discovered during the detector-aided surface sweep of the transects/grid will be left in place. No MEC or MPPEH will be moved during this part of the project.

17.5.5 Detector-Aided Surface Sweep for Geophysical Survey

The area of the geophysical survey is within and including the existing berm (see Figure 17.5-1). This area will be surveyed utilizing a grid system. The UXO Technician will conduct a detector-aided surface sweep of the grid and record the location of each MEC item discovered, if any. Any MEC items will be marked with engineer flagging tape/pin flag and given a unique number starting with the grid number followed by the item number (e.g., AIED-A1-1 for the first grid). All available information about the MEC item will be recorded in the logbook including location, identification, item number, and whether the item is suspect MEC or MPPEH. A digital photograph will be taken of MEC item. In addition to the MEC records stated above, the record will include general information on MPPEH, MD, and other items warranting attention for decision making during follow-up work.

17.5.6 Geophysical Surveying

A Geonics EM61-MK2 and a Geometrics G858 magnetometer are planned for use in the grassy portions of the berm area. The Geometrics G858 magnetometer is planned for use in the wooded survey areas because the types of training devices that are expected targets of the site (e.g., bomb, torpedo, and mine casings) are expected to be ferrous metal objects, and more brush clearance would be required to access the site with an all-metals detector. The geophysical team will conduct a survey of the cleared area (2.5-foot survey line spacing) and surrounding berm (5-foot survey line spacing). Geophysics may also be utilized at selected anomaly clusters identified during the detector-aided sweep. Based on former site usage, it is anticipated that potential target anomalies are shallow (up to 2 feet bgs), except within the berm where items could be as deep as the base of the berm (about 4 to 5 feet). Targets of a geophysical investigation may include small to large object sizes on this site, and therefore survey depths may range from 0 to 6 feet based on a range of target sizes that may include items as large as bomb or torpedo casings (training items). In general, larger metallic objects can be detected at greater depths.

Before the geophysical surveys begin, the UXO team will conduct a visual and detector-aided surface sweep of the survey area. Any suspect MEC found during the surface sweep will be flagged by the UXO team and reported, and the geophysical survey team will avoid these areas. If, during the geophysical survey additional MEC items are observed, these will be marked with engineering flagging tape and given a unique I.D. number by the UXO technician.

17.6 PLANNED MEC FIELD PROGRAM FOR STUMP NECK IMPACT AREA

17.6.1 Rationale

17.6.1.1 Rationale for Selection of Transects

At a minimum, limited pre-survey clearing to allow geophysical data collection on transects will be required.

The Stump Neck Impact Area is an undeveloped marshy and aquatic site that was used as a target area for artillery (37mm and larger, including potential rockets). The site is large, and the target locations unknown; therefore, a geophysical investigation will be conducted using 40-foot-spaced transects to reconnoiter the accessible portions (by foot) of the site identified during the PA. Using a visual sample plan (VSP) model for an assumed 200-foot-radius circular target, the recommended transect spacings of 38 to greater than 73 feet (corresponding to expected target densities above background ranging from 10 to 30 per acre) were calculated using a background density of five per acre to give a 90-percent probability of detection (see VSP model results attached in Appendix B of the MEC UFP SAP). The survey depth will range from 0 to 5 feet depending on target size for artillery projectiles and will increase for larger items (more metal mass and diameter).

17.6.1.2 Rationale for UXO Detector-Aided Surface Sweep Instrumentation

Recommended Instrumentation

The detector-aided surface sweeps will be initially conducted using a magnetic locator (magnetic gradiometer) such as the Schonstedt GA-52Cx instrument or equivalent. During the surface sweep, if visual observations or other information show that non-ferrous metals from suspect MEC may be present, then an all metals detector such as the White's Spectrum XLT or equivalent will be used. The all metals detector will either be used in place of, or in conjunction with, the magnetic locator. The decision as to whether one or both detectors should be used will be based on the ability to place the sensor of the all metals detector within one foot of the ground surface, the relative proportion of ferrous MEC items to non-ferrous MEC items, and the types of items visually observed and their relative potential to be MEC or MPPEH.

17.6.2 Scope

The scope of survey activities at the Stump Neck Impact Area is summarized as follows (see Figure 17.6-1):

- Brush and vegetation clearing will be necessary to support the detector-aided surface sweeps and geophysical investigation.
- UXO detector-aided surface sweeping of the geophysical survey area.
- Geophysical surveying across portions of the site accessible by foot and instrument using a planned 40-foot transect spacing.
- Consultation with the Navy and stakeholders to discuss results and establish SI sampling locations for MC (in accordance with separate MC UFP SAP).

The UXO team leader will report all suspect MEC items to the NSF-IH IR Coordinator and then to the Tetra Tech UXO Manager. Suspect MEC items left in place will be avoided during subsequent geophysical surveying. No MEC items will be moved or disturbed during this phase of the project. Surface MD will be reported on the log sheet and in the logbook for the site.

The geophysical crew will be accompanied by a UXO Technician II or higher during all fieldwork and geophysical mapping. Before the geophysical crew enters an area potentially containing MEC, the UXO Technician will conduct a detector-aided surface sweep and visual survey for surface ordnance and mark each surface MEC anomaly. Before the crew sets monuments or drives stakes, the UXO Technician will conduct a detector-aided surface sweep and visual survey for surface ordnance and a magnetometer or electronic survey of the site to ensure that it is free of anomalies. The UXO Technician will not be required on a full-time basis for non-intrusive activities after the site has been cleared.

17.6.3 Site Preparation

Brush cutting and vegetation removal to support the detector-aided surface sweep will be conducted to the degree necessary to allow the metal detector to get within a few inches of the ground surface. The magnetic detector is approximately 1 inch in diameter and is durable; therefore, it is possible to push the detector through brush and vegetation, and as a result, less brush cutting and vegetation removal is required. The all metals detector has a detection head of approximately 8 inches and is more fragile than

the magnetometer. Therefore, brush and vegetation must be cleared to within a few inches of the ground surface.

The site is mostly wetlands and will require vegetation cutting along the abovementioned geophysical survey transects. The transects will need to be cleared of brush smaller than 2 inches in diameter and other vegetation to a level no greater than 12 inches above the ground surface along 3-foot-wide corridors on each transect to permit the passage of the survey equipment. Trees and brush 2 inches and larger will not be cut. The survey crew will work around these obstacles.

17.6.4 UXO Detector-Aided Surface Sweep

The UXO team will work with the site geophysicist to establish transects for both the detector-aided sweep and geophysical survey. Metal detectors will be used to locate surface metal and debris. The transects will be spaced 40 feet apart, and transect length will be determined by accessibility (mainly related to wetlands and standing water). Rationale for terminating the transects will be recorded in the field notes. If suspect MEC, MPPEH, or MD are encountered, the location of each will be recorded and/or marked using a GPS, tape measure, or other grid coordinate location system. The UXO team will attempt to determine its condition without moving or disturbing the item prior to proceeding with the surface sweep. Each item will be marked with flagging tape and assigned a unique number starting with the transect ID label followed by the item number (e.g., SNI-T-1-1 for the first transect). All available information about the item will be recorded in the logbook, including location, identification, item number, and whether the item is suspect MEC or MPPEH. A digital photograph will be taken of each item. The UXO team will not move or otherwise disturb the item in an attempt to collect information. After all available information is recorded, the UXO team will resume the detector-aided surface sweep.

Every effort will be made to identify each suspect MEC item identified. Under no circumstances will any suspect MEC be moved in an attempt to make a definitive identification. Munitions will be visually examined for markings and other external features such as shape, size, and external fittings. If unknown military munitions are encountered, the NSF-IH IR Coordinator and Tetra Tech UXO Manager will be notified. Prior to any action being performed on an ordnance item, all fuzing will be definitively identified if it is possible to safely do so without disturbing the ordnance item. This identification will consist of fuze type by function and condition (armed or unarmed) and physical state/condition of the fuze (i.e., burned, broken, parts exposed/sheared, etc.).

Only UXO-qualified personnel will perform MEC identification procedures. As an exception, a UXO Technician I may assist in the performance of MEC identification procedures when under the supervision

of a UXO Technician III or higher. All personnel engaged in field operations will be thoroughly trained and capable of recognizing the specific hazards of the procedures being performed. To ensure that these procedures are performed to standards, all field personnel will be under the direct supervision of a UXO Technician III or higher. All suspect MEC items will be recorded following the requirements of this UFP SAP, the project site-specific HASP, applicable ordnance operations procedural safety guidelines, and industry-accepted safe work practices and procedures.

All items discovered during the detector-aided surface sweep of the transects will be left in place. No MEC or MPPEH will be moved during this part of the project.

17.6.5 Geophysical Surveying

A Geometrics G858 magnetometer is planned for use at the site because the expected targets of the site (e.g., artillery shells) are expected to be ferrous metal objects, and more brush clearance would be required to access the site with an all-metals detector. The geophysical team will conduct the geophysical survey along 40-foot-spaced transects. Small subsurface objects such as individual mortar or artillery rounds can generally only be detected at shallow burial depths. However, these items may be buried relatively deep in the marshy ground of the Stump Neck Impact Area, thereby possibly escaping detection by the geophysical survey. Targets of the geophysical investigation may include small to large object sizes at this site, and therefore survey depths may range from 0 to 5 feet based on a range of target sizes that may include items as big as rockets. In general, larger metallic objects can be detected at greater depths.

Before the geophysical survey begins, the UXO team will conduct a visual and detector-aided surface sweep of the survey area. Any suspect MEC found during the surface sweep will be flagged by the UXO team and reported, and the geophysical survey team will avoid these areas. If, during the geophysical survey additional MEC items are observed, these will be marked with engineering flagging tape and given a unique I.D. number by the UXO technician.

17.7 PLANNED MEC FIELD PROGRAM FOR TEST AREA 1

17.7.1 Rationale

17.7.1.1 Rationale for Selection of Grids

Test Area 1, which comprises 4.52 acres, is located near the center of the Stump Neck Annex peninsula. In the 1950s, the Naval Research Laboratory constructed a 220-foot by 263-foot “hole-in-the-ground”

antenna at the range that was used in pioneer moon relay communication experiments. During the 1960s and 1970s, Test Area 1 was used for AA&D training (such as booby traps and trip wires). In the 1980s, Test Area 1 was used for IED and IND training. All training items were inert; however, the devices were connected to working components that would set off small charges (a quarter-pound block of TNT) located a short distance from the training item. The charges were sized for total consumption; however, it is possible that small amounts of residue may remain. From the 1990s to the present, Test Area 1 has been used primarily as an area for robotics testing. The structure of the antenna (nicknamed the bowl) will interfere with detector-aided UXO and geophysical surveying; therefore, a UXO visual survey over 100 percent of the inside of the bowl will be conducted. Outside of the bowl area, a 100-percent UXO detector-aided surface sweep will be conducted on the accessible portions of the remainder of the site boundary determined during the PA. The inert training items are the focus of the detector-aided surface sweeps and geophysical surveys, not the small charges, because the MEC explosive shots (or small charges) themselves are not expected to have physical properties that would allow them to be detected by the UXO sweep or geophysical survey.

17.7.1.2 Rationale for UXO Detector-Aided Surface Sweep Instrumentation

Recommended Instrumentation

The detector-aided surface sweeps will be initially conducted using a magnetic locator (magnetic gradiometer) such as the Schonstedt GA-52Cx instrument or equivalent. During the surface sweep, if visual observations or other information show that non-ferrous metals from suspect MEC may be present, then an all metals detector such as the White's Spectrum XLT or equivalent will be used. The all metals detector will either be used in place of, or in conjunction with, the magnetic locator. The decision as to whether one or both detectors should be used will be based on the ability to place the sensor of the all metals detector within 1 foot of the ground surface, the relative proportion of ferrous MEC items to non-ferrous MEC items, and the types of items visually observed and their relative potential to be MEC or MPPEH.

17.7.2 Scope

The scope of survey activities at Test Area 1 is summarized as follows (see Figure 17.7-1):

- Brush cutting as necessary to support the detector-aided surface sweeps.
- UXO visual surveying (100-percent coverage) of the inside of the bowl.

- UXO detector-aided surface sweeps (100-percent coverage) on the accessible portions of the remainder of the site according to the PA (4.52 acres).

- Consultation with the Navy and stakeholders to discuss results and establish SI sampling locations for MC (in accordance with separate MC UFP SAP).

The UXO team leader will report all suspect MEC items to the NSF-IH IR Coordinator and then to the Tetra Tech UXO Manager. Suspect MEC items left in place will be avoided during subsequent surveying. No MEC items will be moved or disturbed during this phase of the project. All other metal scrap may be removed from the area of concern and consolidated.

17.7.3 Site Preparation

Brush cutting and vegetation removal to support the detector-aided surface sweep will be conducted to the degree necessary to allow the metal detector to get within a few inches of the ground surface. The magnetic detector is approximately 1 inch in diameter and is durable; therefore, it is possible to push the detector through brush and vegetation, and as a result, less brush cutting and vegetation removal is required. The all metals detector has a detection head of approximately 8 inches and is more fragile than the magnetometer. Therefore, brush and vegetation must be cleared to within a few inches of the ground surface.

17.7.4 UXO Visual Survey and Detector-Aided Surface Sweep

The UXO team will establish a coordinate system for the visual survey sweep and detector-aided surface sweep by creating a labeled system of survey stakes. The UXO team will establish 5-foot lanes to survey the established survey areas with 100-percent coverage. If suspect MEC, MPPEH, or MD are encountered, the location of each item will be recorded and/or marked using a GPS, tape measure, or other grid coordinate location system. The UXO team will attempt to determine its condition without moving or disturbing the item prior to proceeding with the surface sweep. Each item will be marked with flagging tape and assigned a unique number starting with the transect ID label followed by the item number (e.g., TA1-1-1 for the first transect). All available information about the item will be recorded in the logbook, including location, identification, item number, and whether the item is suspect MEC or MPPEH. A digital photograph will be taken of each item. The UXO team will not move or otherwise disturb the item in an attempt to collect information. After all available information is recorded, the UXO team will resume the detector-aided surface sweep.

Every effort will be made to identify each suspect MEC item identified. Under no circumstances will any suspect MEC be moved in an attempt to make a definitive identification. Munitions will be visually examined for markings and other external features such as shape, size, and external fittings. If unknown military munitions are encountered, the NSF-IH IR Coordinator and Tetra Tech UXO Manager will be notified. Prior to any action being performed on an ordnance item, all fuzing will be definitively identified if it is possible to safely do so without disturbing the ordnance item. This identification will consist of fuze type by function and condition (armed or unarmed) and physical state/condition of the fuze (i.e., burned, broken, parts exposed/sheared, etc.).

Only UXO-qualified personnel will perform MEC identification procedures. As an exception, a UXO Technician I may assist in the performance of MEC identification procedures when under the supervision of a UXO Technician III or higher. All personnel engaged in field operations will be thoroughly trained and capable of recognizing the specific hazards of the procedures being performed. To ensure that these procedures are performed to standards, all field personnel will be under the direct supervision of a UXO Technician III or higher. All suspect MEC items will be recorded following the requirements of this UFP SAP, the project site-specific HASP, applicable ordnance operations procedural safety guidelines, and industry-accepted safe work practices and procedures.

17.8 PLANNED MEC FIELD PROGRAM FOR VALLEY IMPACT AREA

17.8.1 Rationale

17.8.1.1 Rationale for Selection of Grids

At a minimum, limited pre-survey clearing to allow data collection along 19 transects may be required.

The Valley Impact Area is a very large mixed-use area (about 700 acres). Marshy, open, and large wooded areas are present. The site is believed to have been a peripheral potential impact zone for target fire directed at targets elsewhere that consisted of various-sized HE and shrapnel shot, and consequently, no information about an actual target on the site was identified. Therefore, a VSP model was deemed unsuitable. A UXO detector-aided surface sweep and geophysical investigation will be conducted using 19 transects to reconnoiter the accessible portions (by foot) of the mostly undeveloped portion of the site identified during the PA. Information from the geophysical survey and detector-aided surface sweep of the other sites inside the range fan for the Valley Impact Area will be reviewed and reported in this investigation to determine if further investigation is warranted. The survey depth will be,

at a minimum, the top 2 feet for small artillery shells and will increase for larger items (more metal mass and diameter).

17.8.1.2 Rationale for UXO Detector-Aided Surface Sweep Instrumentation

Recommended Instrumentation

A magnetic locator such as the Schonstedt GA-52Cx instrument will be used for detector-aided surface sweep operations.

17.8.2 Scope

The scope of survey activities at the Valley Impact Area is summarized as follows (see Figure 17.8-1):

- Brush and vegetation clearing will be necessary to support the detector-aided surface sweeps and geophysical investigation.
- UXO detector-aided surface sweeping of the geophysical survey area.
- Geophysical surveying across portions accessible by foot and instrument along 19 transects (approximately 400-foot transect spacing).
- Consultation with the Navy and stakeholders to discuss results and establish SI sampling locations for MC (in accordance with separate UFP SAP).

The UXO team leader will report all suspect MEC items to the NSF-IH IR Coordinator and then to the Tetra Tech UXO Manager. Suspect MEC items left in place will be avoided during subsequent geophysical surveying. No MEC items will be moved or disturbed during this phase of the project. Surface MD will be reported on the log sheets or in the logbook for the site.

The geophysical crew will be accompanied by a UXO Technician II or higher during all fieldwork and geophysical mapping. Before the geophysical crew enters an area potentially containing MEC, the UXO Technician will conduct a detector-aided surface sweep and visual survey for surface ordnance and will mark each surface MEC anomaly. Before the crew sets monuments or drives stakes, the UXO Technician will conduct a detector-aided surface sweep and visual survey for surface ordnance and a

magnetometer survey of the site to ensure that it is free of anomalies. The UXO Technician will not be required on a full-time basis for non-intrusive activities after the site has been cleared.

17.8.3 Site Preparation

Brush cutting and vegetation removal to support the detector-aided surface sweep will be conducted to the degree necessary to allow the metal detector to get within a few inches of the ground surface. The magnetic detector is approximately 1 inch in diameter and is durable; therefore, it is possible to push the detector through brush and vegetation, and as a result, less brush cutting and vegetation removal is required. The all metals detector has a detection head of approximately 8 inches and is more fragile than the magnetometer. Therefore, brush and vegetation must be cleared to within a few inches of the ground surface.

The site is composed of various terrains, and will require brush and vegetation cutting along the abovementioned geophysical survey transects. The transects will need to be cleared of brush smaller than 2 inches in diameter and other vegetation to a level no greater than 12 inches above the ground surface along 3-foot-wide corridors on each transect to permit the passage of the survey equipment. Grassy areas, where encountered, will need to be cut if the grass exceeds 2 feet in height. Trees and brush 2 inches and larger will not be cut. The survey crew will work around these obstacles.

17.8.4 UXO Detector-Aided Surface Sweep

The UXO team will work with the site geophysicist to establish transects for both the detector-aided sweep and geophysical survey. Metal detectors will be used to locate surface metal and debris. Each transect will be perpendicular to the established baseline using a compass or GPS unit to guide the team on a meandering path (avoiding obstacles, heavy brush, wetlands, etc.) along the transect. If suspect MEC, MPPEH, or MD are encountered, the location of each item will be recorded and/or marked using a GPS, tape measure, or other grid coordinate location system. The UXO team will attempt to determine its condition without moving or disturbing the item prior to proceeding with the surface sweep. Each item will be marked with flagging tape and assigned a unique number starting with the transect ID label followed by the item number (e.g., VIAT-1-1 for the first transect). All available information about the item will be recorded in the logbook, including identification, item number, and whether the item is suspect MEC or MPPEH. A digital photograph will be taken of each item. The UXO team will not move or otherwise disturb the item in an attempt to collect information. After all available information is recorded, the UXO team will resume the detector-aided surface sweep.

Every effort will be made to identify each suspect MEC item identified. Under no circumstances will any suspect MEC be moved in an attempt to make a definitive identification. Munitions will be visually examined for markings and other external features such as shape, size, and external fittings. If unknown military munitions are encountered, the NSF-IH IR Coordinator and Tetra Tech UXO Manager will be notified. Prior to any action being performed on an ordnance item, all fuzing will be definitively identified if it is possible to safely do so without disturbing the ordnance item. This identification will consist of fuze type by function and condition (armed or unarmed) and physical state/condition of the fuze (i.e., burned, broken, parts exposed/sheared, etc.).

Only UXO-qualified personnel will perform MEC identification procedures. As an exception, a UXO Technician I may assist in the performance of MEC identification procedures when under the supervision of a UXO Technician III or higher. All personnel engaged in field operations will be thoroughly trained and capable of recognizing the specific hazards of the procedures being performed. To ensure that these procedures are performed to standards, all field personnel will be under the direct supervision of a UXO Technician III or higher. All suspect MEC items will be recorded following the requirements of this UFP SAP, the project site-specific HASP, applicable ordnance operations procedural safety guidelines, and industry-accepted safe work practices and procedures.

All items discovered during the detector-aided surface sweep of the transects will be left in place. No MEC or MPPEH will be moved during this part of the project.

17.8.5 Geophysical Surveying

A Geometrics G858 magnetometer is planned for use at the site because the expected targets of the site (e.g., artillery shells) are expected to be ferrous metal objects, and more brush clearance would be required to access the site with an all-metals detector. The geophysical team will conduct the geophysical survey along 19 transects. Small subsurface objects such as individual mortar or artillery rounds can generally only be detected at shallow burial depths. However, these items may be buried relatively deep in the marshy ground of the Valley Impact Area, thereby possibly escaping detection by the geophysical survey. Targets of the geophysical investigation may include small to large object sizes at this site, and therefore survey depths may range from 0 to 5 feet based on a range of target sizes that may include items as large as large Naval ship artillery rounds (i.e., 14-inch rounds). The larger the buried metallic object, the deeper it can be detected.

Before the geophysical surveys begin, the UXO team will conduct a visual and detector-aided surface sweep of the survey area. Any suspect MEC found during the surface sweep will be flagged by the UXO

team and reported, and the geophysical survey team will avoid these areas. If, during the geophysical survey additional MEC items are observed, these will be marked with engineering flagging tape and given a unique I.D. number by the UXO Technician.

17.9 PLANNED MEC FIELD PROGRAM FOR TORPEDO BURIAL SITE

17.9.1 Rationale

17.9.1.1 Rationale for Selection of Grids

At a minimum, limited pre-survey clearing to allow geophysical data collection on 5-foot-spaced survey lines will be required.

The Torpedo Burial Site is adjacent to the EOD School Demolition Area. Reportedly, the Torpedo Burial Site is believed to have possibly been used to dispose of torpedoes (potentially live) in at least one trench. A torpedo casing is visible in a depression near the southwestern corner of the site. Therefore, a geophysical investigation will be conducted using a planned 5-foot survey line spacing to provide thorough coverage for detection of buried metal caches across the accessible portions of the site identified in the PA.

17.9.1.2 Rationale for UXO Detector-Aided Surface Sweep Instrumentation

Recommended Instrumentation

The detector-aided surface sweeps will be initially conducted using a magnetic locator (magnetic gradiometer) such as the Schonstedt GA-52Cx instrument or equivalent. During the surface sweep, if visual observations or other information show that non-ferrous metals from suspect MEC may be present, then an all metals detector such as the White's Spectrum XLT or equivalent will be used. The all metals detector will either be used in place of, or in conjunction with, the magnetic locator. The decision as to whether one or both detectors should be used will be based on the ability to place the sensor of the all metals detector within 1 foot of the ground surface, the relative proportion of ferrous MEC items to non-ferrous MEC items, and the types of items visually observed and their relative potential to be MEC or MPPEH.

17.9.2 Scope

The scope of survey activities at the Torpedo Burial Site is summarized as follows (see Figure 17.9-1):

- Brush and vegetation clearing will be necessary to support the detector-aided surface sweeps and geophysical investigation.

- UXO detector-aided surface sweeping of the geophysical survey area.

- Geophysical surveying across accessible portions of the site using a planned 5-foot survey line spacing.

- Consultation with the Navy and stakeholders to discuss results and establish SI sampling locations for MC (in accordance with separate MC UFP SAP).

The UXO team leader will report all suspect MEC items to the NSF-IH IR Coordinator and then to the Tetra Tech UXO Manager. Suspect MEC items left in place will be avoided during subsequent geophysical surveying. No MEC items will be moved or disturbed during this phase of the project. Surface MD will be reported on the log sheets or the logbook for the site.

The geophysical crew will be accompanied by a UXO Technician II or higher during all fieldwork and geophysical mapping. Before the geophysical crew enters an area potentially containing MEC, the UXO Technician will conduct a detector-aided surface sweep and visual survey for surface ordnance and will mark each surface MEC anomaly. Before the crew sets monuments or drives stakes, the UXO Technician will conduct a detector-aided surface sweep and visual survey for surface ordnance and a magnetometer or electronic survey of the site to ensure that it is free of anomalies. The UXO Technician will not be required on a full-time basis for non-intrusive activities after the site has been cleared.

17.9.3 Site Preparation

Brush cutting and vegetation removal to support the detector-aided surface sweep will be conducted to the degree necessary to allow the metal detector to get within a few inches of the ground surface. The magnetic detector is approximately 1 inch in diameter and is durable; therefore, it is possible to push the detector through brush and vegetation and, as a result, less brush cutting and vegetation removal is required. The all metals detector has a detection head of approximately 8 inches and is more fragile than the magnetometer. Therefore, brush and vegetation must be cleared to within a few inches of the ground surface.

The site is wooded and will require brush and vegetation cutting in the abovementioned geophysical survey area. The area will need to be clear-cut of brush and vegetation to a level no greater than 6 inches above the ground surface to permit the passage of survey equipment.

17.9.4 UXO Detector-Aided Surface Sweep

The UXO team will work with the geophysicist to establish a grid for both the detector-aided sweep and geophysical survey. Metal detectors will be used to locate surface metal and debris. If suspect MEC, MPPEH, or MD are encountered, the location of each item will be recorded and/or marked using a GPS, tape measure, or other grid coordinate location system. The UXO team will attempt to determine its condition without moving or disturbing the item prior to proceeding with the surface sweep. Each item will be marked with flagging tape and assigned a unique number starting with the grid ID label followed by the item number (e.g., TBS-A1-1 for the first grid). All available information about the item will be recorded in the logbook, including location, identification, item number, and whether the item is suspect MEC or MPPEH. A digital photograph will be taken of each item. The UXO team will not move or otherwise disturb the item in an attempt to collect information. After all available information is recorded, the UXO team will resume the detector-aided surface sweep.

Every effort will be made to identify each suspect MEC item; however, under no circumstances will any suspect MEC be moved in an attempt to make a definitive identification. Munitions will be visually examined for markings and other external features such as shape, size, and external fittings. If unknown military munitions are encountered, the NSF-IH IR Coordinator and Tetra Tech UXO Manager will be notified. Prior to any action being performed on an ordnance item, all fuzing will be definitively identified if it is possible to safely do so without disturbing the ordnance item. This identification will consist of fuze type by function and condition (armed or unarmed) and physical state/condition of the fuze (i.e., burned, broken, parts exposed/sheared, etc.).

Only UXO-qualified personnel will perform MEC identification procedures. As an exception, a UXO Technician I may assist in the performance of MEC identification procedures when under the supervision of a UXO Technician III or higher. All personnel engaged in field operations will be thoroughly trained and capable of recognizing the specific hazards of the procedures being performed. To ensure that these procedures are performed to standards, all field personnel will be under the direct supervision of a UXO Technician III or higher. All suspect MEC items will be recorded following the requirements of this UFP SAP, the project site-specific HASP, applicable ordnance operations procedural safety guidelines, and industry-accepted safe work practices and procedures.

All items discovered during the detector-aided surface sweep will be left in place. No MEC or MPPEH will be moved during this part of the project.

17.9.5 Geophysical Surveying

A Geometrics G858 magnetometer is planned for use at the site because the expected targets of the site (torpedo casings) are expected to be ferrous metal objects, and more brush clearance would be required to access the site with an all-metals detector. The geophysical team will conduct the geophysical survey along parallel survey lines spaced 5 feet apart in one trend providing sufficient coverage to contour the data values and locate subsurface anomalies. Based on former site usage, it is anticipated that potential target anomalies are shallow (within 2 feet bgs) and would generate large instrument responses. Targets of the geophysical investigation will include large object sizes (torpedoes) at this site, and therefore survey depths may range from 0 to 6 feet.

Before the geophysical survey begins, the UXO team will conduct a visual and detector-aided surface sweep of the survey area. Any suspect MEC found during the surface sweep will be flagged by the UXO team and reported, and the geophysical survey team will avoid these areas. If, during the geophysical survey additional MEC items are observed, these will be marked with engineering flagging tape and given a unique I.D. number by the UXO Technician.

17.10 PLANNED MEC FIELD PROGRAM FOR TORPEDO CASING DISPOSAL AREA

17.10.1 Rationale

17.10.1.1 Rationale for Selection of Grids

At a minimum, limited pre-survey clearing to allow geophysical data collection on 10-foot-spaced survey lines will be required.

The Torpedo Casing Disposal Area is a 0.75-acre site wooded site where, according to Navy personnel, a large cache of torpedo casings was buried. Therefore, a 100-percent UXO detector-aided sweep will be conducted in accessible portions of the site, and a geophysical investigation will be conducted using a 10-foot survey line spacing to provide sufficient coverage for detecting possible areas of buried torpedoes within the accessible portions of the site (site identified in the PA Report). The survey depth will range from 0 to 8 feet depending on the target size.

17.10.1.2 Rationale for UXO Detector-Aided Surface Sweep Instrumentation

Recommended Instrumentation

A magnetic locator or magnetic gradiometer such as the Schonstedt GA-52Cx instrument will be used for detector-aided surface sweep operations.

17.10.2 Scope

The scope of survey activities at the Torpedo Casing Disposal Area is summarized as follows (see Figure 17.10-1):

- Brush and vegetation clearing will be necessary to support the detector-aided surface sweeps and geophysical investigation.
- UXO detector-aided surface sweeping of the geophysical survey area.
- Geophysical surveying across accessible portions of the site using a planned 10-foot survey line spacing.
- Consultation with the Navy and stakeholders to discuss results and establish SI sampling locations for MC (in accordance with separate MC UFP SAP).

The UXO team leader will report all suspect MEC items to the NSF-IH IR Coordinator and then to the Tetra Tech UXO Manager. Suspect MEC items left in place will be avoided during subsequent geophysical surveying. No MEC items will be moved or disturbed during this phase of the project. Surface MD will be reported on the log sheets or in the logbook for the site.

The geophysical crew will be accompanied by a UXO Technician II or higher during all fieldwork and geophysical mapping. Before the geophysical crew enters an area potentially containing MEC, the UXO Technician will conduct a detector-aided surface sweep and visual survey for surface ordnance and will mark each surface MEC anomaly. Before the crew sets monuments or drives stakes, the UXO Technician will conduct a detector-aided surface sweep and visual survey for surface ordnance and a magnetometer or electronic survey of the site to ensure that it is free of anomalies. The UXO Technician will not be required on a full-time basis for non-intrusive activities after the site has been cleared.

17.10.3 Site Preparation

Brush cutting and vegetation removal to support the detector-aided surface sweep will be conducted to the degree necessary to allow the metal detector to get within a few inches of the ground surface. The magnetic detector is approximately 1 inch in diameter and is durable; therefore, it is possible to push the detector through brush and vegetation and, as a result, less brush cutting and vegetation removal is required. The all metals detector has a detection head of approximately 8 inches and is more fragile than the magnetometer. Therefore, brush and vegetation must be cleared to within a few inches of the ground surface.

The site is wooded, and will require brush and vegetation cutting along the above mentioned transects. The transects will need to be cleared of brush smaller than 2 inches in diameter and other vegetation to a level no greater than 12 inches above the ground surface along 3-foot-wide corridors along each transect to permit the passage of survey equipment. Trees and brush 2 inches and larger will not be cut. The survey crew will work around these obstacles.

17.10.4 UXO Detector-Aided Surface Sweep

The UXO team will work with the site geophysicist to establish transects for both the detector-aided sweep and geophysical survey. Metal detectors will be used to locate surface metal and debris. The 10-foot-spaced transects will be established perpendicular to the established baseline using a compass or GPS unit to guide the team on a meandering path (avoiding obstacles, heavy brush, wetlands etc.) from one end of the site to the other. If suspect MEC, MPPEH, or MD are encountered, the location of each item will be recorded and/or marked using a GPS, tape measure, or other grid coordinate location system. The UXO team will attempt to determine its condition without moving or disturbing the item prior to proceeding with the surface sweep. Each item will be marked with flagging tape and assigned a unique number starting with the transect ID label followed by the item number (e.g., TCD-T-1-1 for the first transect). All available information about the item will be recorded in the logbook, including location, identification, item number, and whether the item is suspect MEC or MPPEH. A digital photograph will be taken of each item. The UXO team will not move or otherwise disturb the item in an attempt to collect information. After all available information is recorded, the UXO team will resume the detector-aided surface sweep.

Every effort will be made to identify each suspect MEC item identified; however, under no circumstances will any suspect MEC be moved in an attempt to make a definitive identification. Munitions will be visually examined for markings and other external features such as shape, size, and external fittings. If unknown

military munitions are encountered, the NSF-IH IR Coordinator and Tetra Tech UXO Manager will be notified. Prior to any action being performed on an ordnance item, all fuzing will be definitively identified if it is possible to safely do so without disturbing the ordnance item. This identification will consist of fuze type by function and condition (armed or unarmed) and physical state/condition of the fuze (i.e., burned, broken, parts exposed/sheared, etc.).

Only UXO-qualified personnel will perform MEC identification procedures. As an exception, a UXO Technician I may assist in the performance of MEC identification procedures when under the supervision of a UXO Technician III or higher. All personnel engaged in field operations will be thoroughly trained and capable of recognizing the specific hazards of the procedures being performed. To ensure that these procedures are performed to standards, all field personnel will be under the direct supervision of a UXO Technician III or higher. All suspect MEC items will be recorded following the requirements of this UFP SAP, the project site-specific HASP, applicable ordnance operations procedural safety guidelines, and industry-accepted safe work practices and procedures.

All items discovered during the detector-aided surface sweep of the transects will be left in place. No MEC or MPPEH will be moved during this part of the project.

17.10.5 Geophysical Surveying

A Geometrics G858 magnetometer instrument is planned for use at the site because the expected targets of the site (torpedo casings) are expected to be ferrous metal objects, and more brush clearance would be required to access the site with an all-metals detector. The geophysical team will conduct the geophysical survey along 10-foot-spaced survey lines. Targets of the geophysical investigation will include caches of large objects (torpedoes) on this site, and therefore survey depths may range from 0 to 8 feet.

Before the geophysical survey begins, the UXO team will conduct a visual and detector-aided surface sweep of the survey area. Any suspect MEC found during the surface sweep will be flagged by the UXO team and reported, and the geophysical survey team will avoid these areas. If, during the geophysical survey, additional MEC items are observed, these will be marked with engineering flagging tape and given a unique I.D. number by the UXO Technician.

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

(UFP-QAPP Manual Section 3.1.1)

Sampling Location / ID Number	Survey Layout	Depth (bgs)	Survey Methodology	Degree of Investigation	Exclusion Areas	SOP Name[1]
Air Blast Pond	Grid	0 to 2 feet, depending on buried target size	Schonstedt or White's	100-percent UXO detector-aided sweep (see Figure 17.1-1)	None (survey accessible area)	OPS 1 OPS 4 OPS 5
Area 8	Grid/Transects	0 to 6 feet, depending on buried target size and equipment used (small to large target(s) potential)	G-858 (if needed) Schonstedt	Varying degrees of investigation – see WS #17 and Figure 17.2-1 for details	Various areas (see Figure 17.2-1)	OPS 2 OPS 4 OPS 5 OPS 1
EOD School Demolition Area	Grid/Transects	0 to 4 feet, depending on target size and equipment used (small to large target(s) potential)	EM61 and G-858 Schonstedt or White's	100 percent of ready bunker area (UXO detector-aided surface sweep), no greater than 5-ft-spaced lines across ready bunker area (geophysics), 50-ft-spaced transects, anomaly cluster investigation (see Figure 17.3-1)	None (survey accessible area)	OPS 2 OPS 4 OPS 5 OPS 1
Basic IED Area	Grid/Transects	0 to 2 feet, depending on target size (small to medium target(s) potential)	Schonstedt or White's	100 percent of former detonation area, 50-ft-spaced transects for remainder of site, anomaly cluster investigation (see Figure 17.4-1)	None (survey accessible area)	OPS 4 OPS 5 OPS 1
Advanced IED Area	Grid/Transects	0 to 6 feet, depending on target size and equipment used (small to large target(s) potential)	EM61and G-858 Schonstedt or White's	100 percent around SWMU 27 where accessible (see WS #17 and Figure 17.5-1), 50-ft-spaced transects and anomaly cluster investigation (UXO detector-aided surface sweep)	Inside concrete foundation	OPS 2 OPS 4 OPS 5 OPS 1

Sampling Location / ID Number	Survey Layout	Depth (bgs)	Survey Methodology	Degree of Investigation	Exclusion Areas	SOP Name[1]
Stump Neck Impact Area	Transects	0 to 5 feet, depending on target size (small to large target(s) potential)	G-858 Schonstedt	40-ft-spaced transects (see Figure 17.6-1)	Aquatic areas, survey accessible areas by instrument and foot	OPS 2 OPS 4 OPS 5 OPS 1
Test Area 1	Grid	0 to 2 feet, depending on target size (small to large target(s) potential)	Schonstedt or White's	Visual inspection of bowl, 100-percent UXO detector-aided surface sweep outside bowl (see Figure 17.7-1)	None (survey accessible area)	OPS 1 OPS 4 OPS 5
Valley Impact Area	Transects	0 to 5 feet, depending on target size (small to large target(s) potential	G-858 Schonstedt	19 transects (400 feet apart) – see Figure 17.8-1	Aquatic and developed areas, survey accessible area by instrument and foot	OPS 2 OPS 4 OPS 5 OPS 1
Torpedo Burial Site	Grid	0 to 6 feet, depending on target size (small to large cache of potential items)	G-858 Schonstedt	100-percent UXO detector-aided surface sweep, and 5-ft survey line spaced geophysical survey (Figure 17.9-1)	None (survey accessible area)	OPS 2 OPS 1 OPS 4 OPS 5
Torpedo Casing Disposal Area	Grid	0 to 8 feet, depending on target size (large target(s) potential)	G-858 Schonstedt	100-percent UXO detector-aided surface sweep, and 10-ft survey line spaced geophysical survey (see Figure 17.10-1)	None (survey accessible area)	OPS 2 OPS 1 OPS 4 OPS 5

1 SOP or worksheet that describes geophysical surveying procedures (see Appendix A of the MEC UFP SAP).

SAP Worksheet #19 -- Analytical SOP Requirements Table

(UFP-QAPP Manual Section 3.1.1)

✓ **Worksheet Not Applicable**

No laboratory samples are proposed for collection/analysis during this MEC investigation.

SAP Worksheet #20 -- Field Quality Control Sample Summary Table

(UFP-QAPP Manual Section 3.1.1)

Matrix	Analytical Group	Quality Control	Sample	Frequency
Transect	Precision	Resurvey transects to perform a direct comparison to field data collected during detector-aided surface sweep.	Detect all metallic 20mm or larger on surface; non-detection of metallic objects would result in failure of QC.	Resurvey 25% of first four transects and after any failure, then 10% of remaining transects after four transects in a row pass QC. If any transect does not pass QC, UXO team will resurvey entire transect and another QC check will be performed.
Grid	Precision	Resurvey grids to perform a direct comparison to field data collected during detector-aided surface sweep.	Detect all metallic 20mm or larger on surface; non-detection of metallic objects would result in failure of QC.	Resurvey 25% of first four grids and after any failure, then 10% of remaining grids after four grids in a row pass QC. If any grid does not pass QC, UXO team will resurvey entire grid and another QC check will be performed.

SAP Worksheet #21 – Project SOP References Table

(UFP-QAPP Manual Section 3.1.2)

Reference Number	Title	Originating Organization of SOP	Equipment Type	Modified for Project Work? (Y/N)	Comments
OPS1	UXO Detector-Aided Surface Sweeps	Tetra Tech	Magnetic detector All metals detector	N	Describes detector-aided surface sweeps
OPS2	Geophysical Survey	Tetra Tech	EM, Magnetometer	N	Describes geophysical survey activities
OPS3	Geophysical Data Processing and Analysis	Tetra Tech	Software Computer	N	Describes geophysical data processing procedures
OPS4	MEC Management and Accountability	Tetra Tech	GPS Digital Camera	Y	Describes actions to be taken if suspect MEC are encountered
OPS5	GPS	Tetra Tech	GPS	N	Describes usage of hand-held GPS units
SOP-06	Vegetation Management at MEC Sites	Tetra Tech	Hand-held brush cutters, mowers, chain saws, brush hog, wood chipper	N	Describes brush cutting and vegetation clearance activities to take place at MEC sites.

SOPs are contained in Appendix A of the MEC UFP SAP.

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

(UFP-QAPP Manual Section 3.1.2.4)

Field Equipment	Activity[1]	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference[2]	Comments
EM61-MK2 and G858 Units	Warm-up	Power on	5 Minutes	NA	Site Geophysicist	OPS2	
EM61-MK2	Null	EM61-MK2 Null: Power on	Per manufacturer recommendations	NA	Site Geophysicist	OPS2	
EM61-MK2 and G858 Units	Record sensor positions	First day and configuration or equipment change	+/- 2 Inches	NA	Site Geophysicist	OPS2	
EM61-MK2 and G858 Units	Personnel test	Beginning of day	EM61: +/- 2 mV, G858: +/- 2 nT	Remove interference source from operator	Site Geophysicist	OPS2	
EM61-MK2 and G858 Units	Static background and static spike	Beginning of day or equipment change	Acceptance criteria determined from data review. Guidance Criteria: EM61: +/- 3 mV, G858: +/- 5 nT Spike: +/- 20% of standard item response	Fix or replace unit or filter noise – evaluate site noise for survey feasibility	Site Geophysicist	OPS2	

Field Equipment	Activity[1]	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference[2]	Comments
EM61-MK2 and G858 Units	Pull-away test	First day on site and when there is a configuration or equipment change	Minimal effect	Increase distance of GPS to EM or G858 unit	Site Geophysicist	OPS2	
EM61-MK2 and G858 Units	Equipment Function Test	Daily	Anomalous response to all test targets within 20% standard deviation response for each given work site	Repeat test ensuring that items are placed appropriately, check/replace equipment	Site Geophysicist	OPS2	
GPS	Positioning	Beginning and end of each day GPS is used	Accuracy: sub-meter HDOP <3, number of satellites at least six	Wait for better signal, replace unit, or choose alternate location technique	Site Geophysicist /UXO Technician	OPS5	
Magnetic Locator	Operational	Beginning of day and after battery change	Operating properly	Replace battery, replace instrument	UXO Technician	OPS1	
All-Metals Detector	Calibration	Beginning of day	Detect inert surface segregate	Recalibrate, replace instrument	UXO Technician	OPS1	

Activities may include calibration, verification, testing, and maintenance.

cm - Centimeter
mV - Millivolt
nT - nanoTesla
NA - Not applicable

22.1 REGULAR TESTS FOR GEOPHYSICAL SURVEYING EQUIPMENT

Equipment/Electronics Warm-Up. This test minimizes sensor drift caused by thermal stabilization. Most instruments need a few minutes to warm up before data collection begins. All manufacturer instructions will be followed or, if none are given, data readings will be observed until they stabilize. Acceptance Criterion: Equipment Specific (typically 5 minutes). This test will be conducted each time the unit is started.

Equipment Null. The EM61-MK2 equipment should be nulled. The G858 must also be set up according to manufacturer's recommendations prior to surveying.

Record Sensor Positions. The purpose of recording sensor positions is to document relative navigation and sensor offsets, detector separation, and detector heights above the ground surface. This information will ensure that the detector offset corrections and gradient calculations can be done correctly and that the surveys are repeatable. Acceptance Criterion: ±2 inches. This test will be conducted at the beginning of the first day and when an equipment configuration change is made.

Personnel Test. This test ensures that survey personnel have removed all potential interference (metal) sources from their bodies. Common interference sources are ballpoint pens, steel-toed boots, or large metallic belt buckles, which can produce data anomalies similar to investigation targets. All personnel who will be coming near the sensor during survey operations should remove metallic items from themselves, and if this is not possible, readings should be monitored and recorded to judge the effect of the metallic items to meet the following acceptance criteria: EM61 ±2 mV, G858 ±2 nT. This test will be conducted at the beginning of each day if the operator is wearing metallic items that could interfere with equipment operation.

Static Background and Static Spike (or Standard Response) Test. This test quantifies instrument background readings and electronic drift, locates potential interference spikes in the time domain, and determines impulse response and repeatability of the instrument to a standard test item (typically a 2-inch-diameter steel trailer hitch ball). Improper instrument function, the essence of local sources of ambient noise [such as Electromagnetic (EM) transmissions from high-voltage electric lines], and faulty equipment are all potential causes of inconsistent non-repeatable readings. A minimum 3-minute static background test after instrument warm-up, followed by a 1-minute standard response test, followed by an additional 1-minute static background test will be performed. The Site Geophysicist must review the readings to confirm the data are usable. Acceptance criteria will be determined from this data review. Guidance Criteria: Static background test EM61 ± 3 mV, G858 ±5 nT; Static Response Test

±20 percent of standard item response after background correction. Ideally, the test data would meet the guidance criteria; however, in the event they do not, data must be evaluated to see if an equipment change is needed and whether the data are acceptable to achieve project goals. This test will be conducted at the beginning of each day and after equipment changes.

Pull-Away Test. This test demonstrates the effects of the navigational equipment. All equipment will be powered up and operating as it would be during the survey. Acceptance Criterion: document the effects of navigational equipment on geophysical readings. Effects should be small. The test should be performed before the geophysical survey begins and if the equipment configuration changes during the survey.

Equipment Function Test (EFT). The EFT will be implemented on a daily basis once the ITS is completed. The EFT will provide a simple everyday test of equipment functionality over a few metallic targets representing suspected MEC items for the project. The primary objective is to demonstrate that the survey equipment is responding normally to a controlled set of objects (equipment is functioning properly); the objective is not to duplicate the ITS. To make the test practical three targets will be placed on the ground, each spaced 10 feet apart and in the same orientation for each test. This will allow the objects to easily be laid out and transported between subject sites. Site conditions (i.e., soils) may differ between sites, and this could create differences in response; however, responses should be similar when tests are conducted at the same site, as care should be taken to lay out the same objects in the same locations and orientation (i.e., use field marks to help with object placement). Acceptance Criterion Anomalous response to all test targets within 20% standard deviation response for each given work site. All tests should be conducted in an area free of metal. Pre-screening with the geophysical instrument will be necessary to find such an area when work beings at a new site. Field notes will be kept on each test, and all data will be included in the SI report.

GPS Positioning. The GPS will be tested by surveying two survey control points and comparing the GPS coordinates to the documented coordinates for the control points. Acceptance Criterion: sub-meter or better (based on project requirements). The test should be performed at the beginning and end of each day that GPS unit is used. GPS survey instruments should also be closely monitored during field acquisition by using HDOP criteria, or as a minimum, the number of satellite signals being received. HDOP should normally be less than three to obtain high-quality results, and at least six satellites should also indicate high-quality results.

Latency is an issue when a separate GPS controller (from the geophysical controller) is used to acquire GPS data. If a separate controller is used, care will be taken to synchronize the clocks in both the GPS

and geophysical units, and a test must be set up to measure the latency inherent in using two different accuracy clocks. The test will consist of positioning oneself over a linear metallic object (e.g., pipe) at several points and recording data with all of the survey equipment, and then repeating the same measurements using only the GPS equipment to compare the results and determine any necessary adjustment.

22.2 DATA COLLECTION VARIABLES FOR GEOPHYSICAL SURVEYING EQUIPMENT

The same equipment and procedures will be used for the ITS (Worksheet # 12) and the geophysical survey. In addition, only personnel who have been tested on the ITS test plot will perform the surveys. Multiple surveys using the planned geophysical instruments will be performed. Some elements of data collection are subject to modification and evaluation. Data collection variables subject to modification and optimization may include, but not necessarily be limited to, instrument height, instrument orientation and direction of travel, instrument channel selections, measurement interval along survey lines, and survey line spacing.

22.3 GEOPHYSICAL AND POSITIONING INSTRUMENTS

A Geonics EM61-MK2 is a time-domain EM system. The EM61 generates 150 EM pulses per second and measures during the off time between pulses. After each pulse, secondary EM fields are induced briefly in moderately conductive soil and for a longer time in metallic objects. The EM61 waits between each pulse until the response from the conductive earth dissipates and then measures the prolonged buried metal response. This response is recorded in mV. By sensing only the buried metal response, the EM61 detects metallic targets that might otherwise be missed. The EM61 is able to detect all types of metallic objects (not just ferrous material). This capability is important for detection of potential targets at the site that are likely to contain more aluminum than iron or steel (such as pyrotechnics). The EM61 measures multiple time gates (216, 366, 660, and 1,266 microseconds) to provide a more complete measurement of the response decay rate. The EM61 can record up to 12 records per second, four time gates per record, or three time gates of better channel data coupled with one reading for the top channel per second. The sampling rate for the EM61 will be at least five times per second.

The G-858 cesium-vapor magnetometer measures the Earth's magnetic field at selected time increments. As magnetic bodies above and below ground add to or subtract from the Earth's magnetic field, anomalies can be identified by the increases and decreases measured. Diurnal changes in the Earth's magnetic field must be accounted for to correct for potential data shifts that might otherwise be attributed to survey anomalies (ferrous metal objects).

Tetra Tech will use a sub-meter accuracy GPS unit where possible during data collection to provide precise location coordinates for the geophysical data collected. The anticipated tree cover for the survey areas at NSF-IH may dictate that only certain grid nodes are surveyed with GPS in open locations (no or limited tree cover) and the remainder of the survey grid be tied to these locations. The GPS accuracy will be checked on the GPS unit. If the GPS accuracy is not sub-meter, data will not be collected until more satellites are available and the accuracy criteria are met, or surveying with fiducial marks will be employed.

22.4 QUALITY ASSURANCE/QUALITY CONTROL

Operational and test procedures will conform to the manufacturers' standard instructions. QC of the instruments' data will be achieved daily by field testing, checking the sensor and navigation system against a known target to ensure that they are operating properly. All geophysical instruments and equipment used to gather and generate field data will be calibrated with sufficient frequency and in such a manner that accuracy and reproducibility of the results are consistent with the manufacturers' specifications. Calibration, repair, or replacement records will be filed and maintained by the Field Geophysicist and may be subject to audit by the Tetra Tech QAM. Potential data problems include source data errors, data entry errors, data editing errors, and user errors. All data will be reviewed to identify and correct any of these errors if they occur.

SAP Worksheet #23 -- Analytical SOP References Table

(UFP-QAPP Manual Section 3.2.1)

☑ **Worksheet Not Applicable**

No laboratory samples are proposed for collection/analysis during this MEC investigation (see WS #21 for project SOPs).

SAP Worksheet #24 -- Analytical Instrument Calibration Table

(UFP-QAPP Manual Section 3.2.2)

☑ **Worksheet Not Applicable**

No analytical instrument calibration data will be required to support MEC geophysics surveys/investigations (see WS #22 for geophysical equipment calibrations).

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

(UFP-QAPP Manual Section 3.2.3)

☑ **Worksheet Not Applicable**

No analytical instrument equipment maintenance, testing, or inspections will be required to support MEC geophysics surveys/investigations. Field instrumentation maintenance, testing, and inspection for geophysics sensors and magnetometers are presented in Worksheet #22.

SAP Worksheet #26 – MPPEH Handling System

(UFP-QAPP Manual Appendix A)

☑ **Worksheet Not Applicable**

This worksheet is not applicable because this investigation is an SI, and no MPPEH will be handled.

SAP Worksheet #27 – Sample Custody Requirements Table

(UFP-QAPP Manual Section 3.3.3)

☑ **Worksheet Not Applicable**

No samples are proposed for collection/analysis and no MPPEH will be handled during the SI covered by this UFP SAP.

SAP Worksheet #28 -- Laboratory QC Samples Table

(UFP-QAPP Manual Section 3.4)

☑ **Worksheet Not Applicable**

No analytical laboratory QC sampling will be required for this UFP SAP to support MEC geophysics surveys/investigations.

SAP Worksheet #29 -- Project Documents and Records Table

(UFP-QAPP Manual Section 3.5.1)

Document/Record	Producer	Related Work Aspect	Frequency of Completion	Where Maintained
ESS Determination	UXO Manager	Mobilization	One time	SI/PF
Field Checklists	Field UXO and Geophysical Personnel	Field surveys (UXO and Geophysical)	Field collection days	SI/PF
MEC Accountability Log	SUXOS	UXO Detector-Aided Surface Sweeps	As needed	SI/PF
Daily Reports	SUXOS and Site Geophysicist	Field surveying	Field collection days	SI/PF
Medical and OSHA Clearance Letter	HSM and PM	All	As needed	SI/PF
Daily Safety Meeting Sign-In	SSO	All	Daily	SI/PF
Medical Data Sheet	SUXOS	All	As needed	PF
Surface Sweep Grid Map	SUXOS	UXO Detector-Aided Surface Sweeps	Field collection days	SI/PF
Detector-Aided Surface Sweep Data	UXO Personnel	Detector-Aided Surface Sweep data collection	Field collection days	SI/PF/NIRIS
Field notes (detailing equipment and procedure)	Field UXO and Geophysical Personnel	Field Surveys (UXO and Geophysical)	Field collection days	SI/PF
Raw Geophysical Survey Data	Site Geophysicist	Geophysical data Collection	Provided at end of project	PF/NIRIS
Assessment findings and corrective actions	Various (see Worksheet 31)	All	As needed	SI/PF

Document/Record	Producer	Related Work Aspect	Frequency of Completion	Where Maintained
Quality Control Surveillance Report	UXOQC and Project Geophysicist	Field Surveys	UXOC - Minimum of once per phase for each definable feature of work Project Geophysicist - Minimum of daily during ITS performance	SI/PF
Daily Quality Control Report	UXOQC and Project Geophysicist	Field surveys	Daily	SI/PF
Processed final format files (maps) compatible with ArcView Version 8 or specified GIS platform	Site Geophysicist or Project Geophysicist	Geophysical Data Processing	One time	SI/PF/NIRIS
Photographs (may be included in report)	Field UXO and Geophysical Personnel	Field surveys	As needed	SI/PF
Field Task Modification Request (FTMR) forms	SUXOS and Project Geophysicist	Field surveys	As needed	SI/PF
Field Audit Checklist (if an audit is conducted)	PM	Field surveys	As needed	SI/PF
SI Report	Tetra Tech Personnel	SI project work	One time	SI/PF

SI – Site Inspection Report
PF – Project File
NIRIS – Naval Installation Restoration Information Solution

Project documentation will be maintained in the Tetra Tech project file. Processed final format files (maps) compatible with Arcview Version 8 or specified GIS platform will be maintained in the Tetra Tech Geographic Information System (GIS) server and Naval Installation Restoration Information Solution (NIRIS).

29.1 FIELD REPORTING AND RECORDS MANAGEMENT

Tetra Tech will keep the Navy updated via daily reporting and communication of on-site conditions. Suspect MEC discovered on site will be recorded in the MEC tracking log for each site and reported daily to the Navy. MEC discovered on site that present a hazard to personnel will be reported immediately to the Navy. In the event that adverse weather conditions exist or a change in site conditions is identified, Tetra Tech will notify the Navy immediately. The potential for changed site conditions (besides weather) is highly unlikely.

Project documentation will be collected and managed on site during all field activities. Geophysical data, which includes data from the ITS described in Worksheet #12, will be recorded digitally and downloaded periodically to a field computer for review in the field. In addition to the copy of the data saved on the field computer's hard drive, a copy of the data will be saved on a compact diskette (CD) for backup before the data are erased from the equipment. The Site Geophysicist will review the downloaded data to verify that the download system is functioning properly and will also perform a QC review of the field data. This review will verify that the data are valid and useable for the intended purpose. All raw files will be available on site for quality control checks to ensure field and data processing procedures during site activities adhered to the SOP.

As soon as practical after data are collected, the geophysical data will be provided to the stakeholders to aid in establishing locations for MC sampling (in accordance with the separate MC UFP SAP) and for inclusion in the SI MEC Report. All final processed data, geophysical maps, dig sheets, and supporting geophysical interpretations will be included.

It will be important to document those areas that cannot be included in the UXO sweep and/or geophysical survey based on field conditions (e.g., vegetation, wetlands, obstacles, etc.).

29.2 MEC DOCUMENTATION

Tetra Tech will establish a system to record MEC located in each of the investigation areas. The SUXOS will direct the establishment of this system for numbering and recording coordinates for each MEC item. Each piece of MEC will be located using a GPS, survey instrument, or tape measure to determine the northing and easting coordinates of the item. The geophysical survey team will use the same coordinate and numbering system during their survey and data processing.

Field logbooks will be used during each phase of the operation to record significant findings and information using the established numbering and coordinate system. A geo-referenced map of the area investigated will be prepared to detail the location of each MEC item discovered. Coordinate data recorded in the field will be converted, as necessary, to the North American Datum (NAD) 83/Maryland State Plane coordinates in U.S. survey feet. The UXO Technician will also provide observations and recommendations for future maintenance activities, if appropriate.

29.3 LESSONS LEARNED

Lessons learned will be recorded in the site logbook and will be discussed with the project field team during the next day's safety meeting, or sooner as necessary. The Tetra Tech PM will be briefed on lessons learned as soon as possible.

29.4 LONG-TERM STORAGE

All data and information generated as part of the SI will be presented in the SI Report and/or will be available in pdf format on CD.

SAP Worksheet #30 -- Analytical Services Table

(UFP-QAPP Manual Section 3.5.2.3)

☑ **Worksheet Not Applicable**

No analytical services will be required to support MEC geophysics surveys/investigations.

SAP Worksheet #31 -- Planned Project Assessments Table

(UFP-QAPP Manual Section 4.1.1)

Assessment Type	Frequency	Internal or External	Organization Performing Assessment	Person(s) Responsible for Performing Assessment[1] (title and organizational affiliation)	Person(s) Responsible for Responding to Assessment Findings[1] (title and organizational affiliation)	Person(s) Responsible for Identifying and Implementing Corrective Actions[1] (title and organizational affiliation)	Person(s) Responsible for Monitoring Effectiveness of Corrective Actions[1] (title and organizational affiliation)
Personnel Qualifications	One time for all field personnel	Internal	Tetra Tech	SUXOS Project Geophysicist	UXO Manager Project Geophysicist	UXO Manager Project Geophysicist	QAM PM
Accident/Incident Reporting	Per event	Internal	Tetra Tech	SSO	Project Safety Officer	HSM PM	HSM
Preventive Maintenance	Daily	Internal	Tetra Tech	UXOQC	SUXOS	UXO Manager	PM
Communications Equipment Inspection	Daily	Internal	Tetra Tech	UXO Team Leader Site Geophysicist	SUXOS Site Geophysicist	SUXOS Site Geophysicist	UXO Manager PM
Safety Inspections	Daily (inspection); Weekly (formal surveillance)	Internal	Tetra Tech	SSO	SUXOS Site Geophysicist	SUXOS	UXO Manager PM

Assessment Type	Frequency	Internal or External	Organization Performing Assessment	Person(s) Responsible for Performing Assessment(1) (title and organizational affiliation)	Person(s) Responsible for Responding to Assessment Findings(1) (title and organizational affiliation)	Person(s) Responsible for Identifying and Implementing Corrective Actions(1) (title and organizational affiliation)	Person(s) Responsible for Monitoring Effectiveness of Corrective Actions(1) (title and organizational affiliation)
Brush Cutting and Vegetation Management	As needed to support operations	Internal	Tetra Tech	SUXOS Site Geophysicist	UXO Team Leader	UXO Team Leader	PM
ITS – Field Oversight	once	Internal	Tetra Tech	Project Geophysicist	Site Geophysicist	Site Geophysicist Project Geophysicist	Project Geophysicist
Daily field checklists, geophysical	Daily during survey performance	Internal	Tetra Tech	Project Geophysicist	Site Geophysicist	Project Geophysicist	Project Geophysicist
Geophysical Survey – Field Notes Audit	Once during start of fieldwork, and after survey completion	Internal	Tetra Tech	Project Geophysicist	Site Geophysicist	Project Geophysicist Site Geophysicist	PM
Geophysical Survey – SOP Conformance (OPS2 and OPS3)	Monthly during survey performance	Internal	Tetra Tech	Project Geophysicist	Site Geophysicist	Project Geophysicist Site Geophysicist	PM
Geophysical Data – General Appearance Assessment	Daily/after data are processed	Internal	Tetra Tech	Project Geophysicist	Site Geophysicist	Project Geophysicist Site Geophysicist	PM

Assessment Type	Frequency	Internal or External	Organization Performing Assessment	Person(s) Responsible for Performing Assessment[1] (title and organizational affiliation)	Person(s) Responsible for Responding to Assessment Findings[1] (title and organizational affiliation)	Person(s) Responsible for Identifying and Implementing Corrective Actions[1] (title and organizational affiliation)	Person(s) Responsible for Monitoring Effectiveness of Corrective Actions[1] (title and organizational affiliation)
Detector-Aided Surface Sweep	25% of first four transects / grids or after any failure; 10% thereafter	Internal	Tetra Tech	UXOQC	SUXOS	SUXOS	UXO Manager PM
Surveying and Mapping Operations	Initial, then Weekly	Internal	Tetra Tech	UXOQC	SUXOS	SUXOS	UXO Manager
UXO/MEC Accountability	Weekly	Internal	Tetra Tech	UXOQC	SUXOS	SUXOS	UXO Manager PM
Visitor Briefing	Initial, then as needed to support operations	Internal	Tetra Tech	Project Safety Officer	SSO	SSO	HSM
Site-Specific Training	Once at start of fieldwork and at start of each definable feature of work	Internal	Tetra Tech	SUXOS UXO Manager PM	As designated by PM	As designated by PM	PM

Assessment Type	Frequency	Internal or External	Organization Performing Assessment	Person(s) Responsible for Performing Assessment[1] (title and organizational affiliation)	Person(s) Responsible for Responding to Assessment Findings[1] (title and organizational affiliation)	Person(s) Responsible for Identifying and Implementing Corrective Actions[1] (title and organizational affiliation)	Person(s) Responsible for Monitoring Effectiveness of Corrective Actions[1] (title and organizational affiliation)
Hazard Assessment – Risk Analysis	At start of each definable feature of work, then as needed to support operations	Internal	Tetra Tech	Project Safety Officer UXOSO	UXOSO SUXOS	UXOSO SUXOS	HSM
Field Work Systems Audit	1 per contract year	Internal	Tetra Tech	QAM	Project Geophysicist UXO Manager PM	QAM Project Geophysicist UXO Manager	QAM PM

1 Tetra Tech personnel unless otherwise noted. Site geophysicist support will be provided by Tetra Tech and subcontractor personnel.

SAP Worksheet #32 -- Assessment Findings and Corrective Action Responses

(UFP-QAPP Manual Section 4.1.2)

Assessment Type	Nature of Deficiencies Documentation(1)	Individual(s) Notified of Findings (name, title, organization)	Time Frame of Notification	Nature of Corrective Action Response Documentation	Individual(s) Receiving Corrective Action Response (name, title, organization)	Time Frame for Response
Personnel Qualifications	e-mail	Ralph Basinski – PM, Tetra Tech	Immediately upon discovery	e-mail	Ralph Basinski – PM, Tetra Tech	Prior to initiation of task
Accident/Incident Reporting	Accident/Incident Report Form	Ralph Basinski – PM, Tetra Tech Matt Soltis – HSM, Tetra Tech	Immediately	Dependant upon accident/incident	Ralph Basinski – PM, Tetra Tech Ralph Brooks UXO Manager Tetra Tech Matt Soltis – HSM, Tetra Tech	Within 24 hours
Preventive Maintenance	Field Forms	Ralph Brooks UXO Manager Tetra Tech Ralph Basinski – PM, Tetra Tech	Within 24 hours	Field Forms	Ralph Brooks UXO Manager Tetra Tech Ralph Basinski – PM, Tetra Tech	Within 24 hours
Communications Equipment Inspection	Field Forms	Ralph Brooks UXO Manager Tetra Tech Ralph Basinski – PM, Tetra Tech	Within 24 hours	Field Forms	Ralph Brooks UXO Manager Tetra Tech Ralph Basinski – PM, Tetra Tech	Within 24 hours

Assessment Type	Nature of Deficiencies Documentation(1)	Individual(s) Notified of Findings (name, title, organization)	Time Frame of Notification	Nature of Corrective Action Response Documentation	Individual(s) Receiving Corrective Action Response (name, title, organization)	Time Frame for Response
Safety Inspections	Field Forms	Ralph Brooks UXO Manager Tetra Tech Jim Coffman - Project Geophysicist, Tetra Tech Ralph Basinski – PM, Tetra Tech	Within 24 hours	Field Forms	Ralph Brooks UXO Manager Tetra Tech Jim Coffman - Project Geophysicist, Tetra Tech Ralph Basinski – PM, Tetra Tech	Within 24 hours
Brush Cutting and Vegetation Management	Field Forms	Ralph Brooks UXO Manager Tetra Tech Ralph Basinski Tetra Tech Project Manager	Within 24 hours	e-mail	Ralph Brooks UXO Manager Tetra Tech Ralph Basinski Tetra Tech Project Manager	Within 24 hours
ITS – Field Oversight	QC Surveillance Report Form	TBD - Site Geophysicist Jim Coffman - Project Geophysicist, Tetra Tech Ralph Basinski – PM, Tetra Tech	Within 24 hours	e-mail	Jim Coffman - Project Geophysicist ,Tetra Tech Ralph Basinski – PM, Tetra Tech	Within 24 hours

Assessment Type	Nature of Deficiencies Documentation(1)	Individual(s) Notified of Findings (name, title, organization)	Time Frame of Notification	Nature of Corrective Action Response Documentation	Individual(s) Receiving Corrective Action Response (name, title, organization)	Time Frame for Response
Daily Field Checklists, geophysical	Oral and e-mail or fax	TBD - Site Geophysicist Ralph Basinski – PM, Tetra Tech	Within 24 hours after assessment	Updated Geophysical Field Checklist and Forms	Jim Coffman - Project Geophysicist ,Tetra Tech Ralph Basinski – PM, Tetra Tech	Within 48 hours
Geophysical Survey – Field Notes Audit	Letter/e-mail	TBD - Site Geophysicist Ralph Basinski – PM, Tetra Tech	Within 5 business days of receipt	Complete Field Notes	Jim Coffman - Project Geophysicist, Tetra Tech Ralph Basinski – PM, Tetra Tech	Within 5 business days of receipt
Geophysical Survey – Conformance to SOPs (OPS2 and OPS3)	Letter/e-mail	TBD - Site Geophysicist Ralph Basinski – PM, Tetra Tech	Within 5 business days of assessment	Justification or clarification of procedure to be provided in letter correspondence	Jim Coffman - Project Geophysicist ,Tetra Tech Ralph Basinski – PM, Tetra Tech	Within 5 business days of receipt
Geophysical Data – General Appearance Assessment	e-mail	TBD - Site Geophysicist Ralph Basinski – PM, Tetra Tech	Within 24 hours	e-mail	Jim Coffman - Project Geophysicist ,Tetra Tech Ralph Basinski – PM, Tetra Tech	Within 48 hours

Assessment Type	Nature of Deficiencies Documentation(1)	Individual(s) Notified of Findings (name, title, organization)	Time Frame of Notification	Nature of Corrective Action Response Documentation	Individual(s) Receiving Corrective Action Response (name, title, organization)	Time Frame for Response
Detector-Aided Surface Sweep	QC Checklist	Ralph Brooks UXO Manager Tetra Tech Ralph Basinski Tetra Tech Project Manager	Within 1 business day of assessment	Updated QC Checklist	Ralph Brooks - UXO Manager, Tetra Tech Ralph Basinski – PM, Tetra Tech	Within 24 hours
Surveying and Mapping Operations	e-mail	Ralph Brooks UXO Manager Tetra Tech Ralph Basinski – PM, Tetra Tech	Within 24 hours	Updated e-mail	Ralph Brooks UXO Manager Tetra Tech Ralph Basinski – PM, Tetra Tech	Within 24 hours
UXO/MEC Accountability	Field Forms	Ralph Brooks UXO Manager Tetra Tech Ralph Basinski Tetra Tech Project Manager	Within 24 hours	Updated field forms	Ralph Brooks UXO Manager Tetra Tech Ralph Basinski Tetra Tech Project Manager	Within 24 hours
Visitor Briefing	e-mail	SUXOS – TBD Ralph Basinski – PM, Tetra Tech	Within 24 hours	Updated e-mail	SUXOS – TBD Ralph Basinski – PM, Tetra Tech	Within 24 hours

Assessment Type	Nature of Deficiencies Documentation(1)	Individual(s) Notified of Findings (name, title, organization)	Time Frame of Notification	Nature of Corrective Action Response Documentation	Individual(s) Receiving Corrective Action Response (name, title, organization)	Time Frame for Response
Site-Specific Training	e-mail	Ralph Brooks UXO Manager Tetra Tech Ralph Basinski – PM, Tetra Tech	Upon Completion of Training	Updated e-mail	Ralph Brooks UXO Manager Tetra Tech Ralph Basinski – PM, Tetra Tech	Within 24 hours
Hazard Assessment – Risk Analysis	e-mail	Ralph Basinski – PM, Tetra Tech Matt Soltis – HSM, Tetra Tech	Within 24 hours	Updated e-mail	Ralph Basinski – PM, Tetra Tech Matt Soltis – HSM, Tetra Tech	Within 24 hours
Field Work Systems Audit	Letter Report	Ralph Basinski – PM, Tetra Tech Tom Johnston – QAM, Tetra Tech	Within 5 business days of assessment	Letter Report	Ralph Basinski – PM, Tetra Tech Tom Johnston – QAM, Tetra Tech	Within 10 business days of receipt

(1) All referenced forms are presented in Appendix A of Volume II (Standard Operating Procedures and Field Forms).

SAP Worksheet #33 -- QA Management Reports Table

(UFP QAPP Manual Section 4.2)

Type of Report	**Frequency** (daily, weekly monthly, quarterly, annually, etc.)	**Projected Delivery Date(s)**	**Person(s) Responsible for Report Preparation** (title and organizational affiliation)	**Report Recipient(s)** (title and organizational affiliation)
Project monthly progress report	Monthly (written) for duration of the project	Monthly	Project Manager Tetra Tech	Navy RPM NAVFAC
Field Status Reports	Daily (oral or email), during the course of fieldwork	TBD	Site Geophysicist TBD SUXOS Tetra Tech	Project Manager Tetra Tech Project Geophysicist Tetra Tech UXO Manager Tetra Tech
Daily QC Report (Detector-Aided Sweep)	Daily (e-mail)	TBD	UXOQC Tetra Tech	Project Manager Tetra Tech UXO Manager Tetra Tech
Daily QC Report (Geophysics)	Daily (e-mail)	TBD	Site Geophysicist Tetra Tech	Project Manager Tetra Tech Project Geophysicist Tetra Tech
QC Meeting Minutes	Twice per month, during project performance	TBD	Project Geophysicist Tetra Tech	Project Manager Tetra Tech
Rework Items List	Twice per month, during project performance Daily for UXO work	TBD	Site Geophysicist TBD UXOQC	Project Manager Tetra Tech

Type of Report	**Frequency** (daily, weekly monthly, quarterly, annually, etc.)	**Projected Delivery Date(s)**	**Person(s) Responsible for Report Preparation** (title and organizational affiliation)	**Report Recipient(s)** (title and organizational affiliation)
Project QC Report	Internal draft, draft, and final (Appendix to SI MEC Report)	TBD	Project Manager Tetra Tech Project Geophysicist Tetra Tech	Navy RPM NAVFAC

This worksheet will be modified to include the project delivery dates after fieldwork is scheduled.

SAP Worksheet #34 -- Verification (Step I) Process Table - Preparatory and Initial Inspection

(UFP-QAPP Manual Section 5.2.1)

A preparatory phase inspection will be performed prior to beginning each definable feature of work. The purpose of this inspection is to review applicable specifications and verify the necessary resources, conditions, and controls are in place and compliant before start of work activities. An initial phase inspection will be performed at the beginning of each definable feature of work. The purpose of this inspection is to observe/review the application of procedures to ensure their adequacy, ensure adequate resources are applied to the activity and that a clear understanding exists as to the quality control requirements of the definable feature of work. The responsible person will inspect the relevant items from the checklist in the appropriate SOP.

Definable Feature of Work	Description	Internal/ External	Responsible for Verification (name, organization)
Project Readiness/UFP-SAP Review	Project readiness review to be performed by Tetra Tech PM and Navy RPM including UFP-SAP review.	Internal/ External	Ralph Basinski - PM, Tetra Tech Joe Rail - Navy RPM
Pre-Operational Team Training Review	Prior to field crew(s) mobilizing to the field for on-site data collection, the Tetra Tech PM will review resumes and training records, including those for UXO and geophysical field personnel to ensure that all required training and experience requirements identified in Worksheet 7 have been completed for each crew member.	Internal	Ralph Basinski – PM, Tetra Tech
Mobilization/Site Preparation	Review of mobilization and site preparation activities such as: equipment setup and checkout; installation of ITS, and grid survey and layout.	Internal	Ralph Basinski – PM, Tetra Tech Jim Coffman – Project Geophysicist, Tetra Tech Ralph Brooks – UXO Manager, Tetra Tech
Brush Cutting and Vegetation Clearance	Brush clearing and vegetation management will be conducted in accordance with SOP-06.	Internal	Preparatory: Ralph Brooks – UXO Manager, Tetra Tech Initial Inspection: UXOQC

Definable Feature of Work	Description	Internal/ External	Responsible for Verification (name, organization)
Pre-Survey ITS Review	Prior to geophysical crews initiating on-site geophysics investigations, the Project Geophysicist will review the fieldwork procedures and results of the ITS to verify that performance criteria have been satisfactorily attained per Worksheet 12. The PM will review the recommendation of the Project Geophysicist and provide final approval.	Internal	Ralph Basinski - Project Manager, Tetra Tech Jim Coffman - Project Geophysicist, Tetra Tech
Daily EFT	Prior to geophysical crews initiating on-site geophysics daily, the Project Geophysicist will verify items required for this test and oversee the initial EFT.	Internal	Jim Coffman - Project Geophysicist, Tetra Tech
UXO Detector-Aided Surface Sweeps/Quality Control Check	Review of SOP OPS1 (UXO Detector-Aided Surface Sweeps) and SOP OPS4 (MEC Management and Accountability) which document methodology to be utilized during sweeps and quality control procedures.	Internal	Ralph Brooks, - UXO Manager, Tetra Tech TBD – SUXOS TBD – UXOQC
UXO Detector-Aided Surface Sweep Field Data Collection and Transcription	Review of SOP OPS1 (UXO Detector-Aided Surface Sweeps) and SOP OPS4 (MEC Management and Accountability) which include procedures for data collection and transcription. The SUXOS will verify that the data collected during the first lot of field work contains all the elements required by the scope of work and do not contain questionable data or error points.	Internal	Ralph Brooks, - UXO Manager, Tetra Tech TBD – SUXOS
Geophysical Survey	Review of SOP OPS2 (Geophysical Survey) which documents methodology to be utilized during geophysical surveying and includes checklists and field forms.	Internal	Jim Coffman - Project Geophysicist, Tetra Tech TBD - Site Geophysicist

Definable Feature of Work	Description	Internal/ External	Responsible for Verification (name, organization)
Geophysical Survey Field Data Collection and Transcription	Review of SOP OPS3 (Geophysical Data Processing and Analysis). The Project Geophysicist will verify that the data collected during the first lot of field work contains all the elements required by the scope of work and do not contain questionable data or error points.	Internal	Jim Coffman - Project Geophysicist, Tetra Tech TBD - Site Geophysicist
GPS Data	Review of SOP OPS (GPS) which documents procedures to be utilized in the collection of GPS positional data. The SUXOS will verify that the data collected during the first lot of field work contains all the elements required by the scope of work and do not contain questionable data or error points.	Internal	Jim Cofman – Project Geophysicist, Tetra Tech Ralph Brooks – UXO Manager, Tetra Tech
Demobilization	Review of demobilization activities such as: removal of ITS; completion of field forms, return or equipment; and, forwarding all field documentation to PM.	Internal	Ralph Basinski – PM, Tetra Tech Jim Cofman – Project Geophysicist, Tetra Tech Ralph Brooks – UXO Manager, Tetra Tech

SAP Worksheet #35 -- (Tier 2) QC Process Summary Table - Follow-Up Inspections

(UFP-QAPP Manual Section 5.2.2) (Figure 37 UFP-QAPP Manual) (Table 9 UFP-QAPP Manual)

Follow-up inspections are conducted to ensure that procedures are being correctly performed, no changed conditions exist which may impact the quality of work, and lessons learned are being applied as identified. The responsible individual will inspect the relevant follow-up items from the checklist in the appropriate SOP at least as often as specified in this worksheet. Worksheet 32 describes actions to be taken in the event that nonconforming conditions are observed during the QC inspections.

Definable Feature of Work	Frequency of Inspection	Supporting QC Document(s)	Responsible for Validation (name, organization)
Project Readiness/UFP-SAP Review	NA/upon completion of SI field work	No follow-up required for Project Readiness. Verify that the UFP SAP was implemented and carried out as written and that any deviations are documented.	Ralph Basinski - PM, Tetra Tech Joe Rail - Navy RPM
Pre-Operational Team Training Review	NA	No follow-up required for this definable feature of work.	NA
Mobilization/Site Preparation	NA	No follow-up required for this definable feature of work.	NA
Brush Cutting and Vegetation Clearance	Once per week activity is conducted	Checklists and Field Forms which document equipment utilized and progression of brush cutting and vegetation clearing activities.	Ralph Brooks - UXO Manager, Tetra Tech
Pre-Survey ITS Review	NA	No follow-up required for this definable feature of work.	NA

Definable Feature of Work	**Frequency of Inspection**	**Supporting QC Document(s)**	**Responsible for Validation** (name, organization)
Daily EFT	Checklists: once per day after data is collected. Data from tests: project completion	Daily function tests which may be documented on checklist, field forms, or via e-mail.	Jim Coffman - Project Geophysicist, Tetra Tech
UXO Detector-Aided Surface Sweep/Quality Control Check	Minimum of once per day sweeps are conducted or more frequently as necessary	Checklists and Field Forms which document equipment utilized, grids/transcripts swept and grids/transcripts checked for quality control purposes.	Ralph Brooks - UXO Manager, Tetra Tech TBD – SUXOS TBD – UXOQC
UXO Detector-Aided Surface Sweep Field Data Collection and Transcription	As needed, prior to data entry	Prior to entering data (field forms and electronic data) from the detector-aided surface sweeps into the permanent project database, the UXO Manager or designated representative will review the filed forms to ensure that all required information is provided as required by SOPs OPS1 (Detector-Aided Surface Sweep) and OPS4 (MEC Management and Accountability). Verify all data have been transferred correctly and completely during collection. Ensure that data are downloaded and backed up at least once per day to prevent accidental loss of data/field efforts.	Ralph Brooks - UXO Manager, Tetra Tech TBD - SUXOS
Geophysical Survey	Once per day survey is conducted	Daily reports, general data appearance which document equipment utilized, areas surveyed.	Jim Coffman - Project Geophysicist, Tetra Tech TBD - Site Geophysicist

Definable Feature of Work	**Frequency of Inspection**	**Supporting QC Document(s)**	**Responsible for Validation** (name, organization)
Geophysical Survey Field Data Collection and Transcription	After fieldwork is completed Once per day data is collected	Prior to entering data (field forms and electronic data) from the geophysics investigation into the permanent project database, the Project Geophysicist or designated representative will review the forms and data to ensure that all required information is provided as required by SOP OPS2 (Geophysical Survey) and SOP OPS3 (Geophysical Data Processing and Analysis). Verify all data have been transferred correctly and completely during collection. Ensure that data are downloaded and backed up at least once per day to prevent accidental loss of data/field efforts.	Jim Coffman - Project Geophysicist, Tetra Tech TBD - Site Geophysicist
GPS Data	Each day of GPS use	Verify GPS positional accuracy (SOP OPS5, GPS).	TBD - Site Geophysicist
Demobilization	Once upon completion of each phase of project/site	Verify that all demobilization activities, as applicable to phase of work, have been completed.	Ralph Basinski - Project Manager, Tetra Tech Jim Coffman - Project Geophysicist, Tetra Tech Ralph Brooks - UXO Manager, Tetra Tech

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

(UFP-QAPP Manual Section 5.2.2.1)

Step IIa / IIb[1]	Matrix	Analytical Group	Validation Criteria	Data Validator (Title and organization)
IIa	Surface Soil	Detector-Aided Surface Sweep	a) Satisfactory rechecks of 25% of first four grids/transects by the UXOQC, or SUXOS if no UXOQC. b) Satisfactory rechecks of 10% of the grids/ transects by the UXOQC, or SUXOS if no UXOQC, after achievement of satisfactory rechecks on four grids/transects in a row	TBD SUXOS Tetra Tech TBD UXOQC Tetra Tech
IIa	Subsurface Soil	Geophysics Investigation	Achievement of goals established for the ITS.	Jim Coffman Project Geophysicist Tetra Tech

1 IIa = compliance with methods, procedures, and contracts (see Table 10, page 117, UFP-QAPP manual, V.1 March 2005).
IIb not applicable for MEC investigation.

SAP Worksheet #37 -- Usability Assessment
(UFP-QAPP Manual Section 5.2.3)

Data Usability Assessment

The usability of the data directly affects whether project objectives can be achieved. The following characteristics will be evaluated at a minimum. The results of these evaluations will be included in the project report. To the extent required by the type of data being reviewed, the assessors will consult with other technically competent individuals to render sound technical assessments of these data characteristics:

Certification of Proper Operation of Detection and Positioning Systems

The project geophysicist, acting on behalf of the project team, will prepare a table listing planned calibration and QC checks, their occurrence and the results (acceptable or not acceptable) for each type of metal detector, geophysics instrument, and positioning system equipment that was used on the project will be prepared. Data collected by any improperly operating equipment will be identified. A determination will be made as to whether the affected data adversely impacted the ability to meet project objectives. If the project objectives have been adversely impacted, the TtNUS PM will consult with the Navy RPM and other project team members, as necessary (determined by the Navy RPM), to develop appropriate corrective actions.

Qualification / Certification of Survey Team

The project manager, acting on behalf of the project team, will prepare a table listing each member of the detector-aided surface sweep team and subsurface geophysics team, which will list required certifications and training and required demonstrations of competency. Any deviations will be identified. Data collected by team members not meeting the required training and demonstrations of competency will be identified. A determination will be made as to whether affected data impacted the ability to meet project objectives. If the project objectives have been adversely impacted, the Tetra Tech PM will consult with the Navy RPM and other project team members, as necessary (determined by the Navy RPM), to develop appropriate corrective actions..

Coverage of Areas to be Investigated

A project scientist, identified by the Tetra Tech PM and acting on behalf of the project team, will determine whether data was collected in all areas planned to be investigated. Data gaps will be identified. The Tetra Tech PM will consult with the project team to determine the extent to which it is necessary to fill these data gaps in the RI phase

Interpretation of Geophysical Data

A project scientist, acting on behalf of the project team, will analyze the geophysical interpretation and maps to check for completeness of anomaly interpretation (target picking), and whether acceptable anomaly selection criteria were applied in the interpretation of the data. Any deficiencies in anomaly interpretation will be identified, and their impact on the Project Quality Objective (PQOs) will be summarized.

Identify the personnel responsible for performing the usability assessment:

The Tetra Tech PM, Project Geophysicist, and Project Scientist will be responsible for conducting the listed data usability assessments. The data usability assessment will be reviewed with the Navy RPM, the U.S. EPA RPM, and the state of Maryland PM. The review will take place either in a face to face meeting or a teleconference depending on the extent of identified deficiencies. If no significant deficiencies are identified, the data usability assessment will simply be documented in the project report and reviewed during the normal document review cycle.

Describe the documentation that will be generated during usability assessment and how usability assessment results will be presented:

Written documentation will support the non-compliance estimated or rejected data results. The project report will identify and describe the data usability limitations and suggest re-surveying or other corrective actions, if necessary.

Usability Checklist Table			
Phase of Work	**Item to be checked/verified**	**Verified (Yes or No)**	**Comments or Deviations**
Pre-Survey	Qualification of Survey Team evaluated		
	Personnel reviewed and signed-off on relevant SAP section(s)		
Survey	QC evaluation of survey equipment (tests and checklists satisfactorily completed)		
	Instrument Test Strip met requirements specified in SAP		
	Conformance to SAP requirements and procedures for all survey work and rework (including documentation requirements), and all deficiencies documented		
	Coverage of Areas to be Investigated fulfilled and located within accuracy levels required for the SI		
	Interpretation and Summary of Geophysical Data satisfies SAP requirements and conformance with Data Processing Flowchart (WS 17)		

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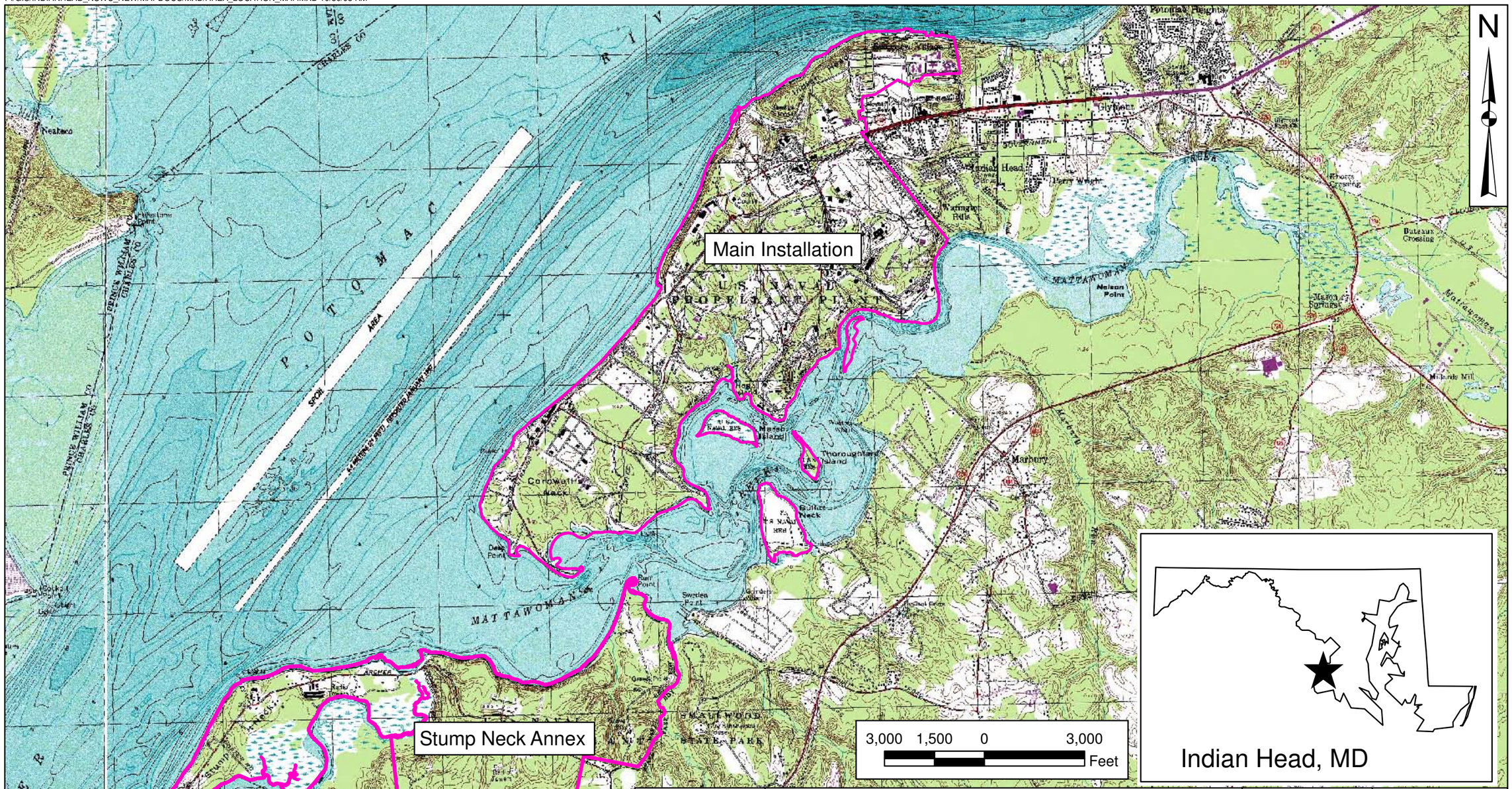

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CHECKED BY M. BLANKEN	DATE 10/30/08	FACILITY LOCATION MAP MAIN INSTALLATION AND STUMP NECK ANNEX NAVAL SUPPORT FACILITY INDIAN HEAD INDIAN HEAD, MARYLAND	APPROVED BY — / DATE —
COST/SCHEDULE-AREA			APPROVED BY — / DATE —
SCALE AS NOTED			FIGURE NO. FIGURE 1-1 / REV 0

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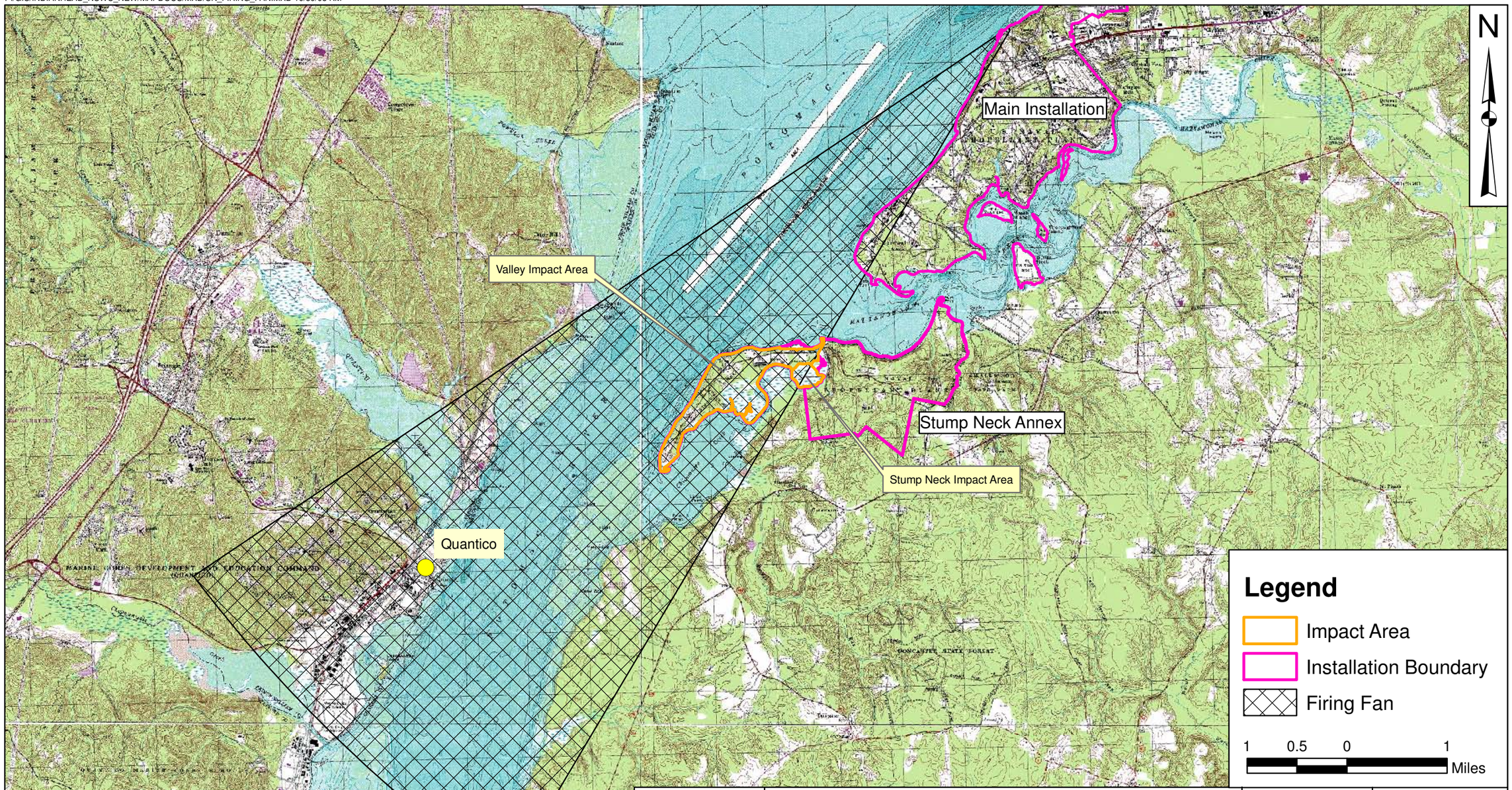

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CHECKED BY	DATE	FACILITY LOCATION MAP	APPROVED BY	DATE
M. BLANKEN	10/30/08	VALLEY IMPACT FAN	—	—
COST/SCHEDULE-AREA		NAVAL SUPPORT FACILITY INDIAN HEAD	APPROVED BY	DATE
		INDIAN HEAD, MARYLAND	—	—
SCALE AS NOTED			FIGURE NO. FIGURE 1-2	REV 0

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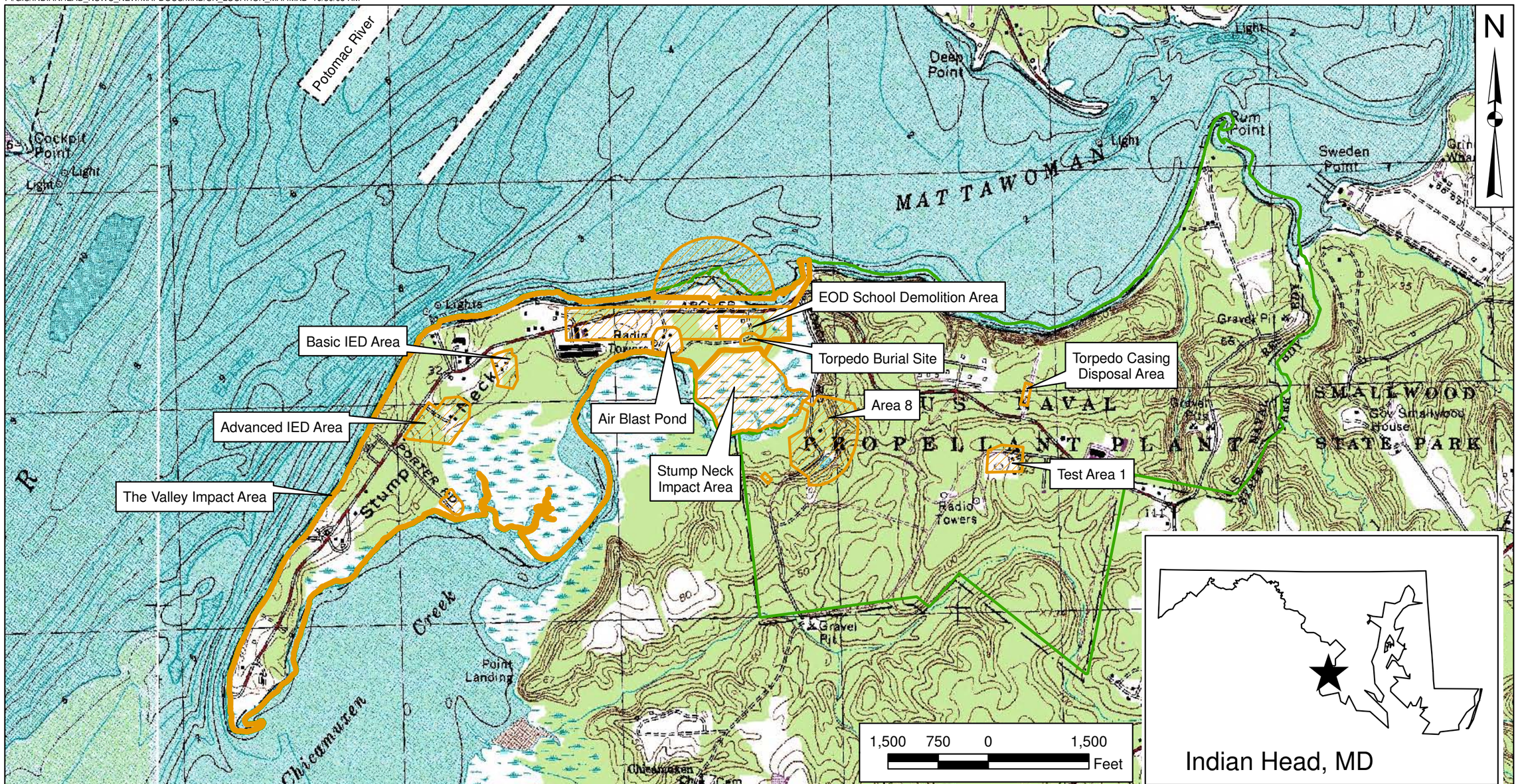

Legend

- MRP Site Boundary for Valley Impact Area
- MRP Site Boundary
- Installation Boundary

DRAWN BY K. MOORE	DATE 08/22/07	Tetra Tech NUS, Inc.	CONTRACT NUMBER 4020 / OWNER NUMBER --
CHECKED BY M. BLANKEN	DATE 10/30/08	RANGE LOCATION MAP NAVAL SUPPORT FACILITY INDIAN HEAD INDIAN HEAD, MARYLAND	APPROVED BY — / DATE —
COST/SCHEDULE-AREA			APPROVED BY — / DATE —
SCALE AS NOTED			FIGURE NO. FIGURE 1-3 / REV 0

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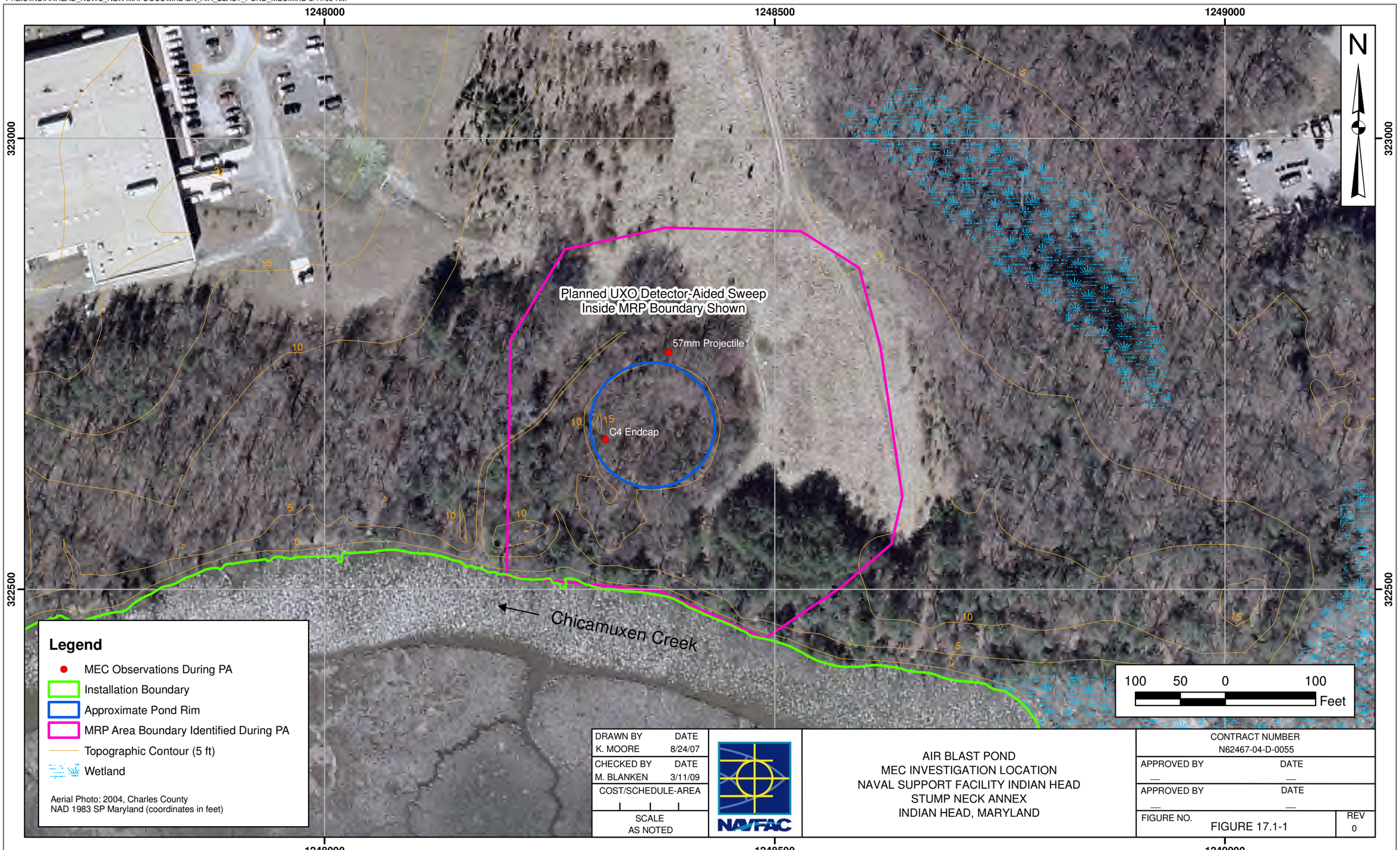

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K. MOORE	8/24/07
CHECKED BY	DATE
M. BLANKEN	3/11/09
COST/SCHEDULE-AREA	
SCALE AS NOTED	

NAVFAC

AIR BLAST POND
MEC INVESTIGATION LOCATION
NAVAL SUPPORT FACILITY INDIAN HEAD
STUMP NECK ANNEX
INDIAN HEAD, MARYLAND

CONTRACT NUMBER N62467-04-D-0055	
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APPROVED BY —	DATE —
FIGURE NO. FIGURE 17.1-1	REV 0

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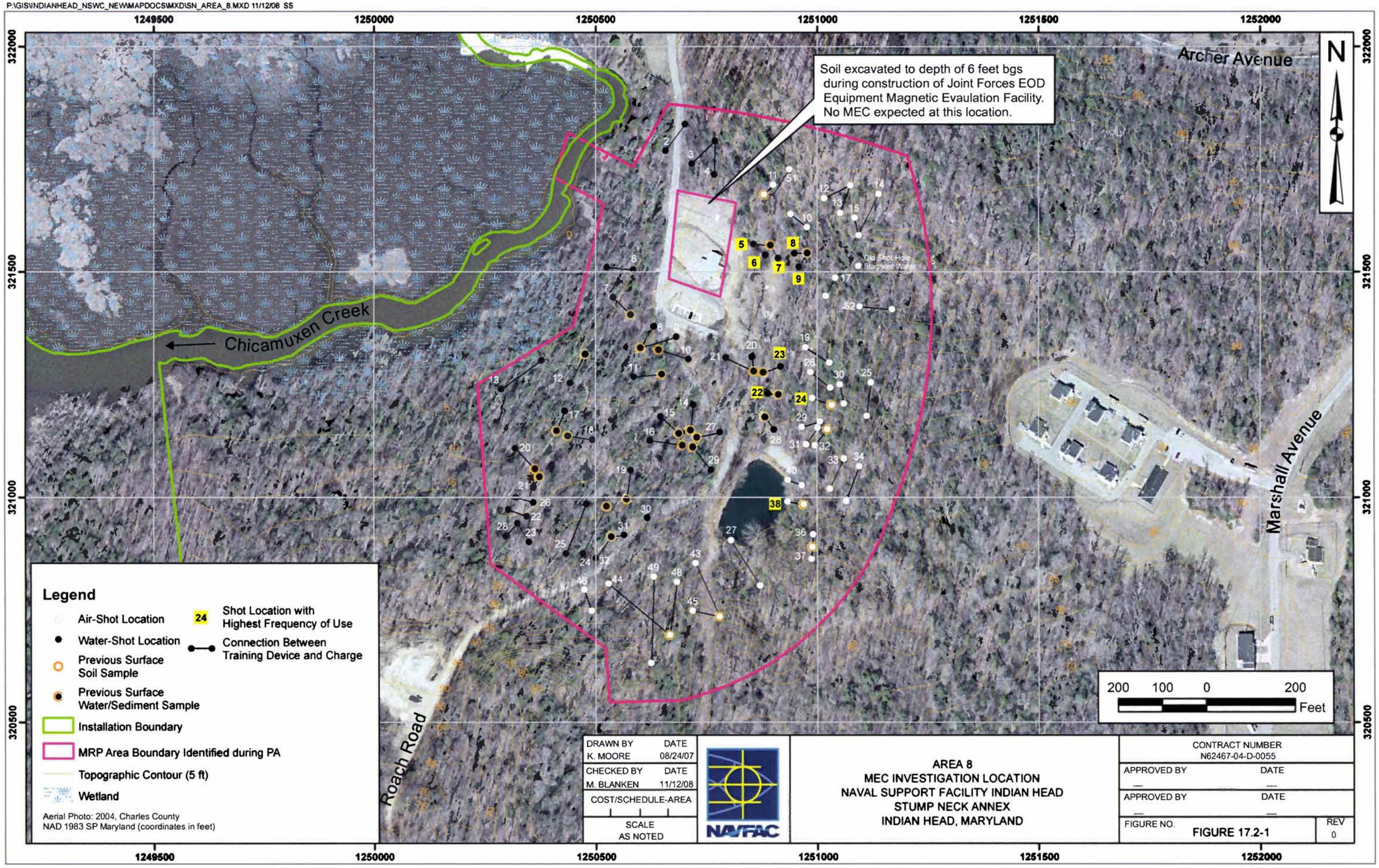

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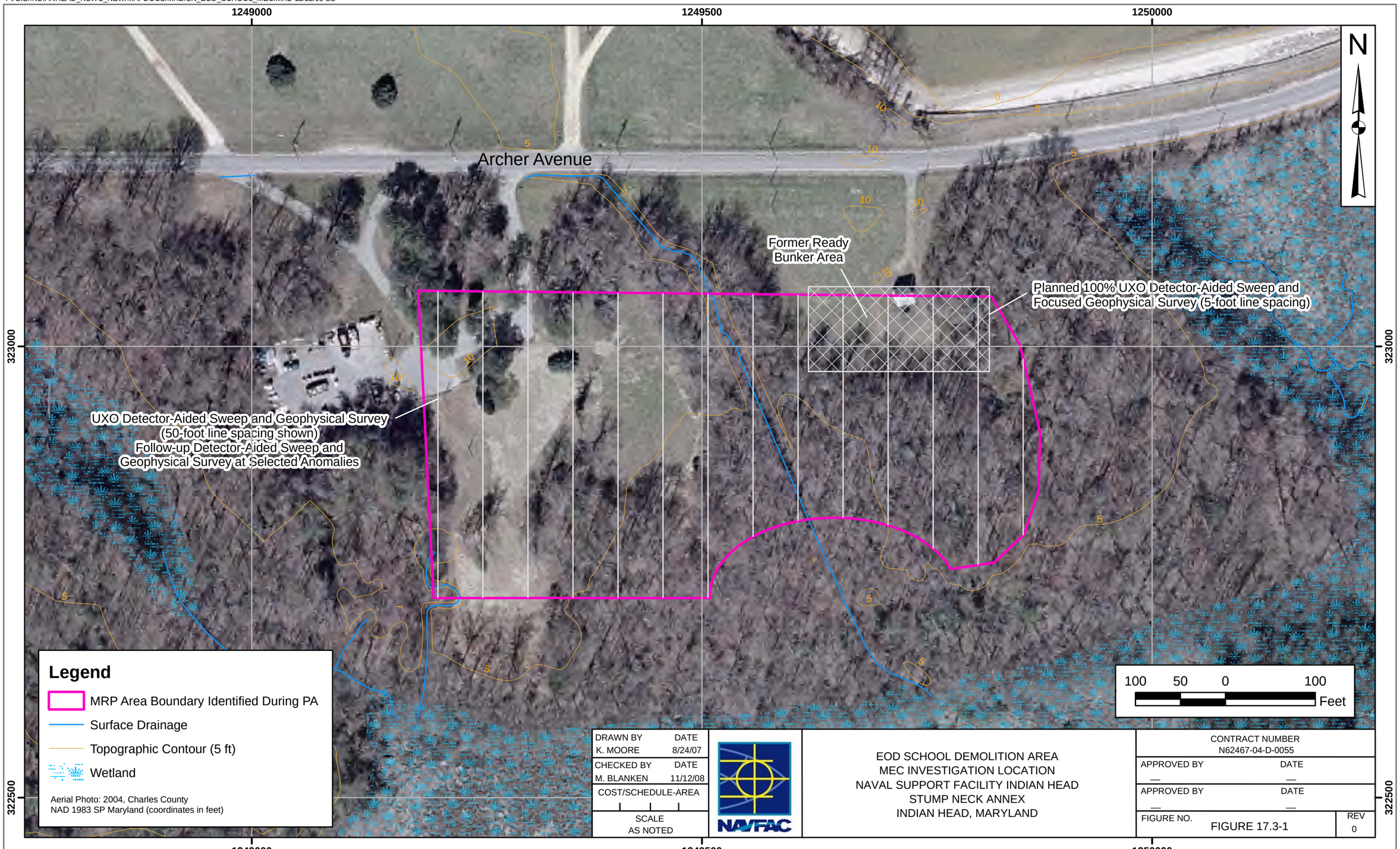


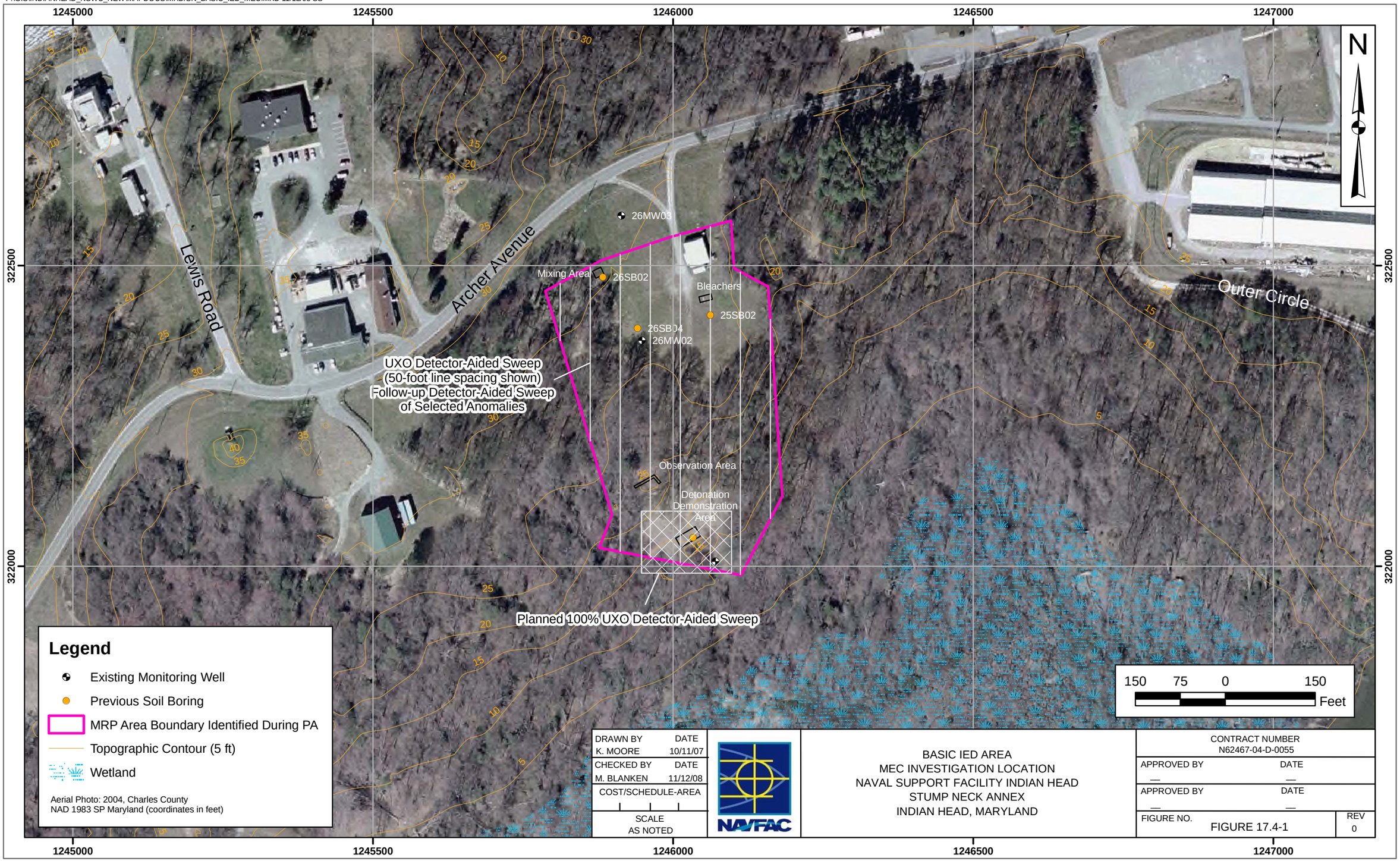
DRAWN BY	DATE
K. MOORE	8/24/07
CHECKED BY	DATE
M. BLANKEN	11/12/08
COST/SCHEDULE-AREA	
SCALE AS NOTED	

NAVFAC

EOD SCHOOL DEMOLITION AREA
MEC INVESTIGATION LOCATION
NAVAL SUPPORT FACILITY INDIAN HEAD
STUMP NECK ANNEX
INDIAN HEAD, MARYLAND

CONTRACT NUMBER N62467-04-D-0055	
APPROVED BY —	DATE —
APPROVED BY —	DATE —
FIGURE NO. FIGURE 17.3-1	REV 0

P:\GIS\INDIANHEAD_NSWC_NEW\MAPDOCS\MXD/SN_BASIC_IED_MEC.MXD 11/12/08 SS



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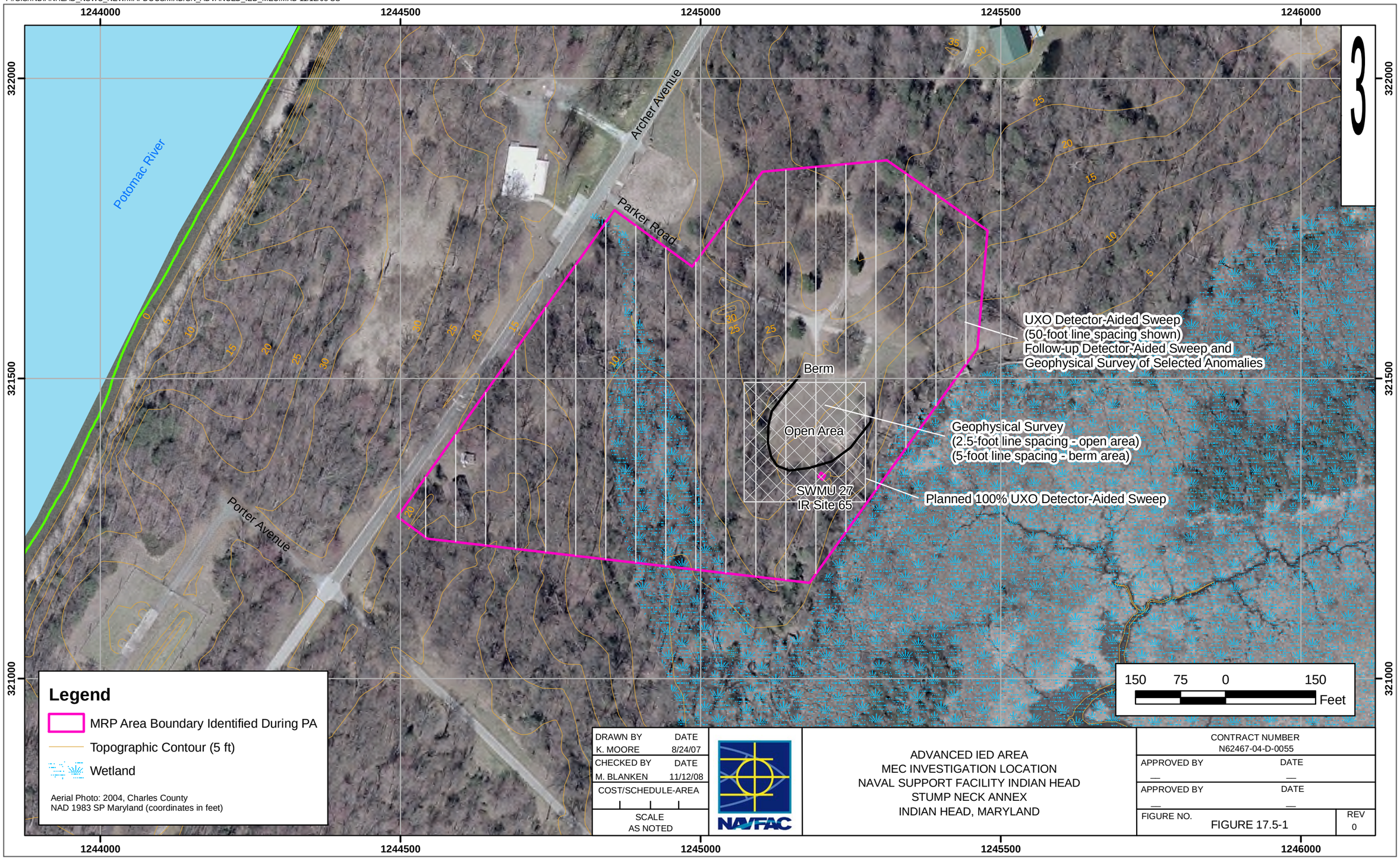

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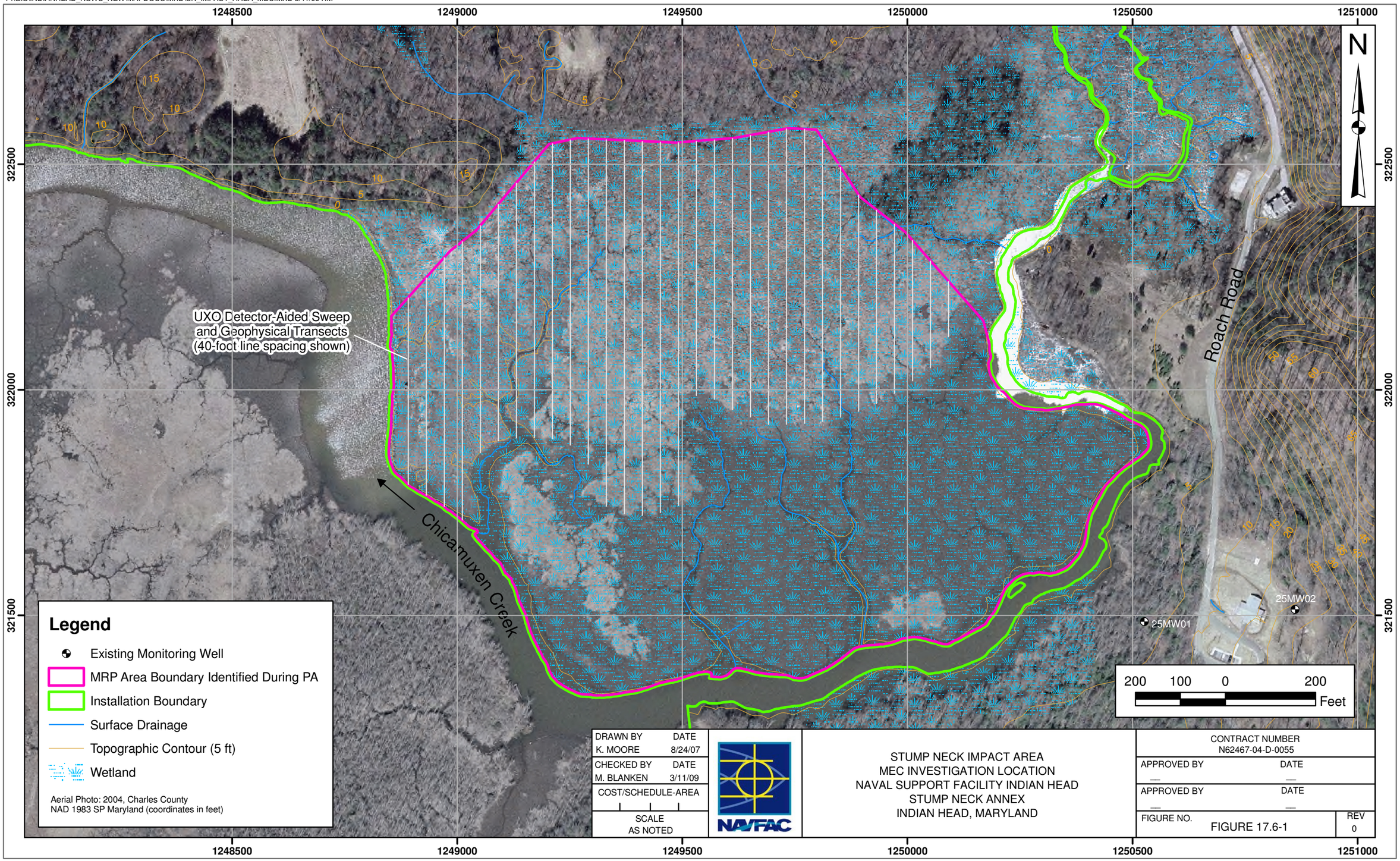

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DRAWN BY	DATE
K. MOORE	8/24/07
CHECKED BY	DATE
M. BLANKEN	11/12/08
COST/SCHEDULE-AREA	
SCALE AS NOTED	

NAVFAC

TEST AREA 1
MEC INVESTIGATION LOCATION
NAVAL SUPPORT FACILITY INDIAN HEAD
STUMP NECK ANNEX
INDIAN HEAD, MARYLAND

CONTRACT NUMBER N62467-04-D-0055	
APPROVED BY —	DATE —
APPROVED BY —	DATE —
FIGURE NO. FIGURE 17.7-1	REV 0

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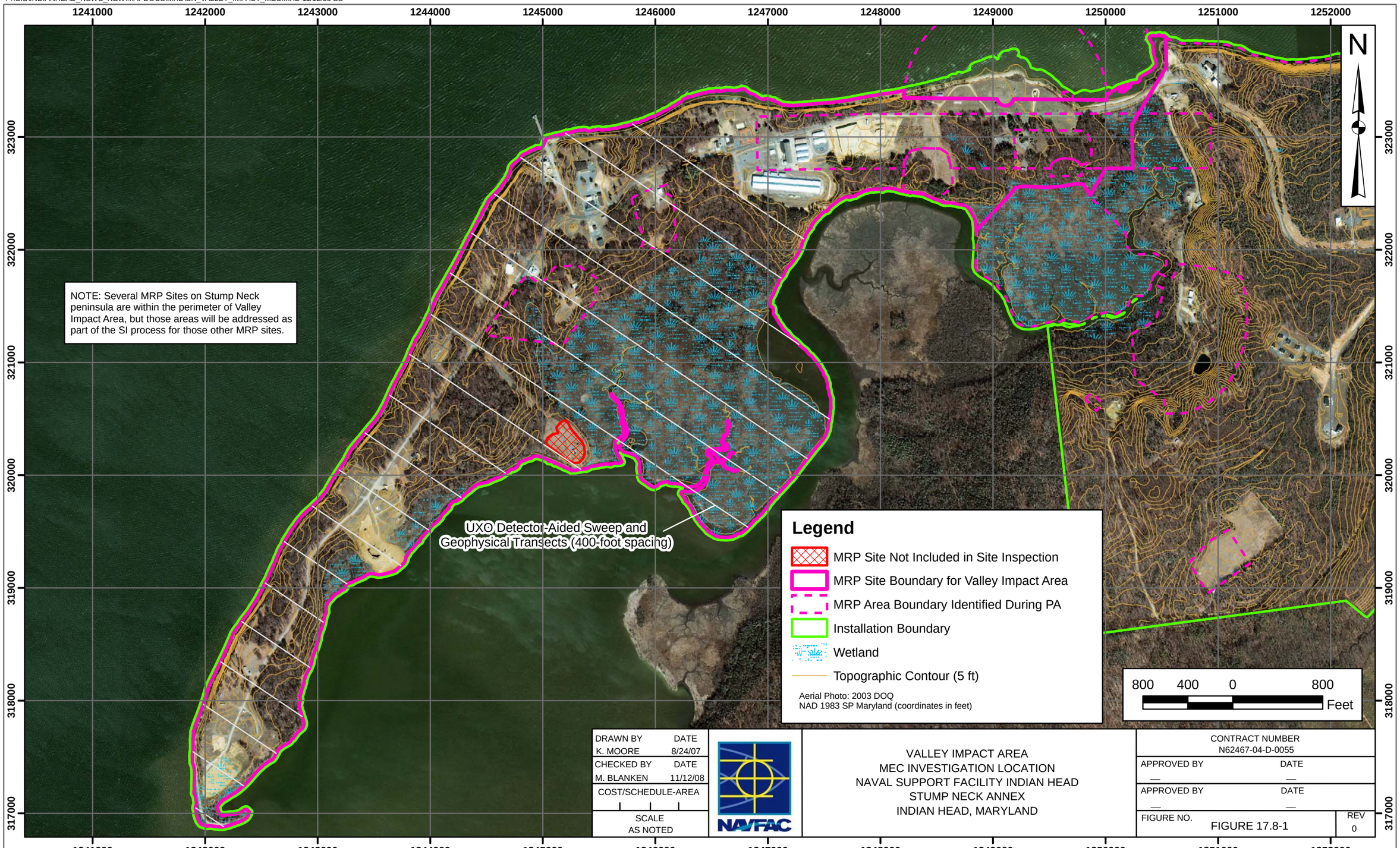

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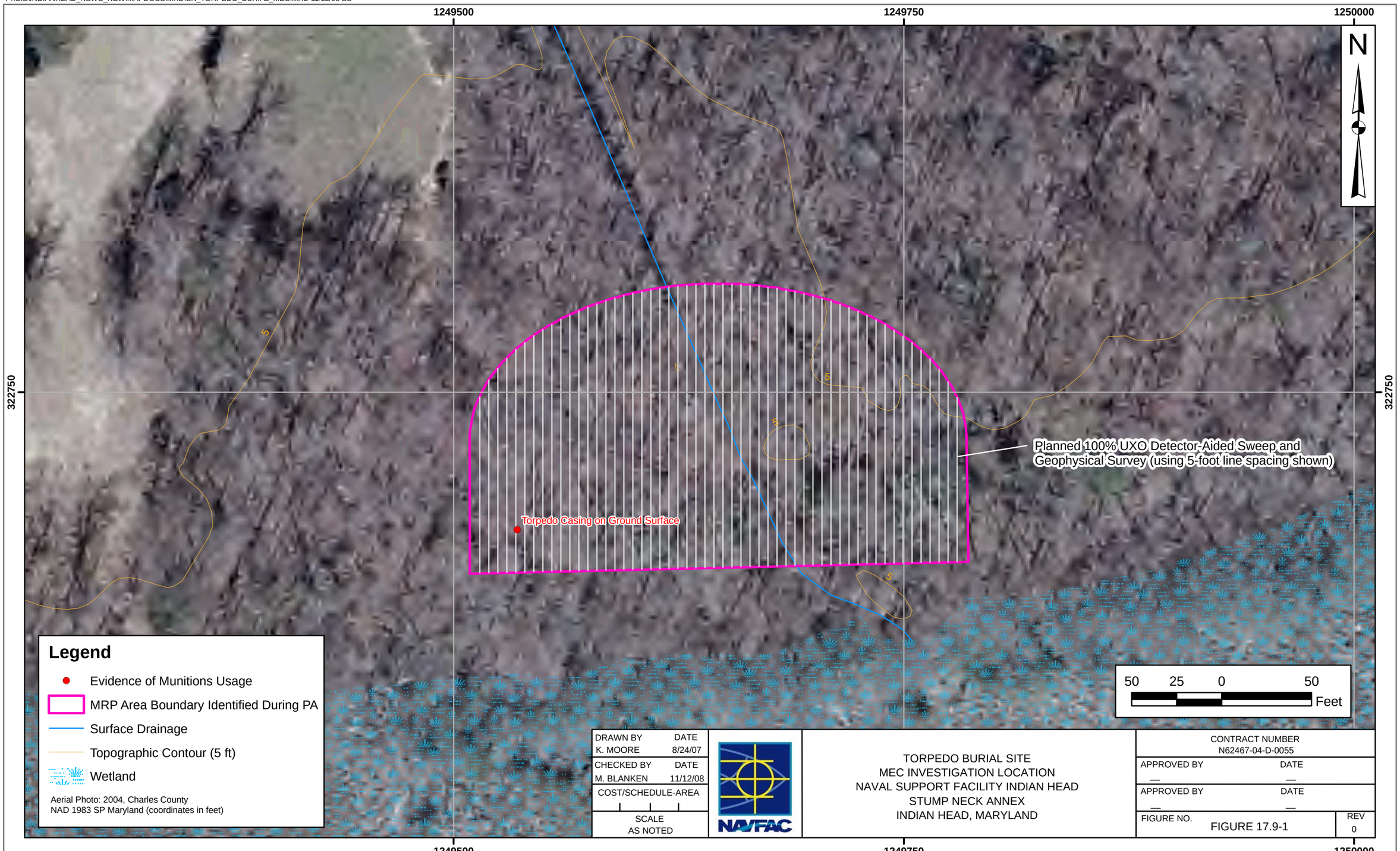

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DRAWN BY	DATE
K. MOORE	8/24/07
CHECKED BY	DATE
M. BLANKEN	11/12/08
COST/SCHEDULE-AREA	
SCALE AS NOTED	

NAVFAC

TORPEDO CASING DISPOSAL AREA
MEC INVESTIGATION LOCATION
NAVAL SUPPORT FACILITY INDIAN HEAD
STUMP NECK ANNEX
INDIAN HEAD, MARYLAND

CONTRACT NUMBER	
N62467-04-D-0055	
APPROVED BY	DATE
—	—
APPROVED BY	DATE
—	—
FIGURE NO. FIGURE 17.10-1	REV 0

1254000

APPENDIX A

STANDARD OPERATING PROCEDURES

APPENDIX A

STANDARD OPERATING PROCEDURES

TABLE OF CONTENTS

SOPs

OPS1	UXO Detector-Aided Surface Sweeps
OPS2	Geophysical Survey
OPS3	Geophysical Data Processing and Analysis
OPS4	MEC Management and Accountability
OPS5	Global Positioning System
SOP-06	Vegetation Management at MEC Sites

STANDARD OPERATING PROCEDURE
SOP OPS1

UXO DETECTOR-AIDED SURFACE SWEEPS

1.0 SCOPE AND APPLICABILITY

This document is designed to set a standard operating procedure (SOP) for the detector-aided surface sweep field operations during activities performed under the Munitions Response Program (MRP). This SOP is not site-specific, but rather is intended as a general guidance document for a variety of sites and conditions.

2.0 BACKGROUND

Detector-aided surface sweep activities will be performed in accordance with all local, State, and federal regulations and will include all applicable DoD requirements. The scope of the detector-aided surface sweep activities for a specific site will be defined in the project-specific work plans. Generally, all areas identified as suspect for munitions and explosives of concern (MEC) will receive an Unexploded Ordnance (UXO) detector-aided surface sweep UXO detector-aided surface sweep operations may be used as a stand-alone method for site survey and assessment or in preparation for geophysical survey operations. UXO escort operations will be required during site visits (initial site assessments, planning, and stakeholders meetings), geophysical operations, and MC sampling operations and any other time where non-UXO trained personnel are conducting work in an MEC site. This SOP does not address UXO escort operations. UXO escort operations are addressed in the Munitions and Explosives of Concern and Chemical Warfare Agents Activities SOP which will be attached to the site-specific health and safety plans (HASPs) for those activities.

3.0 PERSONNEL QUALIFICATIONS

UXO personnel conducting detector-aided surface sweeps shall be graduates of a military Explosive Ordnance Disposal (EOD) School of the United States, Canada, Great Britain, Germany, or Australia or a graduate of a formal training course of instruction or EOD assistant course as stated in DDESB TP-18.

UXO Senior UXO Supervisor (SUXOS)

The SUXOS will have a minimum of ten years experience in all aspects of munitions response actions or range clearance activities. A minimum of five years of the experience shall be in supervisory positions.

UXO Team Leader (UXO Technician III)

The UXO Team Leader will have a minimum of 8 years of EOD/UXO experience including prior military EOD and/or commercial UXO experience in munitions response actions, and/or range clearance activities. The UXO Team Leader may supervise up to six UXO technicians. The UXO Team Leader will conduct detector-aided surface sweep activities as directed by the project manager (PM) and UXO Manager. The UXO Team Leader will be under the direct supervision of the UXO Manager.

UXO Quality Control Specialist (UXOQC)

The UXOQC specialist shall have a minimum of 8 years experience in all phases of munitions response actions and/or range clearance activities.

UXO Safety Officer (UXOSO)

The UXOSO shall have a minimum of 8 years experience in all phases of munitions response actions and/or range clearance activities. The UXOSO will brief the team on the hazards and other issues associated with the definable features of work planned for the day. This briefing will be documented on the attached Tailgate Safety Briefing form.

UXO Technicians II

The UXO Technicians II will have prior military EOD experience or a minimum of 3 years of experience in munitions response actions and/or range clearance activities. The UXO technician will conduct detector-aided surface sweep activities as directed by the UXO Team Leader.

UXO Technician I

The UXO Technician I will have training as specified in DDESB TP-18. The UXO technician I will be directly supervised by a UXO Technician III or higher when conducting UXO activities.

4.0 DETECTOR-AIDED SURFACE SWEEP OPERATIONS

Equipment

A magnetic locator such as the Schonstedt, GA-52Cx instrument or equivalent and/or an all-metal detector such as the White's XLT or equivalent will be used for detector-aided surface sweep operations. The detection depth of the instrument is limited by size and orientation of a target and soil characteristics of the work area. The locators provide an audio signal for response, but do not store data. The magnetic locator does not need to be calibrated. The all-metal detector has field calibration. Calibration settings are specific to the make and model of the all metals detector. Table 1 lists the calibration settings for the White's spectrum XLT.

To ensure each detector is operating properly, the operator turns on the instrument and slowly moves the locator towards metal. As the probe advances toward the target, the audio signal will increase. Failure to detect the object is reason to reject the instrument. The operator will complete the attached Equipment Maintenance/Repair Form to address equipment failure and corrective actions taken.

1) The detector will be checked daily before starting detector-aided surface sweep activities and after any battery change.

2) The normal daily check for detector-aided surface sweep operations is the blanket test.

3) To conduct the blanket test, an area near the work site that is free of anomalies will be identified.

4) The senior UXO Technician or UXOQC will position several inert munitions, or surrogate munitions items on the surface and cover the items with a tarpaulin or similar cover so the items are not visible to the UXO technician. Each UXO technician will conduct a detector aided surface sweep of the blanket test area and locate the test items. The senior UXO technician or UXOQC will compare the results of the test to the actual placement of the items and make corrections as necessary. UXO Technicians will also conduct random checks during daily operations. The operator will complete the attached Equipment Utilization Log for each detector tested.

The normal setting for the Schonstedt instrument is 2; setting the instrument to 3 or 4 will make it more sensitive and setting the instrument to 1 will make it less sensitive. The instrument will not detect copper, brass, or aluminum munitions. The normal setting for the White's all-metal detector will vary according to site conditions.

UXO Detector-Aided Surface Sweep

The objective of the UXO detector-aided surface sweep is to locate suspect MEC. Materials potentially presenting an explosive hazard (MPPEH) and munitions debris (MD) on the ground surface in a munitions response site, (MRS). Early in the planning for the field activities, usually during the DQO process with the regulators and the client, the level of effort is determined for each MRS within a munitions response area, MRA). The level of effort can vary from a 100% UXO investigation where the entire foot print of the MRS receives a UXO detector-aided surface sweep, to transects where five foot wide lanes receive a UXO detector-aided surface sweep and each lane is separated by a set number of feet depending on the budget and size of the MRS, or even a meandering path where a UXO detector-aided surface sweep is conducted as the UXO technician meanders across the MRS. Each of these will be discussed in some detail below:

100% UXO Detector-aided Surface Sweep

The first step in conducting a 100% UXO detector-aided surface sweep is to identify the boundaries of the MRS. This can be done with a GPS with preloaded grid coordinates, or surveyed by a land surveyor.

The next step is to remove brush and small trees within the MRS to allow access to the locations where the surface sweep is to be conducted. The degree of removal will depend on site-specific conditions. This can be accomplished with a bush cutting crew and a UXO escort, or the UXO team can conduct the brush cutting themselves depending on the size of the area and the amount of brush removal needed. Care must be taken to ensure that personnel do not disturb suspect MEC, MPPEH or munitions debris on the surface that may be obscured by vegetation

The next step is to establish a grid system across the MRS. The normal grid is 100ft X 100ft but may be larger or smaller if the MRS would be better covered with a different size. The grid is established using a GPS with preloaded grid corners, or surveyed by a land surveyor to establish the grid corners.

The next step in the set-up process is to divide each grid into search lanes. This is normally done by running a tape measure between the bottom and top east/west corner stakes. Then the UXO team will run rope lines from the 0 point on one tape to the 0 point on the other tape, from the 5ft point on one tape to the 5ft point on the next tape, and so on until the entire 100 ft grid has been divided in to lanes.

The UXO team members will now start the UXO detector-aided surface sweep of each lane. Each UXO team member will start at one of the tapes and using the metal detector, proceed toward the other tape and locate any surface MEC within their lane. If suspect MEC is encountered, its location will be recorded and/or marked using a GPS, tape measure, or other grid coordinate location system. The UXO Team will attempt to determine its condition without moving or disturbing the item prior to proceeding with the surface sweep. Each item will be marked with engineer flagging and given a unique ID number (See MEC Management and Accountability SOP). All available information about the item will be recorded in the logbook/MEC Accountability Log, including suspect MEC location, identification, and ID number. A digital photograph will be taken of each item. The UXO Team will not move or otherwise disturb the item in an attempt to collect information. After all available information is recorded; the UXO Team will resume the detector-aided surface sweep.

When the UXO detector-aided surface sweep of a grid is complete and all items have been located with coordinates and digitally photographed, the tape measures, ropes and other equipment will be moved to the next grid and reestablished as stated above. This process will continue until the entire MRS has been investigated with as close as possible to 100% UXO detector-aided surface sweep.

Transect UXO Detector-aided Surface Sweep

The first step in conducting a transect UXO detector-aided surface sweep is to identify the boundaries of the MRS. This can be done with a GPS with preloaded grid coordinates, or surveyed by a land surveyor.

The next step is to establish the end stakes of each transect across the MRS. The transect end stakes are established using a GPS with preloaded end stake locations, or surveyed by a land surveyor. The distance between transects will be established in the site-specific work plan. The direction should be either north/south, or east west although other directions may be appropriate in specific circumstances. If a geophysical survey using a magnetometer is to follow the detector-aided surface sweep, the direction of the transects should be north/south because the magnetometer operates on the principle of the Earth's polarity.

If necessary, each transect may require some brush cutting to aid in the surface sweep. If brush cutting is determined to be necessary, the transect should be at least 5 ft. wide. This can be accomplished with a bush cutting crew and a UXO escort, or the UXO team can conduct the brush cutting themselves depending on the size of the area and the amount of brush removal needed. Care must be taken to ensure that personnel do not disturb suspect MEC items on the surface that may be obscured by brush and tall grass.

The UXO team members will now start the UXO detector-aided surface sweep of each transect. Each UXO team member will start at one of the end stakes and using the metal detector proceed in a deliberate pattern to locate any surface MEC within their 5ft wide transect, toward the other corresponding end stake. The UXO team member will use a GPS or compass to maintain a generally straight transects during the investigation. If suspect MEC is encountered, its location will be recorded and/or marked using a GPS, tape measure, or other grid coordinate location system. The UXO Team will attempt to determine its condition without moving or disturbing the item prior to proceeding with the surface sweep. Each item will be marked with engineer flagging and given a unique ID number (See MEC Management and Accountability SOP). All available information about the item will be recorded in the logbook/MEC Accountability Log, including suspect MEC location, identification, and ID number. A digital photograph will be taken of each item. The UXO Team will not move or otherwise disturb the item in an attempt to collect information. After all available information is recorded; the UXO Team will resume the detector-aided surface sweep.

When the UXO detector-aided surface sweep of a transect is complete and all items have been located with coordinates and digitally photographed, the UXO team member may proceed to the next transect. This process will continue until the transects have been completed over the entire MRS as planned in the WP.

Meandering Path UXO Detector-aided Surface Sweep

Generally the meandering path UXO detector-aided surface sweep is very similar to the transect UXO detector-aided surface sweep. The main difference is there is very little need to cut brush as the UXO team members will meander around heavy brush and other obstacles.

The GPS will have information about the MRS preloaded so as to ensure that the path stays within the MRS. Again the meandering path will be approximately 5ft wide and proceed across the MRS until the objective, (a set amount of time, distance, or suspect MEC items) have been investigated with the UXO detector-aided surface sweep. The site-specific work plans will establish the area within the MRS to be covered with the meandering transects.

If suspect MEC is encountered, its location will be recorded and/or marked using a GPS, compass, and/or tape measure, or other grid coordinate location system. The UXO Team will attempt to determine its condition without moving or disturbing the item prior to proceeding with the surface sweep. Each item will be marked with engineer flagging and given a unique ID number (See MEC Management and

Accountability SOP). All available information about the item will be recorded in the logbook/MEC Accountability Log, including suspect MEC location, identification, and ID number. A digital photograph will be taken of each item. The UXO Team will not move or otherwise disturb the item in an attempt to collect information. After all available information is recorded; the UXO Team will resume the detector-aided surface sweep.

Every effort will be made to identify each suspect MEC or MPPEH item located. Under no circumstances will any suspect MEC be moved in an attempt to make a definitive identification. The MEC item will be visually examined for markings and other external features such as shape, size, and external fittings. If unknown military munitions are encountered, the facility point of contact (POC) and Tetra Tech UXO Manager will be notified.

Only UXO-qualified personnel will perform MEC identification procedures. As an exception, a UXO Technician I may assist in the performance of MEC identification procedures when under the supervision of a UXO Technician III or higher. All personnel engaged in field operations will be thoroughly trained and capable of recognizing the specific hazards of the procedures being performed. To ensure that these procedures are performed to standards, all field personnel will be under the direct supervision of a UXO Technician III or higher. All suspect MEC items will be recorded following the requirements of this SOP, the site-specific Work Plan/QAPP, the project site-specific HASP, applicable ordnance operations procedural safety guidelines, and industry-accepted safe work practices and procedures.

All munitions-related items discovered during the detector-aided surface sweep of the transects/grid will be left in place. No MEC will be moved during this part of the project. The facility POC will be notified of the presence of MEC so that arrangements may be made through the facility for proper disposition of the item(s). If the facility initiates an emergency response or disposal action, follow-up documentation must be obtained to detail the date and method of disposition. This is also needed to ascertain the actual type and condition of the item (live or inert filled) to aid in future classification of the site.

Quality Control

The UXOQC will review the definable features of work prior to the start of work each day. A new definable feature of work will receive a preparatory phase QC inspection prior to the start of work. This inspection is recorded on the attached Quality Control Surveillance Report. Work started on a new definable feature of work will receive an initial phase QC inspection. During the detector aided surface sweep the UXOQC, or Senior UXO technician if there is no UXOQC, will recheck 25% of the first four units of work (grids or transects). If quality requirements are not met on any unit, that unit will be rejected

and the UXO team will rework the entire unit. Once quality requirements are met for four units in a row, the UXOQC, or Senior UXO technician if there is no UXOQC may reduce the level of rechecks to 10% of each unit (grids or transects). If at any time a unit fails the quality control check, that complete unit will be reworked and the rechecks will be increased to 25% until four units in a row pass the recheck. These follow up phase QC inspections will be recorded on the attached Quality Control Surveillance Report. All work will be conducted in accordance with the MEC SAP and the SOPs attached to that MEC SAP. All requested changes to the approved MEC SAP will be documented on the attached Record-of-Change Form and submitted to the PM and UXO Manager for action/approval. The UXOQC will prepare the attached Daily Quality Control Report for each day worked summarizing the definable features of work inspected, the phase of that work, the locations, and personnel at the work site.

Detector-Aided Surface Sweep for Geophysical Survey

The UXO Technician will conduct a detector-aided surface sweep of the grid or area to be surveyed and record the location of any MEC items discovered. Each item will be marked and recorded as described above. UXO avoidance will be practiced during the geophysical survey.

Explosive Safety Submission (ESS)

When allowed by the conditions of the ESS determination, any non-munitions debris may be moved to facilitate a more effective surface sweep and/or geophysical survey. Non-munitions debris may be collected and stockpiled in a designated area within the boundaries of the site. The facility must agree to take possession of this non-munitions debris and arrange the proper disposition of the material before any items may be moved or disturbed.

Senior UXO Technician On Site

The SUXOS or Senior UXO Technician on site will complete the attached MEC Field Activity Daily Log for each day work is conducted. The log will be used to document and report significant events, logbook entries, phone calls, visitors, and other items of interest to the PM and UXO Manager. This report will be submitted as soon as possible at the end of the work day. The attached Field Activity Weekly Log is a summary of the week's events.

TABLE 1

White's Spectrum XLT Settings		
Basic Adjustments:	**UXO 1**	
Target Volume	58	
Audio threshold	23	
Tone (audio frequency)	226	
Audio Disc.	on	
Silent Search	off	
Mixed-Mode	on	
A.C. Sensitivity	60	Adjust at a test Grid. Compare with another White's
D.C. Sensitivity	30	Adjust at a test Grid. Compare with another White's
Backlight	0	
Viewing Angle	25	
Pro Options:		
"Audio"		
Ratchet Pinpointing	on	
S.A.T. Speed	7	
Tone I.D.	on	
V.C.O.	on	
Absolute Value	off	
Modulation	on	
"G.E.B/Trac"		
Autotrac	on	
Trac View	off	
Autotrac Speed	14	
Autotrac Offset	+1	
Trac Inhibit	on	
Coarse B.E.B.	54	These numbers are variable and will change automatically.
Fine G.E.B.	160	These numbers are variable and will change automatically.
"Discrimination"		
Disc. Edit	+95 Accept	
Block Edit	+95 Accept	
Learn Accept	off	
Learn Reject	off	
Recovery Speed	20	
Bottlecap Reject	20	

White's Spectrum XLT Settings		
Basic Adjustments:	**UXO 1**	
"Display"		
Visual Disc.	off	
Icons	on or off	
V.D.I. Sensitivity	55	
D.C. Phase	9on	
Graph Averaging	on	
Graph Accumulating	on	
Fade Rate	u	
"Signal"		
Transmit Boost	off	
Transmit Frequency	1 to 7	
Preamp Gain	4	

TETRA TECH NUS, INC.

Project:			
Tailgate Safety Briefing			
Date: _____		**Location: _____**	
Time: _____		**Team #: _____**	
1. Reason for Briefing:			
	Daily Safety Briefing		**New Site Procedure**
	Initial Safety Briefing		**New Site Information**
	New Task Briefing		**Review of Site Information**
	Periodic Safety Meeting		**Other: (Specify)**

2. Personnel Attending		
Name	**Signature**	**Position**

Briefing Given By:		
Name	**Signature**	**Position**

TETRA TECH NUS, INC.

3. Topics: (Check All That Apply)			
	Site Safety Personnel		Decontamination Procedures
	Site/Work Area Description		Emergency Response/Equipment
	Physical Hazards		On-Site Injuries/Illness
	Chemical/Biological Hazards		Reporting Procedures
	Heat/Cold Stress		Directions to Medical Facility
	Work/Support Zones		Drug and Alcohol Policies
	PPE		Medical Monitoring
	Safe Work Practices		Evacuation/Egress Procedures
	Air Monitoring		Communications
	Task Training		Confined Spaces
	OE Precautions		Other:
4. Remarks:			

TETRA TECH NUS, INC.

Name	Signature	Position

TETRA TECH NUS, INC.

EQUIPMENT MAINTENANCE/REPAIR

MAINTENANCE/REPAIR NO._____
NECESSARY ATTACHMENTS _____ PACKING SLIP, and/or _____ MRR, abd _____LOGS

TYPE OF EQUIPMENT	SERIAL NO.
MAKE:	MODEL:
P O NUMBER	DELIVERY ORDER NO.
STANDARD MAINTENANCE	DATE
DESCRIPTION OF PROBLEM (if any)	

MAINTENANCE/REPAIRS TO BE PERFORMED

IN-HOUSE REPAIRS	DATE
SENT OUT TO	COST ESTIMATE AIRBILL NO. P O NO. DATE RET'D
CORRECTIVE ACTION	

PARTS LIST

PART DESCRIPTION	QUANTITY	COST/EA

TOTAL LABOR (hours) PERFORMED BY	DATE
RETURNED TO WHICH JOB SITE/Stone Mountain, GA	

TETRA TECH NUS, INC.

EQUIPMENT UTILIZATION LOG

EQUIPMENT I.D._____

DESCRIPTION_____

DATE OUT	TIME OUT	COND. CODE & COMMENTS OUT	CHECKED OUT BY	DATE IN	TIME IN	CHECKED IN BY	COND. CODE & COMMENTS IN

TETRA TECH NUS, INC.

QUALITY CONTROL SURVEILLANCE REPORT		Report Number:	
Project Name:		Contract No:	
Client:		Project Manager:	
1 - Activity			
☐ Project Readiness UFP-SAP Review	☐ Pre-Operational Team Training Review	☐ Mobilization/Site Preparation	☐ Brush Cutting and Vegetation Clearance
☐ Pre-Survey ITS Review	☐ Daily Function Test	☐ UXO Detector-Aided Surface Sweeps/Quality Control Check	☐ UXO Detector-Aided Surface Sweep Field Data Collection &Transcription
☐ Geophysical Survey	☐ Geophysical Survey Field Data Collection and Transcription	☐ GPS Data	☐ Demobilization
☐ Other:	☐ Other:	☐ Other:	☐ Other:
2 - Phase			
☐ Preparatory	☐ Initial	☐ Follow up	
3 - References(1)			
4 – Observed Condition/Activities and Comments(1)			
5 – Results of Surveillance			
☐ Acceptable	☐ Unacceptable	Deficiency #: NCR #:	
Conducted By:	Signature:	Date:	
6 – Project Manager Review			
☐ Concur ☐ Non-Concur	Signature:	Date:	
7 - Distribution			
☐ PM ☐ FOL ☐ SUXOS ☐ UXO Manager ☐ Safety ☐ Other:			

(1) Add/reference continuation sheets as necessary.

TETRA TECH NUS, INC.

DAILY QUALITY CONTROL REPORT		
Contract Number:	Project:	
Report Number:	Location:	Date:

Phase	List Definable Features of Work, Locations, and List Personnel Present	
Preparatory		
Initial		Inspection Performed
Follow up		Inspection Performed

Rework Items Identified Today (Not Corrected by Close of Business)	Rework Items Corrected Today

Remarks

On behalf of the contractor, I certify that this report is complete and correct and the equipment and material used and work performed during this reporting period is in compliance with the contract drawings and specifications to the best of my knowledge except as noted in this report.	Project Quality Control Officer	Date

Client Quality Assurance

Quality Assurance Representative Remarks and/or Exceptions to the Report

Client QA Representative | Date

TETRA TECH NUS, INC.

FIELD ACTIVITY DAILY LOG

DATE	
NO.	
SHEET OF	

PROJECT NAME:	PROJECT NO:
FIELD ACTIVITY SUBJECT:	
DESCRIPTION OF DAILY ACTIVITIES AND EVENTS:	
VISITORS ON SITE:	CHANGES FROM PLANS AND SPECIFICATIONS, AND OTHER SPECIAL ORDERS AND IMPORTANT DECISIONS:
WEATHER CONDITIONS:	IMPORTANT TELEPHONE CALLS:
PERSONNEL ON SITE:	
SIGNATURE:	DATE:

TETRA TECH NUS, INC.

FIELD ACTIVITY DAILY LOG

DATE	
NO.	
SHEET	OF

PROJECT NAME:	PROJECT NO:
FIELD ACTIVITY SUBJECT:	
DESCRIPTION OF DAILY ACTIVITIES AND EVENTS (CONTINUED):	

TETRA TECH NUS, INC.

FIELD ACTIVITY WEEKLY LOG

DATE	
NO.	
SHEET	OF

PROJECT NAME:	PROJECT NO:
FIELD ACTIVITY SUBJECT:	
DESCRIPTION OF DAILY ACTIVITIES AND EVENTS:	
VISITORS ON SITE:	CHANGES FROM PLANS AND SPECIFICATIONS, AND OTHER SPECIAL ORDERS AND IMPORTANT DECISIONS:
WEATHER CONDITIONS:	IMPORTANT TELEPHONE CALLS:
PERSONNEL ON SITE:	
SIGNATURE:	DATE:

RECORD-OF-CHANGE FORM

PROJECT NAME:	**PROJECT NO.**	
TO:	**LOCATION:**	**DATE:**

RE:

Worksheet #/SOP # _____ Title: _____

Specific Sections: _____

1. DESCRIPTION (items involved(1):

2. REASON FOR CHANGE(1):

3. RECOMMENDED ACTION(1)

_____ Minor Change _____ Major Change (Impacts Cost, Schedule)

4. DISPOSITION: (Approval Required by Client Representative)

_____ Not Approved (give reason).

_____ Considered minor change – APPROVED per recommended disposition – Documents will not be formally revised. Field office to maintain as –built records.

_____ Considered major change – Client approval required via contract modification process

Prepared by (Signature)	**Date:**
TtNUS Project Manager (Signature)	**Date:**
Point of Contact / Client Representative (Signature)	**Date:**

(1) Attach continuation sheets, sketches, etc., as applicable.

STANDARD OPERATING PROCEDURE
SOP OPS2

GEOPHYSICAL SURVEY

1.0 SCOPE AND APPLICABILITY

This operating procedure is designed to provide a regular set of guidelines for conducting geophysical surveys for the Munitions Response (MR) Program. The general procedure is intended to apply to a wide variety of investigations.

2.0 SUMMARY OF METHOD

Various military operations (transport, training, practice and experimental) over time have resulted in the deposition of a wide assortment of munitions and explosives of concern (MEC), and a large effort is underway to search and remove such items from many of the active and inactive military sites across the country. MEC range from small objects (20 mm) to large objects (bombs), and their potential abundance on a site can vary considerably as well. Geophysics is a non-intrusive approach often used to locate buried objects that could be MECs. Numerous steps are involved in selecting a geophysical approach, and they are described below.

All unexploded ordnance (UXO) survey and avoidance activities and geophysical surveys will be carried out in accordance with all local, state, and federal regulations, and will include general guidance from applicable United States Army Corps of Engineers (USACE) requirements, including Engineer Pamphlet EP-75-1-2 dated 01 August 2004 (USACE, 2004b), Data Item Descriptions; MR-001 (USACE, 2003a), MR-005-05A (USACE, 2003c), MR-005-05 (USACE, 2003d), and MR-005-07 (USACE, 2003e). Additional guidance is provided in Ordnance and Explosives Digital Geophysical Mapping Guidance – Operational Procedures and Quality Control Manual (DGM QC Guidance) (USACE, 2003f).

3.0 PERSONNEL QUALIFICATIONS

Personnel responsible for designing or conducting geophysical processes should possess education and training in geophysics to insure proper procedures are followed. Sub-contractors should possess similar personnel requirements when implementing a geophysical plan. Personnel will meet the requirements of USACE Data Item Description OE – 025.02 (USACE, 2004a) described below.

Project Geophysicist - This individual will have a degree in geophysics, geology, geological engineering, or a closely related field, and will have a minimum of 5 years of directly related geophysical experience. This individual has overall responsibility for design, implementation, and management of all geophysical investigations required for the work effort, but may not necessarily be on-site full time. This individual will be the project geophysicist-of-record.

Site Geophysicist - This individual will have the same education requirements as the Project Geophysicist, except the 5 years minimum experience requirement is waived, if working under the general supervision of a Project Geophysicist. This individual is responsible for day-to-day operations of the site geophysical investigations. This individual may also be the Project Geophysicist if he/she meets the identified qualifications.

4.0 SURVEY DESIGN

Several considerations must be taken into account when designing a geophysical survey:

Site Preparation: Sites suspected to contain MEC must be inspected by a properly qualified UXO technician. The inspection will include, as a minimum, a visual inspection which may be assisted by a hand-held magnetic or all-metals locator. This is to ensure safety for setting monuments or survey stakes, and in collecting the survey data. All movable aboveground non-munitions metal debris should be removed from the site prior to commencement of the geophysical survey in order to obtain more complete subsurface information (not be interfered with by the aboveground metal that could mask subsurface metal).

Vegetation can also create limitations for survey coverage. Brush cutting and vegetation clearing may be necessary to acquire geophysical data.

Equipment Selection: An understanding of the nature of the suspect MEC must be established first in order to select the proper equipment for the survey site.

Magnetometer surveys are selected when the potential MEC targets are comprised of a substantial ferrous (iron) component, and the site is expected to have low levels of cultural ‘noise’ (ex. power lines, scrap mixed in with the soil, numerous aboveground metallic objects that cannot be removed from the survey area). Maximum prospecting depth is limited by the strength of the magnetic field for the potential MEC (controlled by the mass, diameter and orientation of the buried metallic object). Sensor height will

be determined by the Geophysicist based on the nature of site conditions and expected target sizes and depths.

Electromagnetic (EM) induction surveys are selected when the potential MEC targets are comprised of a significant component of any type of metal. Normally maximum prospecting depths are limited to about 12 to 18 feet below ground surface for the largest potential targets, but will range to very shallow depths for small metallic objects.

Certain geologic conditions may be prohibitive to the success of a geophysical survey, and in such cases a pilot test or Geophysical Prove Out (GPO) may be required to determine whether the survey equipment can detect the buried targets. Examples of such conditions include ultra-mafic soils or shallow bedrock, high electrically conductive soils (perhaps fill containing scrap metal) or salt water conditions which can interfere with the detection capabilities of the survey equipment. No such prohibitive conditions are expected to affect the geophysical approaches on this project, and a GPO is not considered to be necessary for this project. An Instrument Test Strip (ITS) will be used instead, to test the equipment and operator(s) in detecting a small variety of buried munitions or surrogates to verify that the method is functioning properly.

Survey Coverage: Expected target sizes, anticipated burial depths and the target metal mass must be evaluated by the Geophysicist in order for proper selection of survey line spacing given the selection of geophysical equipment in order to possess a high level of confidence that the project goals can be accomplished. Surveys conducted using 2.5 foot line spacing with an EM61 or G-858 magnetometer will provide 100% effective survey coverage for most MEC targets. Conversely, in cases where a reconnaissance survey is needed, meandering path or non-traditional survey geometries may be substituted to accomplish the project goals. In all cases, consideration must be given to past, current and future land uses to assure that the survey approach meets the client objectives.

Survey Location: Locating survey lines (data) can be accomplished in a few ways. The level of accuracy needed and the surrounding site features will help determine the acceptable location technique. Small survey areas may be located with a high level of accuracy using tape measures to create survey lines (grids). The grids may then be referenced directly to permanent and semi-permanent site features.

Larger survey areas or survey areas in remote areas may need a different location method to maintain a high level of accuracy. Professional surveying or integrating differential global positioning system (DGPS) measurements with the geophysical data can be used in large areas to maintain high location accuracy. Numerous global positioning systems (GPS) units are readily available to achieve sub-meter accuracy.

Specialized GPS units (Real Time Kinematic or RTK) should be employed when sub-foot accuracies are needed. GPS units do not normally operate effectively in wooded areas, and professional surveying or total stationing methods may be required for high level accuracy in those areas. Alternatively, wooded survey areas may be established by tape measure, followed by GPS (where a clear GPS signal can be received), total stationing or professional surveying of several survey grid points or corners.

Data Sampling: Data must be collected at intervals to satisfactorily sample the anticipated targets. Expected target sizes, anticipated burial depths and the target metal mass must be evaluated by the Geophysicist in order for proper selection of data sampling intervals. Data station intervals will normally be determined from the movement speed along the survey lines with respect to the data initiation interval (normally automatic or sometimes manual as a function of time). Measurements may be triggered by a survey wheel attached to the survey instrument when sufficient data density can be achieved. Calibration of the survey wheel may be needed depending on the instrument setup.

5.0 EQUIPMENT

Instrument Checks:

Equipment Standardization. Geophysical sensors and support equipment, navigation equipment, and operator performance will be checked and tested at specific intervals and must meet the appropriate acceptance criteria. Table 1 lists the tests and their required frequencies and acceptance criteria modified from USACE Engineering Pamphlet 75-1-2 (2004). These tests plus the initial out-of-box tests are detailed below.

Out-of-Box-Tests. The following out-of-box procedures will be conducted before the pre-seed geophysical survey of the test plot area begins:

- Inventory and inspect all equipment to confirm all components are present and in good condition.
- Assemble the equipment and power up.

Regular Tests.

1. **Equipment/Electronics Warm-Up.** This test minimizes sensor drift caused by thermal stabilization. Most instruments need a few minutes to warm up before data collection begins. All manufacturer instructions will be followed or, if none are given, data readings will be observed until they stabilize.

Acceptance Criterion: Equipment Specific (typically 5 minutes). This test will be conducted each time the unit is started.

2. **Equipment Null.** The EM61 equipment will be nulled before data collection at each site. The units will be nulled in areas determined to represent background levels (non-anomalous areas 'quiet areas').

3. **Record Sensor Positions.** The purpose is to document relative navigation and sensor offsets, detector separation, and detector heights above the ground surface. This information will ensure that the detector offset corrections and gradient calculations can be done correctly and that the surveys are repeatable. Acceptance Criterion: ±1 inch. This test will be conducted at the beginning of the 1st day and when an equipment configuration change is made.

4. **Personnel Test.** This test ensures that survey personnel have removed all potential interference (metal) sources from their bodies. Common interference sources are ballpoint pens, steel-toe boots, or large metallic belt buckles, which can produce data anomalies similar to OE targets. All personnel who will be coming near the sensor during survey operations will remove metallic items from themselves, and if not possible then readings will be monitored and recorded to judge the effect of the metallic items in order to meet the following acceptance criteria. Acceptance Criterion: EM 61 3 mV, magnetometer 3 nT. This test will be conducted at the beginning of each day if the operator is wearing metallic items that could interfere with equipment operation.

5. **Static Background and Static Spike (or Standard Response) Test.** These tests quantify instrument background readings and electronic drift, locate potential interference spikes in the time domain, and determine impulse response and repeatability of the instrument to a standard test item (typically a 2-inch-diameter steel trailer hitch ball). Improper instrument function, the essence of local sources of ambient noise (such as EM transmissions from high-voltage electric lines), and faulty equipment are all potential causes of inconsistent, non-repeatable readings. A minimum of 3 minutes static background test after instrument warm-up, followed by a 1-minute standard response test, in turn followed by an additional 1 minute static background test, will be performed. The field geophysicist must review the readings to confirm they are stable before the geophysical survey continues. Guidance Criteria: Static Background test EM 61 ± 3 mV, magnetometer ± 3 nT; Static Response Test ±20% of standard item response after background correction. This test will be conducted at the beginning of each day.

6. **Base-Line Test.** This test is conducted in an area that has low background noise and no sources of anomalous response. The test line will be well marked to facilitate data collection over exactly the

same line each time the test is performed. The test may need to be conducted at the beginning, middle and end of each day to check for instrument drift (baseline shift in data values) or in the situation where a magnetic base station is not used during a magnetometer survey in order to make any necessary data value adjustments.

7. **Pull-Away Test.** This test demonstrates the effects of the navigational equipment. All equipment will be powered up and operating as it would be during the survey. Acceptance Criterion: document the effects of the navigational equipment on the geophysical readings. Effects should be small. Test will be performed before the geophysical survey begins, and if the equipment configuration changes during the survey.

8. **GPS Positioning.** The GPS positioning system will be tested by surveying two survey control points. The GPS coordinates are compared with the documented coordinates for the control points. Acceptance Criterion: sub-meter or better (based on project requirements). Test should be performed as a minimum at the beginning of the project and if an equipment change is made. GPS survey instruments should also be closely monitored during field acquisition by using dilution of precision (DOP) criteria, or as a minimum # of satellite signals received criteria. DOP should normally be less than 3 to obtain high quality results, and at least 6 satellites should also indicate high quality results.

   a) Latency is an issue when a separate GPS controller (from the geophysical controller) is used to acquire the GPS data.

   b) If separate controllers are used, care will be taken to synchronize the clocks in both the GPS and geophysical units, and a test must be set up to measure the latency inherent in using two different accuracy clocks.

   c) The test will consist of positioning oneself overtop of a linear metallic object (ex. pipe) at several points and recording data with the survey equipment, and again using only the GPS equipment to compare the results and determine the necessary adjustment.

9. **Azimuth Test.** The purpose of this test is to optimize the sensor orientation to avoid optically pumped magnetometer sensor “dead zones”, and obtain a strong signal strength.

6.0 QUALITY ASSURANCE / QUALITY CONTROL

All documentation will be available to client personnel. Operational and test procedures will conform to the manufacturer's standard instructions. Quality control (QC) of the instruments' data will be achieved daily by field testing, checking the sensor and navigation system against a known target to ensure that they are operating properly. All geophysical instruments and equipment used to gather and generate field data will be calibrated with sufficient frequency and in such a manner that accuracy and reproducibility of the results are consistent with the manufacturer's specifications. Calibration, repair, or replacement records will be filed and maintained by the field geophysicist and may be subject to audit by the quality assurance (QA) manager. Potential data problems include source data errors, data entry errors, data editing errors, and user errors. All data will be reviewed to identify and correct any of these errors should they occur.

7.0 FIELD REPORTING AND RECORDS MANAGEMENT

Field data sheets/notes will be maintained for all geophysical activities. At the end of this SOP is a copy of the field forms for the project including:

- Equipment Maintenance Form (to document equipment repair or replacement).
- QC Surveillance Report Form (to document fieldwork QC assessments).
- Daily QC Report (to document daily QC performed).
- Daily Checklists (ITS Location Design, Out of Box).
- Initial Instrument Tests.
- Daily Instrument Checks.
- EM61 Operating Procedures and Field Editing.

Project documentation will be collected and managed on-site during the life of all field activities. Geophysical data will be recorded digitally and downloaded to a field computer for review in the field. In addition to the copy of data saved on the field computers hard drive, a copy of the data will be saved on a compact disk (CD) for backup before the data are erased from the equipment. The project geophysicist will review the downloaded data to verify that the download system is functioning properly. This review will also check the field data for QC review. The review will verify that the data are valid and useable for the intended purpose.

8.0 INSTRUMENT TEST STRIP

An Instrument Test Strip (ITS) will be performed to evaluate geophysical surveying techniques that apply to the MEC sites and personnel that will be conducting the surveys. ITSs are important in testing the survey technique to determine whether it is capable of detecting the target items.

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Instrument Test Strip

The specific objectives for the ITS will be:

- Verify that the proposed geophysical method is functioning properly.
- Provide a safe area with a known set of isolated objects (for example, inert UXO or UXO surrogates). The sensor signatures from these items will be used to evaluate the equipment response in the site geologic setting and to optimize equipment, procedures, and data analysis.
- Assess the operators' performance and update related procedures to assist in the development of operator measurement techniques.
- Evaluate average speed, minimum along-track sampling, and line separation distance in detecting target items.
- Evaluate all data processing, including distance corrections, map production, and target selection, to produce final datasets.
- Evaluate detection depth capabilities.
- Identify horizontal positions of detected seed items to be within project specified limits.

Test Strip Design.

a. Test Strip Size and Location. The test strip location should be in an area where cultural interferences are at a minimum, and separation of seed items should be sufficiently large to enable the anomalies from the seed items to be fully defined. This separation is project (seed size) dependent, and should be determined by the Project Geophysicist. Selection of the test-strip area will be based upon the technical and site-specific considerations developed and finalized during the project planning process

and/or project team meetings. It may be advantageous to plan the test strip location outside of areas where digging is restricted to UXO technicians and/or oversight by UXO technicians. Once a location(s) is chosen, proper notifications and submissions must be made through the Base Remedial Project Manager (RPM) to obtain all necessary dig permits and utility clearances.

b. Seed Items. The planned seeding methodology for known items will be described. Once placed, all seeded items and end markers will be surveyed and photographed. The planned ITS target layout plan will be updated to reflect the "as built" configuration. The seeded items will be tagged with a non-biodegradable label identifying the items as inert and providing a contract reference, a point of contact address, phone number, and a target identifier.

   A tabulated list, available in digital format, containing the seed item descriptions, ID numbers, locations, orientation (or survey information on the nose, tail, and center point of the item) will be generated. Inert MEC items should be used whenever possible.

c. Site Preparation. Describe any preparation that may be necessary to allow accessibility with geophysical instruments. This may include vegetation removal and/or surface clearance. After this step, the test plot should duplicate, as closely as possible, the conditions under which the geophysical surveys will be conducted.

d. Positional Surveying. Describe the positional methods to be employed for locating the geophysical data. The location of the test plot corners and seed items will be surveyed to a horizontal accuracy established during the project planning process and/or project team meetings. In addition, surface elevation will be measured after seed item burial, to accurately determine depth below ground surface.

e. Pre-Seeding (Background) Geophysical Mapping. Describe background geophysical mapping. After a site has been selected and the surface prepared, pre-seeding geophysical surveys will be performed with each detector type in order to determine and document base-line geophysical conditions at the site.

f. Quality Control. Describe Quality Control measures to be implemented.

g. Anomaly Avoidance. Anomaly avoidance will be performed by all site workers for all anomalies located, visually or with metal detectors, during preparation of the test plot site. A statement that the contractor will use anomaly avoidance techniques will be included. This is to ensure the location of

each excavation and corner marker/stake is clear of metallic anomalies before placing seed items or site corner markers, and includes utilizing the background geophysical data.

h. Data Collection Variables. It is important to collect and analyze test plot data using the same equipment and procedures that are planned for field use. Key personnel from the ITS will perform the production survey to minimize the learning curve and provide project continuity. Some data collection elements are subject to modification, and evaluation and multiple geophysical surveys using each proposed geophysical instrument may be performed. These elements include: instrument height, instrument orientation and direction of travel, instrument channel selections, measurement interval along survey line, lane width, etc.

i. Data Analysis and Interpretation. All data collected across the test strip will be processed and analyzed. Comparison of selected target anomalies to seed item locations will be evaluated.

j. Reacquisition. The contractor will perform anomaly reacquisition and verification when necessary to meet project goals, and record these measurements. This should be done to the same extent and with the same equipment as planned for the production geophysical investigation.

After the ITS field work has been completed, the contractor will document the ITS in a brief letter report including the following:

a. As-built drawing of the ITS plot;
b. Color maps or profiles of the geophysical data;
c. Summary of the ITS results;
d. Geophysical equipment, techniques, and methodologies; and
e. Sufficient supporting information to justify the project team's recommendations.

<u>The Contractor may not proceed with production geophysical mapping until the Tetra Tech Project Manager or their designee approves the ITS results.</u>

Table 1: Geophysical Equipment QC Tests
Munitions and Explosives of Concern Sites
Military Munitions Response Program

Test No.	Test Description	Acceptance Criteria	Power On	Beginning of Day	Beginning, Middle and End of Day	1st Day on Site
1	Equipment Warm-up	Equipment specific (typically 5 minutes)	X			
2	Equipment Null	Conduct in non-anomalous areas				X
3	Record Sensor Positions	± 1 inch (2.54 cm)				X
4	Personnel Test	EM61 2 mV (channel 3 on MkII), magnetometer 2 nT		X		
5	Static Background and Static Spike	Guidance Criteria: Background: EM61 ± 3 mV, magnetometer ± 3 nT. Spike: ± 20% of standard item response, after background correction		X		
6	Base-Line Test	Check for instrument drift /diurnal change (to correct data readings if needed)			X (EM31 or MAG)	
7	Pull Away Test	Navigation equipment should have minimal effect on readings				X
8	GPS Positioning	Positional accuracy: sub-meter / foot				X
9	Azimuth Test	Strong signal strength, no data dropouts				X
10	Equipment Function Test	Anomalous response from all targets within project specified acceptance limits		X		

Notes: cm – Centimeter, mV – Millivolt, nT – nanoTesla

TETRA TECH NUS, INC.

EQUIPMENT MAINTENANCE/REPAIR

MAINTENANCE/REPAIR NO._____
NECESSARY ATTACHMENTS _____ PACKING SLIP, and/or _____ MRR, abd _____LOGS

TYPE OF EQUIPMENT	SERIAL NO.
MAKE:	MODEL:
P O NUMBER	DELIVERY ORDER NO.
STANDARD MAINTENANCE	DATE
DESCRIPTION OF PROBLEM (if any)	

MAINTENANCE/REPAIRS TO BE PERFORMED

IN-HOUSE REPAIRS	DATE
SENT OUT TO	COST ESTIMATE AIRBILL NO. P O NO. DATE RET'D
CORRECTIVE ACTION	

PARTS LIST

PART DESCRIPTION	QUANTITY	COST/EA

TOTAL LABOR (hours) PERFORMED BY	DATE
RETURNED TO WHICH JOB SITE/Stone Mountain, GA	

TETRA TECH NUS, INC.

QUALITY CONTROL SURVEILLANCE REPORT		Report Number:	
Project Name:		Contract No:	
Client:		Project Manager:	
1 - Activity			
☐ Project Readiness UFP-SAP Review	☐ Pre-Operational Team Training Review	☐ Mobilization/Site Preparation	☐ Brush Cutting and Vegetation Clearance
☐ Pre-Survey ITS Review	☐ Daily Function Test	☐ UXO Detector-Aided Surface Sweeps/Quality Control Check	☐ UXO Detector-Aided Surface Sweep Field Data Collection &Transcription
☐ Geophysical Survey	☐ Geophysical Survey Field Data Collection and Transcription	☐ GPS Data	☐ Demobilization
☐ Other:	☐ Other:	☐ Other:	☐ Other:
2 - Phase			
☐ Preparatory	☐ Initial	☐ Follow up	
3 - References(1)			
4 – Observed Condition/Activities and Comments(1)			
5 – Results of Surveillance			
☐ Acceptable	☐ Unacceptable	Deficiency #: NCR #:	
Conducted By:	Signature:	Date:	
6 – Project Manager Review			
☐ Concur ☐ Non-Concur	Signature:	Date:	
7 - Distribution			
☐ PM ☐ FOL ☐ SUXOS ☐ UXO Manager ☐ Safety ☐ Other:			

(1) Add/reference continuation sheets as necessary.

TETRA TECH NUS, INC.

DAILY QUALITY CONTROL REPORT		
Contract Number:	Project:	
Report Number:	Location:	Date:

Phase	List Definable Features of Work, Locations, and List Personnel Present	
Preparatory		
Initial		Inspection Performed
Follow up		Inspection Performed

Rework Items Identified Today (Not Corrected by Close of Business)	Rework Items Corrected Today

Remarks

On behalf of the contractor, I certify that this report is complete and correct and the equipment and material used and work performed during this reporting period is in compliance with the contract drawings and specifications to the best of my knowledge except as noted in this report.	Project Quality Control Officer	Date

Client Quality Assurance

Quality Assurance Representative Remarks and/or Exceptions to the Report

Client QA Representative | Date

Checklist for ITS Location Design

Project Name: _____

Project Location: _____

CEHNC POC: _____

Reviewer's Name and Title: _____

Date of Review: _____

Objectives	**Y**	**N**	**NA**
a. Have survey objectives been determined, clarified, and documented?	☐	☐	☐
b. Has EM-1110-1-4009 been consulted to ensure that all applicable objectives mentioned therein will be met?	☐	☐	☐
c. Will the ITS be available during the project for the evaluation of suspected instrument malfunctions?	☐	☐	☐
d. Will the ITS be available during the project for the evaluation of new equipment and operators?	☐	☐	☐
e. Is the contractor prepared to demonstrate target reacquisition techniques in the ITS area?	☐	☐	☐
Site Selection			
a. Has the proposed ITS site been evaluated for the following criteria:			
• Easy access for project personnel?	☐	☐	☐
• Restricted access for non-project personnel?	☐	☐	☐
b. Is the ITS located in close proximity to the survey area?	☐	☐	☐
c. Does the ITS have geophysical noise conditions similar to those expected in the survey area?	☐	☐	☐
d. Does the ITS have terrain and vegetation conditions similar to those of the survey area?	☐	☐	☐
e. Has a backup ITS site been identified?	☐	☐	☐
Site Preparation			
a. Has surface clearance been performed?	☐	☐	☐
b. Geophysical map entire area prior to burial?	☐	☐	☐

1

Checklist for ITS Location Design

Seeding ITS Grid	**Y**	**N**	**NA**
a. Have all available sources been consulted to determine appropriate seed items and orientations?	☐	☐	☐
b. Have DQOs been established and documented?	☐	☐	☐
c. Have appropriate burial depths been determined for the seed items?	☐	☐	☐
d. Is the contractor prepared to demonstrate target reacquisition techniques in the ITS area?	☐	☐	☐
e. Has a list been made to document the range of burial depths for different MEC items?	☐	☐	☐
f. Have the following steps been taken to ensure accurate locations for the seeded items:			
• Specify location requirements in x,y,z?	☐	☐	☐
• Measure depth to top and center of mass of each object?	☐	☐	☐
• Thorough notes taken on each item's burial?	☐	☐	☐
• GPS or a land surveyor employed to record the position of each item?	☐	☐	☐

Checklist for Out of Box Equipment Tests

Project Name: _____

Project Location: _____

CEHNC POC: _____

Equipment Source: _____

Equipment Serial Numbers: _____

Reviewer's Name and Title: _____

Date of Review: _____

	Y	N	NA
a. Has the equipment been inventoried and inspected for damage or wear?	☐	☐	☐
b. Are spare parts (cables) included with system?	☐	☐	☐
c. Has the cable shake test been performed? (Replace any faulty components if necessary)	☐	☐	☐

1

Checklist for Initial Instrument Tests

Project Name: _____

Project Location: _____

CEHNC POC: _____

Equipment Source: _____

Equipment Serial Numbers: _____

Reviewer's Name and Title: _____

Date of Review: _____

	Y	N	NA
a. Has the sensor travel test been performed and are the results acceptable to meet survey objectives?	☐	☐	☐
b. Has the GPS unit been checked for accuracy requirements against two known locations?	☐	☐	☐
c. Has the optimum sensor height for each instrument been determined?	☐	☐	☐
d. Have the pull-away and interferences tests been performed and successfully demonstrated no influence for navigational or towing equipment?	☐	☐	☐

2

Checklist for Daily Instrument Checks

Project Name: _____

Project Location: _____

CEHNC POC: _____

Equipment Source: _____

Equipment Serial Numbers: _____

Reviewer's Name and Title: _____

Date of Review: _____

	Y	N	NA
a. Has the operator been checked for presence of metal?	☐	☐	☐
b. Has the instrument been warmed-up?	☐	☐	☐
c. Has the sensor position been measured and recorded?	☐	☐	☐
d. Has instrument (EM only) been nulled?	☐	☐	☐
e. Has a static background test been performed and demonstrated <20% deviation in response over at least 3 minutes: • Start of day?	☐	☐	☐
f. Has the operator been thoroughly examined with the geophysical instrument for any sources of response that may not be readily apparent?	☐	☐	☐
g. Has the Equipment Function Test been performed with detection of all of the test targets within specified limits?	☐	☐	☐
h. Has the GPS positioning been compared to two known locations to ensure project accuracy limits are being met?	☐	☐	☐

Checklist for EM-61 Operating Procedures

Project Name: _____
Project Location: _____
CEHNC POC: _____
Reviewer's Name and Title: _____
Date of Review: _____

	Y	N	NA
a. Has a careful inspection been made to ensure that all metal has been removed from the operator?	☐	☐	☐
b. Has the instrument been warmed-up for 5 minutes?	☐	☐	☐
• Was a static test performed during warm-up to document ambient noise at the site?	☐	☐	☐
c. Were battery levels checked and recorded?	☐	☐	☐
d. Has an appropriate data acquisition rate been selected?	☐	☐	☐
e. Have the EM61 wheels been evaluated for the presence of metal and replaced, if necessary?	☐	☐	☐
f. Have all loose cables been secured?	☐	☐	☐
g. Has the established nulling station been occupied:			
• Power On	☐	☐	☐
h. Were the data monitored during data collection for anything unusual or unexpected?	☐	☐	☐

STANDARD OPERATING PROCEDURE
SOP-OPS3

GEOPHYSICAL DATA PROCESSING AND ANALYSIS

1.0 SCOPE AND APPLICABILITY

This operating procedure is designed to provide a regular set of criteria to be taken into account during data processing and analysis for geophysical surveys performed as part of Munitions Response Programs (MRPs). The general procedure is intended to apply to a wide variety of investigations (targets).

2.0 BACKGROUND

The way in which data processing and analysis is performed is dependent on the type of geophysical method employed. We focus here on the two most common general methods used on MRP sites: magnetics or magnetometry (MAG) and electromagnetic induction (EMI). Initially data are recorded electronically during fieldwork and subsequently downloaded to computer. From there, specific equipment-related (proprietary) software is used to process the data for navigation, correction factors, filtering and ultimately for exporting data files that can be read by a data contouring package. The government has partnered with Geosoft, Inc. in order to develop a data contouring package specifically optimized for MRP geophysical data (Oasis montaj w/UX Detect module). Contour maps or data profiles and dig sheets (anomaly locations) are normally produced as end products of the geophysical survey.

3.0 PERSONNEL QUALIFICATIONS

Personnel responsible for processing should possess education and training in geophysics to insure proper procedures are followed. Personnel will meet the requirements of USACE Data Item Description OE – 025.01 (USACE 2002) for a Project Geophysicist or for a Site Geophysicist that is directly under the supervision of the Project Geophysicist.

4.0 PROCESSING AND ANALYZING

Standard corrections will be applied to the data using equipment-specific (proprietary) software and by using Geosoft's Oasis montaj software, and the data processing checklist attached to this SOP should be

completed by the data processor. Instrument settings and survey line spacing should be taken into account during data processing to properly represent the data. Diurnal corrections, corrections to navigation (geometry) and rotation or translation of coordinate systems, removal of data spikes (judged to be artificial) and dropouts, corrections for fiducial marks, instrument drift and leveling, heading error corrections, and latency corrections may be items to address during processing. Filtering and enhancements may also be needed depending on the nature or quality of the data.

The data analysis performed by the Project Geophysicist or under his/her direct supervision will focus on identifying anomaly responses that could represent MEC. A detailed map and anomaly investigation report will be produced [ex. dig sheet, Data Item Description MR-005-05 (USACE, 2003c)] depicting the northing and easting of all anomalies that meet the identification criteria of potential ordnance items for the site, and actual data stations locations will also be provided. Each anomaly will be assigned a unique reference number for potential field reacquisition.

Checklist for Field Editing

Project Name: _____

Project Location: _____

CEHNC POC: _____

Reviewer's Name and Title: _____

Date of Review: _____

	Y	N	NA
a. Have the following items been evaluated for correctness and edited if necessary:			
• Line numbers?	☐	☐	☐
• Start and end points?	☐	☐	☐
• Line direction?	☐	☐	☐
• Fiducial locations?	☐	☐	☐
b. Have the data been examined in profile and evaluated for geophysical noise?	☐	☐	☐
c. Have the data been examined for the presence of drop-outs and spikes?	☐	☐	☐
d. Have the edited data been converted to the appropriate .xyz format?	☐	☐	☐
e. If using magnetics, have the following steps been taken:			
• Examined base station data for any problems?	☐	☐	☐
• Performed diurnal correction to field magnetometer data?	☐	☐	☐
f. Have the positional data been evaluated for accuracy and completeness?	☐	☐	☐

Checklist for Data Processing

FILENAMES:

Site:	_____	Raw: Edited:	_____
Location:	_____	Processed:	_____
Contractor:	_____	Contour Map:	_____
Sector: Grid:	_____	Target List:	_____
Processor(s):	_____	Target Map:	_____

Preprocessing	**Y**	**N**	**NA**
a. Coordinate Conversion Projected Coordinate System _____	☐	☐	☐
• Removal of Drift	☐	☐	☐
• Latency and Offset	☐	☐	☐

Preprocessing			
a. Initial Gridding			
• Calculation of 3D Analytic Signal	☐	☐	☐
• Digital Filtering and Enhancement	☐	☐	☐
Filter 1: _____	☐	☐	☐
Filter 2: _____	☐	☐	☐
Filter 3: _____	☐	☐	☐
Filter 4: _____	☐	☐	☐
• Threshold Selection Threshold value: _____	☐	☐	☐
• Anomaly Selection Number of targets: _____	☐	☐	☐

STANDARD OPERATING PROCEDURE
SOP OPS4

MEC MANAGEMENT AND ACCOUNTABILITY

A. SCOPE AND APPLICABILITY

This document is designed to set a standard operating procedure (SOP) for the management and accountability of Munitions and Explosives of Concern (MEC) encountered during activities performed under the Munitions Response Program (MRP).

B. BACKGROUND

MEC activities will be performed in accordance with all local, State, and federal regulations and will include all applicable DoD requirements. Generally, MEC will be encountered during the performance of Unexploded Ordnance (UXO) detector-aided surface sweep operations, subsurface geophysics investigations and UXO Escort operations. UXO detector-aided surface sweep operations may be used as a stand-alone method for site survey and assessment or in preparation for geophysical survey and other operations. UXO escort operations may be required during site visits (initial site assessments, planning, and stakeholders meetings), geophysical operations, construction support during subsurface activities, and MC sampling operations.

C. PERSONNEL QUALIFICATIONS

UXO personnel shall be graduates of a military Explosive Ordnance Disposal (EOD) School of the United States, Canada, Great Britain, Germany, or Australia or a graduate of a formal training course of instruction or EOD assistant course as stated in DDESB TP-18.

D. MEC MANAGEMENT AND ACCOUNTABILITY OPERATIONS

<u>UXO Detector-Aided Surface Sweep</u>

If suspect MEC is encountered, its location will be recorded and/or marked using a GPS, tape measure, or other grid coordinate location system. The UXO Team will attempt to determine its condition without moving or disturbing the item prior to proceeding with the surface sweep. Each item will be marked with engineer flagging and given a unique ID number. ID numbers will start with a letter(s) corresponding to

the site or grid in which the item is located. This will be followed by the transect number of the site or grid specific to the location of the item. Lastly, a number will be assigned to the individual items within the transect. These numbers will start at 01 and run consecutively. For example:

*The site name is **O**pen **B**urn **P**it. The first transect within the Open Burn Pit is **A1**. The first item encountered in transect A1 is item **01**. The ID number assigned to the item is **OBP-A1-01.***

All available information about the item will be recorded in the logbook/MEC Tracking Log as presented in Attachment 1 to this SOP, including suspect MEC location, identification, and ID number. A digital photograph will be taken of each item. The UXO Team will not move or otherwise disturb the item in an attempt to collect information. After all available information is recorded; the UXO Team will resume the detector-aided surface sweep.

Every effort will be made to identify each suspect MEC item located. Under no circumstances will any suspect MEC be moved in an attempt to make a definitive identification. The MEC item will be visually examined for markings and other external features such as shape, size, and external fittings. Prior to any documentation being developed on an MEC item, all fusing will be definitively identified if it is possible to safely do so visually without disturbing the ordnance item. This identification will consist of fuse type by function and condition (armed or unarmed) and the physical state/condition of the fuse, i.e., burned, broken, parts exposed/sheared, etc.

Only UXO-qualified personnel will perform MEC identification procedures. As an exception, a UXO Technician I may assist in the performance of MEC identification procedures when under the supervision of a UXO Technician III or higher. All personnel engaged in field operations will be thoroughly trained and capable of recognizing the specific hazards of the procedures being performed. To ensure that these procedures are performed to standards, all field personnel will be under the direct supervision of a UXO Technician III or higher. All suspect MEC items will be recorded following the requirements of this SOP, the site-specific Work Plan/QAPP, the project site-specific HASP, applicable ordnance operations procedural safety guidelines, and industry-accepted safe work practices and procedures.

Detector-Aided Surface Sweep for Geophysical Survey

The UXO Technician will conduct a detector-aided surface sweep of the grid or transect to be surveyed and record the location of each MEC item discovered, if any. Each item will be marked and recorded as described above. UXO avoidance will be practiced during the geophysical survey.

Explosive Safety Submission (ESS)

When allowed by the conditions of the Explosive Safety Submission (ESS) determination, any non-munitions debris may be moved to facilitate a more effective surface sweep and/or geophysical survey. Non-munitions debris may be collected and stockpiled in a designated area within the boundaries of the site. The facility must agree to take possession of this non-munitions debris and arrange the proper disposition of the material before any items may be moved or disturbed.

UXO Escort Operations

One UXO Technician, qualified as a UXO Technician II or higher, will be required to support each field team engaged in operations in areas that might contain MEC. If any MEC is encountered, the item will be avoided during this phase of the project.

The UXO Technician will not attempt to identify the type or condition of the ordnance during escort operations. Any area with visible ordnance or MEC will be clearly marked, and the area will be avoided. The location of visible ordnance or MEC will be recorded and noted in the field logs. If more senior level personnel are present on site, MEC findings will be reported to the UXO Team Leader. No ordnance, munitions, explosives, or ordnance-related materials will be moved, removed, or disposed of during UXO Escort duties.

Quality Control

The UXOQC will review the definable features of work prior to the start of work each day. A new definable feature of work will receive a preparatory phase QC inspection prior to the start of work. This insepction is recorded on the attached Quality Control Surveillance Report. Work started on a new definable feature of work will receive an initial phase QC inspection. During MEC management and accountability the UXOQC, or Senior UXO Technician if there is no UXOQC, will recheck 25-percent of the first four units of work (grids or transects). If quality requirements are not met on any unit, that unit will be rejected and the UXO Team will rework the entire unit. The initial phase QC inspection will be documented on the attached Quality Control Surveillance Report. Once quality requirements are met for four units in a row, the UXOQC, or Senior UXO Technician if there is no UXOQC, may reduce the level of rechecks to 10-percent of each unit (grids or transects). If at any time a unit fails the quality control check, the complete unit will be reworked and the rechecks will be increased to 25-percent until four units in a row pass the recheck. These follow up phase QC inspections will be recorded on the attached Quality Control Surveillance Report. All work will be conducted in accordance with the MEC SAP and the SOPs attached to that MEC SAP. All requested changes to the approved MEC SAP will be documented

on the attached Record-of-Change Form and submitted to the PM and UXO Manger for action/approval. The UXOQC will prepare the attached Daily Quality Control Report for each day worked summarizing the definable features or work inspected, the phase of work, the locations, and personnel at the work site.

E. NOTIFICATIONS IF MEC IS ENCOUNTERED

Any MEC item discovered during a detector-aided surface sweep, geophysical survey, or UXO escort operation will be left in place and will not be moved. Should MEC be encountered, the following scenarios should be addressed as follows:

(1) If a complete MEC item or ordnance related material is encountered that is believed to pose a hazard, is unexpectedly encountered at a given site, is encountered outside of the current established site boundaries, or is unknown, the UXO Team Leader, with support by UXO Technicians on site as necessary, will document the following information, as provided on Attachment 1, for notification purposes:

- Site Name
- Date/Time Encountered
- Name and UXO category of Person providing Notification
- Location of Item (provide coordinates)
- Type of Item (provide digital photograph)
- Apparent Fuze Condition (armed or unarmed)
- Physical Condition (burned, broken, parts exposed/sheared, etc)
- Physical Appearance (buried, staged, etc.)
- Activity in Progress

The UXO Team Leader will attempt to identify the type and/or condition of the ordnance and its location, as described above, and will immediately report this information to the client point of contact at the facility and the Tetra Tech UXO Manager. Prior to any documentation being performed on a suspect MEC item, all fuzing will be definitively identified only if it is possible to safely do so visually without disturbing the item. If directed by the point of contact at the facility, UXO personnel may take emergency non-invasive action such as securing the area until the appropriate exclusion and safety zones have been determined.

The Navy point of contact at the facility will be responsible for notifying appropriate EOD personnel or for designating this notification task to the Tetra Tech UXO Team Leader. The notification to EOD

personnel should be immediate if a live MEC item is encountered which could be a hazard to personnel, or if the item is unknown so that arrangements may be made through the facility for proper disposition of the item(s). If the facility initiates an emergency response or disposal action, follow-up documentation should be obtained to detail the date and method of disposition. This information is also needed to ascertain the actual type and condition of the item (live or inert filled) to aid in future classification of the site.

(2) If the MEC item cannot be identified by type as a conventional munition, and/or if in the unlikely event that the MEC is suspected to be potential Chemical Warfare Material (CWM), personnel will withdraw upwind from the area, assemble at a pre-designated rally point, secure the site, and immediately request assistance from the point of contact at the facility and notify the Tetra Tech UXO Manager. If so directed, UXO personnel will take emergency non-invasive actions such as covering the item with plastic sheeting and securing the area until the appropriate exclusion and safety zones have been determined.

(3) If Hazardous, Toxic, or Radiological Waste (HTRW) is encountered on-site, the work site will be evacuated until the Tetra Tech Project Health and Safety Officer, with concurrence of the client point of contact at the facility, identifies and implements appropriate protective measures.

For any of the scenarios, upon receiving notification from the Tetra Tech UXO Team Leader, the Tetra Tech UXO Manager will then immediately inform the Tetra Tech Project Manager, who will then immediately inform the client Project Manager. Tetra Tech Program Management personnel will then be notified. The client Project Manager will then make all other necessary notifications within the client's organization.

The following table lists contacts information.

Position	Name	Organization	Direct Dial Phone	Cell Phone
Project Manager	Ralph Basinski	Tetra Tech	412.921.8308	412.251.9736
UXO Manager	Ralph Brooks	Tetra Tech	770.413.0965 x231	404.661.4916
Indian Head POC	Jeffrey Bossart	NSF Indian Head	301.744.4705	
Navy Remedial Project Manager	Joe Rail	NAVFAC Washington	202.685.3105	

ATTACHMENT 1

MEC TRACKING LOG

NSF INDIAN HEAD – STUMP NECK ANNEX, MD

SITE:_____

ID #	ITEM IDENTIFICATION	UXO TECH NAME	ITEM COORDINATES	DATE/TIME FOUND	DIGITAL PHOTGRAPH NUMBER	ARMED / UNARMED	PHYSICAL CONDITION / APPEARANCE	DATE DESTROYED

TETRA TECH NUS, INC.

QUALITY CONTROL SURVEILLANCE REPORT		Report Number:	
Project Name:		Contract No:	
Client:		Project Manager:	
1 - Activity			
☐ Project Readiness UFP-SAP Review	☐ Pre-Operational Team Training Review	☐ Mobilization/Site Preparation	☐ Brush Cutting and Vegetation Clearance
☐ Pre-Survey ITS Review	☐ Daily Function Test	☐ UXO Detector-Aided Surface Sweeps/Quality Control Check	☐ UXO Detector-Aided Surface Sweep Field Data Collection &Transcription
☐ Geophysical Survey	☐ Geophysical Survey Field Data Collection and Transcription	☐ GPS Data	☐ Demobilization
☐ Other:	☐ Other:	☐ Other:	☐ Other:
2 - Phase			
☐ Preparatory	☐ Initial	☐ Follow up	
3 - References(1)			
4 – Observed Condition/Activities and Comments(1)			
5 – Results of Surveillance			
☐ Acceptable	☐ Unacceptable	Deficiency #: NCR #:	
Conducted By:	Signature:	Date:	
6 – Project Manager Review			
☐ Concur ☐ Non-Concur	Signature:	Date:	
7 - Distribution			
☐ PM ☐ FOL ☐ SUXOS ☐ UXO Manager ☐ Safety ☐ Other:			

(1) Add/reference continuation sheets as necessary.

TETRA TECH NUS, INC.

DAILY QUALITY CONTROL REPORT		
Contract Number:	Project:	
Report Number:	Location:	Date:

Phase	List Definable Features of Work, Locations, and List Personnel Present	
Preparatory		
Initial		Inspection Performed
Follow up		Inspection Performed

Rework Items Identified Today (Not Corrected by Close of Business)	Rework Items Corrected Today

Remarks

On behalf of the contractor, I certify that this report is complete and correct and the equipment and material used and work performed during this reporting period is in compliance with the contract drawings and specifications to the best of my knowledge except as noted in this report.	Project Quality Control Officer	Date

Client Quality Assurance

Quality Assurance Representative Remarks and/or Exceptions to the Report

Client QA Representative | Date

RECORD-OF-CHANGE FORM

PROJECT NAME:	**PROJECT NO.**	
TO:	**LOCATION:**	**DATE:**
RE: Worksheet #/SOP # _____ Title: _____ Specific Sections: _____		
1. DESCRIPTION (items involved(1):		
2. REASON FOR CHANGE(1):		
3. RECOMMENDED ACTION(1) _____ Minor Change _____ Major Change (Impacts Cost, Schedule)		
4. DISPOSITION: (Approval Required by Client Representative) _____ Not Approved (give reason). _____ Considered minor change – APPROVED per recommended disposition – Documents will not be formally revised. Field office to maintain as –built records. _____ Considered major change – Client approval required via contract modification process		
Prepared by (Signature)	**Date:**	
TtNUS Project Manager (Signature)	**Date:**	
Point of Contact / Client Representative (Signature)	**Date:**	

(1) Attach continuation sheets, sketches, etc., as applicable.

STANDARD OPERATING PROCEDURE
SOP OPS5

GLOBAL POSITIONING SYSTEM

1.0 PURPOSE

The purpose of this Standard Operating Procedure (SOP) is to provide the Field Technicians with basic instructions for operating a handheld Global Positioning System (GPS) unit allowing them to set GPS parameters in the receiver, record GPS positions on the field device, and update existing Geographic Information System (GIS) data. This SOP is specific to GIS quality data collection for Trimble-specific hardware and software.

If possible, the Trimble GeoXM or GeoXH Operators Manual should be downloaded onto the operator's personal computer for reference before or while in the field. The manual can be downloaded at http://trl.trimble.com/docushare/dsweb/Get/Document-311749/TerraSyncReferenceManual.pdf

Unless the operator is proficient in the setup and operation of the GPS unit, the Project Manager (or designee) should have the GPS unit shipped to the project-specific contact listed below in the Pittsburgh, Pennsylvania office at least five working days prior to field mobilization so project-specific shape files, data points, background images, and correct coordinate systems can be uploaded into the unit.

Tetra Tech NUS, Inc.
Attn: Ralph Basinski
661 Anderson Drive, Bldg #7
Pittsburgh, PA 15220

2.0 REQUIRED EQUIPMENT

The following hardware and software should be utilized for locating and establishing GPS points in the field:

2.1 Required GPS Hardware

- Hand-held GPS Unit capable of sub-meter accuracy (i.e. Trimble GeoXM or Trimble GeoXH). This includes the docking cradle, a/c adapter, stylus, and USB cable for data transfer.

Optional Accessories:

- External antenna
- Range pole
- Hardware clamp (for mounting Geo to range pole)
- GeoBeacon

- Indelible marker
- Non-metallic pin flags for temporary marking of positions

2.2 Required GPS Software

The following software is required to transfer data from the handheld GPS unit to a personal computer:

- Trimble TerraSync version 2.6 or later (pre-loaded onto GPS unit from vendor)

- Microsoft ActiveSync version 4.2 or later. Download to personal computer from: http://www.microsoft.com/windowsmobile/en-us/downloads/eulas/eula_activesync45_1033.mspx?ProductID=76

- Trimble Data Transfer Utility (freeware version 2.1 or later). Download to personal computer from: http://www.trimble.com/datatransfer.shtml

3.0 START-UP PROCEDURES

Prior to utilizing the GPS in the field, ensure the unit is fully charged. The unit may come charged from the vendor, but an overnight charge is recommended prior to fieldwork.

The Geo-series GPS units require a docking cradle for both charging and data transfer. The Geo-series GPS unit is docked in the cradle by first inserting the far domed end in the top of the cradled, then gently seating the contact end into the latch. The power charger is then connected to the cradle at the back end using the twist-lock connector. Attach a USB cable as needed between the cradle (B end) and the laptop/PC (A end).

It is recommended that the user also be familiar and check various Windows Mobile settings. One critical setting is the Power Options. The backlight should be set as needed to conserve power when not in use.

Start Up:

1) Power on the GPS unit by pushing the small green button located on the lower right front of the unit.

2) Utilizing the stylus that came with the GPS unit, launch **TerraSync** from the Windows Operating System by tapping on the start icon located in the upper left hand corner of the screen and then tap on **TerraSync** from the drop-down list.

3) If the unit does not default to the Setup screen, tap the Main Menu (uppermost left tab, just below the Windows icon) and select Setup.

4) If the unit was previously shipped to the Pittsburgh office for setup, you can skip directly to Section 4.0. However, to confirm or change settings, continue on to Section 3.1.

3.1 Confirm Setup Settings

Use the Setup section to confirm the TerraSync software settings. To open the Setup section, tap the Main Menu and select Setup.

1) Coordinate System
   a. Tap on the Coordinate System.
   b. Verify the project specs are correct for your specific project by scrolling through the various settings. Edit as needed and then tap OK; otherwise, tap Cancel to return to Setup Menu. **Note:** It is always best to utilize the Cancel tab rather than the OK tab if no changes are made since configurations are easily changed by mistake.
   c. Tap on the Units.
   d. Verify the user preferences are correct for your specific project by scrolling through the various settings. Edit as needed and then tap OK; otherwise, tap Cancel to return to Setup Menu.
   e. Tap Real-time Settings.
   f. Verify the Real-time Settings are correct for your specific project by scrolling through the various settings. Edit as needed and then tap OK; otherwise, tap Cancel to return to Setup Menu.
   g. The GPS unit is now configured correctly for your specific project.

4.0 ANTENNA CONNECTION

1) If a connection has been properly made with the internal antenna, a satellite icon along with the number of usable satellites will appear at the top of the screen next to the battery icon. If no connection is made (e.g.: no satellite icon), tap on the GPS tab to connect antenna.
2) At this point the GPS unit is ready to begin collecting data.

5.0 COLLECTING NEW DATA IN THE FIELD

1) From the Main Menu select Data.
2) From the Sub Menu (located below the Data tab) select New which will bring up the New Data File menu.
3) An auto-generated filename appears and should be edited for your specific project. If the integral keyboard does not appear, tap the small keyboard icon at the bottom of the screen.
4) After entering the file name, tap Create to create the new file.
5) Confirm antenna height if screen appears. Antenna height is the height that the GPS unit will be held from the ground surface (Typically 3 to 4 feet).
6) The Choose Feature screen appears.

5.1 Collecting Features

1) If not already open, the Collect Feature screen can be opened by tapping the Main Menu and selecting Data. The Sub Menu should default to Collect.
2) **Do not begin the data logging process until you are at the specific location for which you intend to log the data.**
3) A known reference or two should be shot at the beginning and at the end of each day in which the GPS unit is being used. This allows for greater accuracy during post-processing of the data.
4) Upon arriving at the specific location, tap on Point_generic as the Feature Name.
5) Tap Create to begin data logging.
6) In the Comment Box enter sample ID or location-specific information.
7) Data logging can be confirmed by viewing the writing pencil icon in the upper part of the screen. Also, the logging counter will begin. As a Rule of Thumb, accumulate a minimum of 20 readings on the counter, per point, as indicated by the logging counter before saving the GPS data.
8) Once the counter has reached a minimum number of counts (i.e. 20), tap on OK to save the data point to the GPS unit. Confirm the feature. All data points are automatically saved within the GPS unit.

9) Repeat steps 2 through 8, giving each data point a unique name or number.

Note: If the small satellite icon or the pencil icon is blinking, this is an indication the GPS unit is not collecting data. A possible problem may be too few satellites. While still in data collection mode, tap on Main Menu in upper left hand corner of the screen and select Status. Skyplot will display as the default showing the number of available satellites. To increase productivity (number of usable satellites) use the stylus to move the pointer on the productivity and precision line to the left. This will decrease precision, but increase productivity. The precision and productivity of the GPS unit can be adjusted as the number of usable satellites changes throughout the day. To determine if GPS is correctly recording data, see Section 5.2.

5.2 Viewing Data or Entering Additional Data Points to the Current File

1) To view the stored data points in the current file, tap on the Main Menu and select Map. Stored data points for that particular file will appear. Use the +/- and <-/-> icons in lower left hand corner of screen to zoom in/out and to manipulate current view.
2) To return to data collection, tap on the Main Menu and select Data. You are now ready to continue to collect additional data points.

5.3 Viewing Data or Entering Data Points from an Existing File

1) To view data points from a previous file, tap on Main Menu and select Data, then select File Manager from the Sub Menu.
4) Highlight the file you want to view and select Map from the Main Menu.
5) To add data points to this file, tap on Main Menu and select Data. Continue to collect additional data points.

6.0 NAVIGATION

This section provides instructions on navigating to saved data points in an existing file within the GPS unit.

1) From the Main Menu select Map.
2) Using the Select tool, pick the point on the map to where you want to navigate.
3) The location you select will have a box placed around the point.
4) From the Options menu, choose the Set Nav Target (aka set navigation target).
5) The location will now have double blue flags indicating this point is you navigation target.

6) From the Main Menu select Navigation.
7) The dial and data on this page will indicate what distance and direction you need to travel to reach the desired target.
8) Follow the navigation guide until you reach the point you select.
9) Repeat as needed for any map point by going back to Step 1.

7.0 PULLING IN A BACKGROUND FILE

This section provides instructions on pulling in a pre-loaded background file. These files are helpful in visualizing your current location.

1) From the Main Menu select Map, then tap on Layers, select the background file from drop down list.
2) Select the project-specific background file from the list of available files.
3) Once the selected background file appears, the operator can manipulate the screen utilizing the +/- and <-/-> functions at the bottom of the screen.
4) In operating mode, the operator's location will show up on the background file as a floating "x".

8.0 DATA TRANSFER

This section provides instructions on how to transfer stored data on the handheld GPS unit to a personal computer. Prior to transferring data from the GPS unit to a computer, Microsoft ActiveSync and Trimble Data Transfer Utility software must be downloaded to the computer from the links provided in Section 2.2 (Required GPS Software). If a leased computer is utilized in which the operator can not download files, see the Note at the end of Section 8.0.

1) See Attachment A at the end of this SOP for instructions on how to transfer data from the GPS to a personal computer.

Note: If you are unable to properly transfer data from the GPS unit to a personal computer, the unit should be shipped to the project-specific contact listed in Section 1.0 where the data will be transferred and the GPS unit then shipped back to the vendor.

9.0 SHUTTING DOWN

This section provides instruction for properly shutting down the GPS unit.

1) When shutting down the GPS unit for the day, first click on the “X” in the upper right hand corner.
2) You will be prompted to ensure you want to exit TerraSync. Select Yes.
3) Power off the GPS unit by pushing the small green button located on the bottom face of the unit.
4) Place the GPS unit in its cradle to recharge the battery overnight. Ensure the green charge light is visible on the charging cradle.

ATTACHMENT A

How to Transfer Trimble GPS Data between Data Collector and PC
original 11/21/06 (5/1/08 update) – John Wright

Remember – Coordinate System, Datum, and Units are critical!!!

Trimble Data Collection Devices:
Standard rental systems include the Trimble ProXR/XRS backpack and the newer handheld GeoXT or GeoXH units. Some of the older backpack system may come with either a RECON "PDA-style" or a TSCe or TSC1 alpha-numeric style data collector.

The software on all of the above units should be Trimble TerraSync (v 2.53 or higher – current version is 3.20) and to the user should basically look and function similar. The newer units and software versions (which should always be requested when renting) include enhancements for data processing, real-time display functions, and other features.

Data Transfer:
Trimble provides a free transfer utility program to aid in the transfer of GIS and field data. The Data Transfer Utility is a standalone program that will run on a standard office PC or laptop.

To connect a field data collector such as a RECON, GeoXM, GeoXT, GeoXH, or ProXH, you must first have Microsoft ActiveSync installed to allow the PC and the data collector to talk to one another. A standard USB cable is also needed to connect the two devices.

A CD or USB drive is provided with the data collector for use in data transfer. If needed, these programs are also available without charge via the web at:

• **Trimble Data Transfer Utility** (v 1.38) program to download the RECON or GeoXH field data to your PC: http://www.trimble.com/datatransfer.shtml

• **ActiveSync** from Microsoft to connect the data collector to the PC. The latest version (v4.5) can be found at: http://www.microsoft.com/windowsmobile/activesync/default.mspx
(see page 2 for data transfer instructions)

To Transfer Data Collected in the Field:

• Install the Data Transfer and ActiveSync software installed on your PC
• Connect the RECON or GeoXH to your PC via an A/B USB cable (blade end and square end type "HP printer" style)
• ActiveSync should auto-detect the connection and recognize the data collector
• Make sure the data file desired is CLOSED in TerraSync prior to transfer
• Connect via ActiveSync as a guest (not a partnership)
• Run the Trimble Data Transfer Utility program on your PC
• Select "***GIS Datalogger on Windows CE***" or similar selection
• Hit the green connect icon to the right - the far right area should say "***Connected to ....***" if successful
• Select the "***Receive***" data tab (under device)
• Select "***Data***" from file types on the right
• Find the file(s) needed for data transfer. You can sort the data files by clicking on the date/time header
• Select or browse to a C-drive folder you can put this file for emailing
• When the file appears on the list, hit the "***Transfer All***"
• Go to your Outlook or other email, send a message to: John.Wright@tetratech.com (or GIS department)
• Attach the file(s) you downloaded from your C-drive. For each TerraSync data file created you should have a packet of multiple data files. All need to be sent as a group – make sure you attach all files (the number of files may vary – examples include: ssf, obx, obs, gix, giw, gis, gip, gic, dd, and car)

To Transfer GIS Data from PC to the Field Device (must be converted in Pathfinder Office):

• Obtain GIS file(s) desired from GIS Department and have converted to Trimble extension
• Contact John Wright (John.Wright@tetratech.com) if needed for file conversion and upload support
• The GIS file(s) can be quickly converted if requested and sent back to the field user in the needed "Trimble xxx.imp" extension via email – then quickly downloaded from Outlook to your PC for transfer
• Install the Data Transfer and ActiveSync software installed on your PC
• Connect the RECON or GeoXH to your PC via an A/B USB cable (blade end and square end type "HP printer" style)
• ActiveSync should auto-detect the connection and recognize the data collector
• Connect via ActiveSync as a guest (not a partnership)
• Run the Trimble Data Transfer Utility program on your PC
• Select "***GIS Datalogger on Windows CE***" or similar selection
• Hit the green connect icon to the right - the far right area should say "***Connected to ....***" if successful
• Select the "**Send**" data tab (under device)
• Select "**Data**" from file types on the right (you can also send background files)
• Browse to the location of the data on your PC (obtain the file from Pathfinder Office or from the person who converted the data for field use)
• Select the options as appropriate for the name and location of the data file to go on the data collector (usually you can choose main memory or a data storage card)
• When the file(s) appears on the list, hit the "***Transfer All***"
• Run TerraSync on the field device and open the existing data files. Your transferred file should appear (make sure you have selected Main Memory, Default, or Storage Card as appropriate)

STANDARD OPERATING PROCEDURE
SOP-OPS6

VEGETATION MANAGEMENT AT MEC SITES

1.0 SCOPE AND APPLICABILITY

This document is designed to set a standard operating procedure (SOP) for vegetation management during activities performed at Munitions and Explosives of Concern (MEC) sites. Inherently, a strong possibility exists that MEC and material potentially presenting an explosive hazard (MPPEH) may be encountered. The procedures detailed in SOP OPS1, UXO Detector-Aided Surface Surveys, provide specific guidance for UXO survey operations and equipment. SOP OPS4, MEC Management and Accountability, provides instructions and procedures to be followed in the event that suspect MEC/MPPEH is encountered. Additionally, MEC activities will be performed in accordance with all local, State, and federal regulations and will include all applicable DoD requirements.

2.0 BACKGROUND

Vegetation management may be required in preparation for field activities at MEC sites. Trees, brush, grass, and other vegetation can impede the performance of MEC operations, geophysical surveys, and related investigation and remediation activities. The degree of vegetation removal will be site-specific and based upon the conditions encountered and activities to be conducted. Following is a general discussion of the type of equipment/techniques that will be used.

- Hand held brush cutters (string or blade) will be used to cut light vegetation and small grassy areas.
- Mechanized lawn mowers will be used to mow larger grassy areas.
- Chain saws will be used in heavier brush areas, to trim tree limbs, and to cut small trees up to 2 inches in diameter.
- Tractor-mounted brush hogs will be used in larger areas and heavier brush areas.
- Brush/vegetation cutting will be left at the site of the area cleared. If this is impractical, a wood chipper may be utilized.

Smaller brush cutting/vegetation management operation will be conducted by the Unexploded Ordnance (UXO) staff. On larger project sites, subcontractors may be utilized. If it is necessary to utilize subcontractors, an UXO escort will be provided during subcontracted brush/vegetation management operation.

If the UXO escort is the only Tetra Tech UXO person on site, he/she will perform the functions of the UXOSO and UXOQC as stated below.

3.0 PERSONNEL QUALIFICATIONS

UXO personnel shall meet the training requirements as stated in DDESB TP-18. Subcontractors will meet the training and medical surveillance requirements as stated in the Tetra Tech NUS Health and Safety Guidance Manual. Where applicable, vegetation management equipment will only be operated by personnel licensed or certified on that equipment.

4.0 VEGETATION MANAGEMENT

Vegetation management at MEC sites may range from minor grass cutting and tree limb trimming to the total removal of all site vegetation. The extent and methods of vegetation management are driven primarily by the project specific scope of work, but will also be influenced by such factors as munition sensitivity, terrain, impacts to the environment, threatened or endangered species, current and future land use, available technology, and cost.

Prior to conducting vegetation management operations, a visual UXO surface survey will be conducted. All suspect MEC/MPPEH will be located and marked. UXO avoidance will be practiced during vegetation management operations. Vegetation management crews will not work within marked areas containing suspect MEC/MPPEH. Additionally, brush and grass will be cut no closer than 6 inches from the ground surface to avoid inadvertent contact with partially buried or shallow subsurface MEC.

Site Setup

The boundary of the work area will be established by land survey or GPS coordinates. Corner points of grids and start and end points of transects will also be located. Boundary lines of grids and transect lines will be marked using engineers flagging tape to provide visual guidance for the vegetation management crew when line of sight between stakes or markers is impeded.

UXO Escort will be provided for survey personnel and no stakes or markers will be driven into the ground until the immediate area of the stake or marker is surveyed and declared clear of surface and shallow subsurface anomalies.

Tree Cutting

Tree cutting will occur on a case-by-case basis as required to accomplish the site specific scope of work. Trees will be cut using chainsaws or hand tools. Generally, trees 2 inches in diameter and smaller will be cut as necessary to facilitate the planned site activities. Trees will be sectioned, if necessary, and removed from the immediate work area to avoid interfering with site operations.

Brush Cutting

Brush cutting will be accomplished using hand held brush cutters equipped with string or blade cutting attachments. Larger or heavier brush may require the use of chainsaws. Where appropriate, a tractor or skid-steer with a bush hog mower attachment may also be used. Brush will be cut to a height that allows clearance for UXO operations and geophysical equipment operation but no closer than 6 inches above the ground surface.

Grass Cutting

Grass cutting will be accomplished using mechanized lawn mowing equipment or hand held brush cutters equipped with string attachments. Grass will be cut to a height that allows clearance for UXO operations and geophysical equipment operation but no closer than 6 inches above the ground surface.

Alternative Methods

In rare instances, large scale vegetation clearance methods such as controlled burning or hydraulic ax deforestation may be necessary. An UXO escort will be provided during large scale vegetation clearance operations. At no time will UXO staff directly engage in controlled burning operations or in the operation of hydraulic ax deforestation equipment.

Quality Control

The UXOQC will review the definable features of work prior to the start of work each day. A new definable feature of work will receive a preparatory phase QC inspection prior to the start of work. This inspection is recorded on the attached Quality Control Surveillance Report. Work started on a new

definable feature of work will receive an initial phase QC inspection. During MEC management and accountability the UXOQC, or Senior UXO Technician if there is no UXOQC, will recheck 25-percent of the first four units of work (grids or transects). If quality requirements are not met on any unit, that unit will be rejected and the UXO Team will rework the entire unit. The initial phase QC inspection will be documented on the attached Quality Control Surveillance Report. Once quality requirements are met for four units in a row, the UXOQC, or Senior UXO Technician if there is no UXOQC, may reduce the level of rechecks to 10-percent of each unit (grids or transects). If at any time a unit fails the quality control check, the complete unit will be reworked and the rechecks will be increased to 25-percent until four units in a row pass the recheck. These follow up phase QC inspections will be recorded on the attached Quality Control Surveillance Report. All work will be conducted in accordance with the MEC SAP and the SOPs attached to that MEC SAP. All requested changes to the approved MEC SAP will be documented on the attached Record-of-Change Form and submitted to the PM and UXO Manager for action/approval. The UXOQC will prepare the attached Daily Quality Control Report for each day worked summarizing the definable features or work inspected, the phase of work, the locations, and personnel at the work site.

5.0 VEGETATION DISPOSAL

Vegetation disposal must be coordinated with the facility environmental office and, as applicable, the facility natural resources office. Provided that site activities do not result in significant quantities of material, the preferred method of vegetation disposal will be on-site disposal. Vegetation will be removed from the immediate work area to avoid interfering with site activities, and allowed to naturally decompose.

A wood chipper may also be used to effectively dispose of vegetation without removing the vegetation from the work site. Wood chips will be disposed of away from the immediate work area to avoid interfering with site activities when possible. If necessary, wood chips will be spread over the work site to a depth of no greater than 4 inches to avoid interference with detection depth capabilities of UXO and geophysics equipment.

6.0 SAFETY

General safety precautions are located in the Tetra Tech NUS Health and Safety Guidance Manual. Specific guidelines are located in the site-specific Health and Safety Plan (HASP) and the Accident Prevention Plan (APP).

Personal Protective Equipment (PPE)

PPE for vegetation management operations will be level D protection with the following additions:

- Logging helmet with attached face shield
- Chainsaw chaps
- Hearing protection
- Leather work gloves

Personnel Safety

The UXO Safety Officer (UXOSO) will be on-site at all times during vegetation management operations. The primary responsibilities of the UXOSO during vegetation management activities are:

- To provide a safety brief detailing the operation, safety, and maintenance of the specific equipment being utilized, this briefing will be documented on the attached Tailgate Safety Briefing form;

- To insure that MEC/MPPEH hazards remain a primary concern for personnel involved in vegetation management activities;

- To insure that PPE is serviceable and worn properly during vegetation removal activities; and

- To insure that individual personnel utilizing vegetation removal equipment maintain safe working distances from other personnel within the work area.

Additionally, an UXO Escort will be provided at all times during vegetation management activities. The UXO Escort will be utilized even when UXO Staff perform vegetation management. This will provide a more focused observation of the work area for MEC/MPPEH and related hazards.

Equipment Safety

Equipment will be inspected for serviceability daily prior to the commencement of vegetation management activities. Periodic spot checks will also be conducted throughout the day to insure that chains and blades remain properly tightened and sharpened. All equipment will be operated and maintained in accordance with the manufacturer's recommendations.

7.0 REPORTS

Senior UXO Technicians on site will complete the attached Field Activity Daily Log for each day work is conducted. The log will be used to document and report significant events, logbook entries, phone calls, visitors, and other items of interest to the PM and UXO Manager. This report will be submitted as soon as possible at the end of the work day. The attached Field Activity Weekly Log is a summary of the week's events.

TETRA TECH NUS, INC.

Project:			
Tailgate Safety Briefing			
Date: _____		**Location: _____**	
Time: _____		**Team #: _____**	
1. Reason for Briefing:			
	Daily Safety Briefing		**New Site Procedure**
	Initial Safety Briefing		**New Site Information**
	New Task Briefing		**Review of Site Information**
	Periodic Safety Meeting		**Other: (Specify)**

2. Personnel Attending		
Name	**Signature**	**Position**

Briefing Given By:		
Name	**Signature**	**Position**

TETRA TECH NUS, INC.

3. Topics: (Check All That Apply)			
	Site Safety Personnel		Decontamination Procedures
	Site/Work Area Description		Emergency Response/Equipment
	Physical Hazards		On-Site Injuries/Illness
	Chemical/Biological Hazards		Reporting Procedures
	Heat/Cold Stress		Directions to Medical Facility
	Work/Support Zones		Drug and Alcohol Policies
	PPE		Medical Monitoring
	Safe Work Practices		Evacuation/Egress Procedures
	Air Monitoring		Communications
	Task Training		Confined Spaces
	OE Precautions		Other:
4. Remarks:			

TETRA TECH NUS, INC.

Name	Signature	Position

TETRA TECH NUS, INC.

FIELD ACTIVITY DAILY LOG

DATE	
NO.	
SHEET	OF

PROJECT NAME:	PROJECT NO:
FIELD ACTIVITY SUBJECT:	
DESCRIPTION OF DAILY ACTIVITIES AND EVENTS:	
VISITORS ON SITE:	CHANGES FROM PLANS AND SPECIFICATIONS, AND OTHER SPECIAL ORDERS AND IMPORTANT DECISIONS:
WEATHER CONDITIONS:	IMPORTANT TELEPHONE CALLS:
PERSONNEL ON SITE:	
SIGNATURE:	DATE:

TETRA TECH NUS, INC.

FIELD ACTIVITY DAILY LOG

DATE	
NO.	
SHEET	OF

PROJECT NAME:	PROJECT NO:
FIELD ACTIVITY SUBJECT:	
DESCRIPTION OF DAILY ACTIVITIES AND EVENTS (CONTINUED):	

TETRA TECH NUS, INC.

FIELD ACTIVITY WEEKLY LOG

DATE	
NO.	
SHEET	OF

PROJECT NAME:	PROJECT NO:
FIELD ACTIVITY SUBJECT:	
DESCRIPTION OF DAILY ACTIVITIES AND EVENTS:	
VISITORS ON SITE:	CHANGES FROM PLANS AND SPECIFICATIONS, AND OTHER SPECIAL ORDERS AND IMPORTANT DECISIONS:
WEATHER CONDITIONS:	IMPORTANT TELEPHONE CALLS:
PERSONNEL ON SITE:	
SIGNATURE:	DATE:

APPENDIX B

VISUAL SAMPLE PLAN

Transect Sampling for Unexploded Ordnance (UXO) Target Detection

Summary

This report summarizes the probability of traversing and detecting a target area of specific size and shape for different transect spacing's. Simulation details and a power curve estimate how well the specified design would detect the target.

The following table summarizes the sampling design developed.

SUMMARY OF SAMPLING DESIGN	
Primary Objective of Design	Ensure high probability of traversing and detecting a target area that has a specified size and shape
Required Probability of Traversing the Target	100%
TARGET AREA AND TRANSECT INPUTS	
Type of Sampling Design	**Transects**
Transect Pattern	**Parallel**
Transect Width	**3 feet**
Area of target area	**125663.71 ft^2**
Shape of target area of concern	**Circular**
Radius of target area of concern	**200 feet**
SIMULATION PARAMETERS FOR PROBABILITY OF DETECTION	
Formula for calculating the probability of traversing and detecting target area	Monte Carlo Simulation (method described below)
Decision Rule	Flag if at least 90% confident an area has density greater than background density
Background Density of the Site	5 anomalies / acre
Expected Target Area Density Above Background	10 anomalies / acre Target average
Distribution of target area density above background	Bivariate Normal
Transect spacing evaluation range	20 to 100 feet
Instrument false negative rate	15%
Minimum precision	0.1
Maximum error	0.05
Search Window Diameter	178 feet
PROPOSED TRANSECT DESIGN	
Computed spacing between transects	22.6726 feet
Computed spacing between transect centers	25.6726 feet

Primary Sampling Objective

The primary purpose of sampling at this site is to traverse and detect target areas of a given size and shape with required high probability. The transect design tools provide a statistically defensible method to use transect survey data that covers only a small proportion of the total study area.

Selected Sampling Approach

The specified sampling approach was random parallel transect sampling. If parameters change from those specified in the table above, then the probability of detecting the target area will be different from those computed by VSP and reported here.

Simulation Details

To generate an estimated probability on a graph, VSP runs a Monte Carlo simulation based on the entered parameters. For each iteration, VSP creates a square site with the target area centered at the

origin and rotated at a random angle. A parallel transect pattern is placed randomly so that 3 feet wide transects are parallel to the x axis.

VSP calculates the total area of the site traversed by transects, A_b, which can vary for each iteration. The expected number of detected background anomalies, λ_b, is calculated as $\lambda_b = D_b A_b (1 - P_{fn})$ where D_b is the background density of 5 anomalies / acre and P_{fn} is the instrument false negative rate of 0.15. A random number of detected background anomalies is generated using a Poisson distribution with parameter λ_b. VSP randomly places these anomalies within the traversed areas of the site.

To simulate the number of additional anomalies in the target area, VSP uses an approximation technique to randomly place additional detected anomalies in the traversed areas of the target area. Portions of transects overlapping the target area are divided into small sections. For each section, the quantile of the target area in which it lies is determined, the expected number of additional anomalies is determined, and a random number of detected anomalies is determined using a Poisson distribution and placed within the section.

VSP uses a moving window along each transect to determine which areas have density significantly greater than background density. The window moves 1/6 of the search window diameter for each iteration. Where D_a is the actual density for the current window, the null and alternative hypotheses for determining if the area inside the window has density significantly greater than background density, D_b, are as follows:

Null Hypothesis: $H_o : D_a \leq D_b$

Alternative Hypothesis: $H_a : D_a > D_b$

VSP checks each window to see if the actual number of detected anomalies is significantly greater than the expected number of anomalies for a Poisson distribution. If any windows intersecting the target area are flagged as significant, then we determine the target area has been detected.

250 iterations are run to begin the simulation to estimate a probability of detection. If the specified Maximum Error has not been achieved, additional iterations are run until the Maximum Error is met. If the total number of iterations is *n* and the proportion of target areas detected is *p*, then another iteration is run if

Maximum Error < $1.96 * \sqrt{\frac{p(1-p)}{n}}$

The quantity $1.96 * \sqrt{\frac{p(1-p)}{n}}$ is the 95th percentile of the standard error of the mean for a binomial distribution. We are 95% certain that the estimated probability is close to the true probability (within the maximum error). When all iterations are completed, VSP tabulates the estimated probability the target area has been detected, *p* / *n*. VSP repeats this process for a number of transect spacings determined by simulation results and the minimum precision specified.

This report was automatically produced* by Visual Sample Plan (VSP) software version 5.1.1.

Software and documentation available at http://dqo.pnl.gov/vsp

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* - The report contents may have been modified or reformatted by end-user of software.

Transect Sampling for Unexploded Ordnance (UXO) Target Detection

Summary

This report summarizes the probability of traversing and detecting a target area of specific size and shape for different transect spacing's. Simulation details and a power curve estimate how well the specified design would detect the target.

The following table summarizes the sampling design developed.

SUMMARY OF SAMPLING DESIGN	
Primary Objective of Design	Ensure high probability of traversing and detecting a target area that has a specified size and shape
Required Probability of Traversing the Target	100%
TARGET AREA AND TRANSECT INPUTS	
Type of Sampling Design	**Transects**
Transect Pattern	**Parallel**
Transect Width	**3 feet**
Area of target area	**125663.71 ft^2**
Shape of target area of concern	**Circular**
Radius of target area of concern	**200 feet**
SIMULATION PARAMETERS FOR PROBABILITY OF DETECTION	
Formula for calculating the probability of traversing and detecting target area	Monte Carlo Simulation (method described below)
Decision Rule	Flag if at least 90% confident an area has density greater than background density
Background Density of the Site	5 anomalies / acre
Expected Target Area Density Above Background	20 anomalies / acre Target average
Distribution of target area density above background	Bivariate Normal
Transect spacing evaluation range	20 to 100 feet
Instrument false negative rate	15%
Minimum precision	0.1
Maximum error	0.05
Search Window Diameter	306 feet
PROPOSED TRANSECT DESIGN AND COST INFORMATION	
Computed spacing between transects	53.6748 feet
Computed spacing between transect centers	56.6748 feet

Primary Sampling Objective

The primary purpose of sampling at this site is to traverse and detect target areas of a given size and shape with required high probability. The transect design tools provide a statistically defensible method to use transect survey data that covers only a small proportion of the total study area.

Selected Sampling Approach

The specified sampling approach was random parallel transect sampling. If parameters change from those specified in the table above, then the probability of detecting the target area will be different from those computed by VSP and reported here.

Simulation Details

To generate an estimated probability on a graph, VSP runs a Monte Carlo simulation based on the entered parameters. For each iteration, VSP creates a square site with the target area centered at the

origin and rotated at a random angle. A parallel transect pattern is placed randomly so that 3 feet wide transects are parallel to the x axis.

VSP calculates the total area of the site traversed by transects, A_b, which can vary for each iteration. The expected number of detected background anomalies, λ_b, is calculated as $\lambda_b = D_b A_b (1 - P_{fn})$ where D_b is the background density of 5 anomalies / acre and P_{fn} is the instrument false negative rate of 0.15. A random number of detected background anomalies is generated using a Poisson distribution with parameter λ_b. VSP randomly places these anomalies within the traversed areas of the site.

To simulate the number of additional anomalies in the target area, VSP uses an approximation technique to randomly place additional detected anomalies in the traversed areas of the target area. Portions of transects overlapping the target area are divided into small sections. For each section, the quantile of the target area in which it lies is determined, the expected number of additional anomalies is determined, and a random number of detected anomalies is determined using a Poisson distribution and placed within the section.

VSP uses a moving window along each transect to determine which areas have density significantly greater than background density. The window moves 1/6 of the search window diameter for each iteration. Where D_a is the actual density for the current window, the null and alternative hypotheses for determining if the area inside the window has density significantly greater than background density, D_b, are as follows:

Null Hypothesis: $H_o : D_a \leq D_b$

Alternative Hypothesis: $H_a : D_a > D_b$

VSP checks each window to see if the actual number of detected anomalies is significantly greater than the expected number of anomalies for a Poisson distribution. If any windows intersecting the target area are flagged as significant, then we determine the target area has been detected.

250 iterations are run to begin the simulation to estimate a probability of detection. If the specified Maximum Error has not been achieved, additional iterations are run until the Maximum Error is met. If the total number of iterations is *n* and the proportion of target areas detected is *p*, then another iteration is run if

Maximum Error < $1.96 * \sqrt{\frac{p(1-p)}{n}}$

The quantity $1.96 * \sqrt{\frac{p(1-p)}{n}}$ is the 95th percentile of the standard error of the mean for a binomial distribution. We are 95% certain that the estimated probability is close to the true probability (within the maximum error). When all iterations are completed, VSP tabulates the estimated probability the target area has been detected, *p* / *n*. VSP repeats this process for a number of transect spacings determined by simulation results and the minimum precision specified.

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Transect Pattern	**Parallel**
Transect Width	**3 feet**
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Shape of target area of concern	**Circular**
Radius of target area of concern	**200 feet**
SIMULATION PARAMETERS FOR PROBABILITY OF DETECTION	
Formula for calculating the probability of traversing and detecting target area	Monte Carlo Simulation (method described below)
Decision Rule	Flag if at least 90% confident an area has density greater than background density
Background Density of the Site	5 anomalies / acre
Expected Target Area Density Above Background	30 anomalies / acre Target average
Distribution of target area density above background	Bivariate Normal
Transect spacing evaluation range	20 to 100 feet
Instrument false negative rate	15%
Minimum precision	0.1
Maximum error	0.05
Search Window Diameter	359 feet
PROPOSED TRANSECT DESIGN	
Computed spacing between transects	73.0958 feet
Computed spacing between transect centers	76.0958 feet

Primary Sampling Objective

The primary purpose of sampling at this site is to traverse and detect target areas of a given size and shape with required high probability. The transect design tools provide a statistically defensible method to use transect survey data that covers only a small proportion of the total study area.

Selected Sampling Approach

The specified sampling approach was random parallel transect sampling. If parameters change from those specified in the table above, then the probability of detecting the target area will be different from those computed by VSP and reported here.

Simulation Details

To generate an estimated probability on a graph, VSP runs a Monte Carlo simulation based on the entered parameters. For each iteration, VSP creates a square site with the target area centered at the

origin and rotated at a random angle. A parallel transect pattern is placed randomly so that 3 feet wide transects are parallel to the x axis.

VSP calculates the total area of the site traversed by transects, A_b, which can vary for each iteration. The expected number of detected background anomalies, λ_b, is calculated as $\lambda_b = D_b A_b (1 - P_{fn})$ where D_b is the background density of 5 anomalies / acre and P_{fn} is the instrument false negative rate of 0.15. A random number of detected background anomalies is generated using a Poisson distribution with parameter λ_b. VSP randomly places these anomalies within the traversed areas of the site.

To simulate the number of additional anomalies in the target area, VSP uses an approximation technique to randomly place additional detected anomalies in the traversed areas of the target area. Portions of transects overlapping the target area are divided into small sections. For each section, the quantile of the target area in which it lies is determined, the expected number of additional anomalies is determined, and a random number of detected anomalies is determined using a Poisson distribution and placed within the section.

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Maximum Error < $1.96 * \sqrt{\frac{p(1-p)}{n}}$

The quantity $1.96 * \sqrt{\frac{p(1-p)}{n}}$ is the 95th percentile of the standard error of the mean for a binomial distribution. We are 95% certain that the estimated probability is close to the true probability (within the maximum error). When all iterations are completed, VSP tabulates the estimated probability the target area has been detected, *p* / *n*. VSP repeats this process for a number of transect spacings determined by simulation results and the minimum precision specified.

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