

N62661.AR.003298
NS NEWPORT
5090.3a

FINAL REMEDIAL INVESTIGATION WORK PLAN TIER II SAMPLING AND ANALYSIS PLAN
CODDINGTON POINT BURIED DEBRIS AREAS NS NEWPORT RI
01/22/2014
RESOLUTION CONSULTANTS

**RI WORK PLAN /
TIER II SAMPLING AND ANALYSIS PLAN**

**Coddington Point Buried Debris Areas
Naval Station (NAVSTA) Newport, Rhode Island**

FINAL

Prepared for:



**Department of the Navy
Naval Facilities Engineering Command, Mid-Atlantic
9742 Maryland Ave.
Norfolk, VA 23511-3095**

Contract Number N62470-11-D-8013

CTO WE30

Prepared by:



**Resolution Consultants
A Joint Venture of AECOM & EnSafe
1500 Wells Fargo Building
440 Monticello Avenue
Norfolk, VA 23510**

January 22, 2014

Final

RI WORK PLAN / TIER II SAMPLING AND ANALYSIS PLAN

January 22, 2014

**Buried Debris Areas – Coddington Point
NAVSTA, Newport, RI**

**Prepared for:
Department of the Navy
Naval Facilities Engineering Command, Mid-Atlantic
9742 Maryland Ave.
Norfolk, VA 23511-3095**

**Prepared by:
Resolution Consultants
A Joint Venture of AECOM & EnSafe
1500 Wells Fargo Building
440 Monticello Avenue
Norfolk, VA 23510**

**Prepared under:
Contract Number N62470-11-D-8013**

CTO WE30

Review Signature:	Thurber, Neil <small>Digitally signed by Thurber, Neil DN: dc=com, dc=aecomnet, dc=na, ou=AECOMUsers, ou=USNortheast, ou=USWAK1, cn=Thurber, Neil Date: 2014.01.22 17:41:23 -05'00'</small>	1/22/2014	
	_____ Neil Thurber, Project Manager Resolution Consultants	Date	
Approval Signature:	_____ Janice Nielsen/Chemist, QA Manager US Navy	Date	
Other Approval Signature:	OCONNOR.DOMINIC.T.122887 8754 <small>Digitally signed by OCONNOR.DOMINIC.T.1228878754 DN: c=US, o=U.S. Government, ou=DoD, ou=PKI, ou=USN, cn=OCONNOR.DOMINIC.T.1228878754 Date: 2014.01.27 10:35:59 -05'00'</small>	_____ Dominic O'Connor, Navy RPM US Navy	Date

EXECUTIVE SUMMARY

This Remedial Investigation (RI) Work / Sampling and Analysis Plan (SAP) [referred to as this "SAP"] was prepared by Resolution Consultants (Resolution) for the U.S. Department of the Navy (Navy) to implement a remedial investigation (RI) and feasibility study (FS) for the buried debris areas located at Coddington Point, which is part of the Naval Station (NAVSTA) Newport, Rhode Island, and referred to as Site 23. There are five areas of buried debris that are planned for investigation under this SAP. Specifically, the Navy is performing this effort to assess the adequacy of existing cover materials in these areas to mitigate impacts from possible buried asbestos-containing materials and to assess areas with buried debris for the presence of residual contamination.

The five areas of concern, or buried debris locations, are situated at the following landmarks:

- (1) Naval Supply School (MARDET Building 1112CP)
- (2) Combat Training Pool (Building 1357CP)
- (3) P 451 New OTC Barracks
- (4) Nimitz Field
- (5) Bishop's Rock (and recreation areas)

The overall goal of this effort is for the completion of an RI, including risk assessments if warranted, of the five areas of concern, and the development of a focused feasibility study to develop limited remedial action alternatives based on the findings of the RI. This effort will be documented in a combined Remedial Investigation/Feasibility Study report for review by the regulatory agencies (EPA and RIDEM).

These buried debris areas were identified during previous construction and investigation activities and are considered areas with potential asbestos-containing materials (ACM) mixed with construction and/or demolition (C&D) debris in soil.

The site background and investigations are reported in the Evaluation of Urban Fill, Coddington Point (Tetra Tech, 2012) and Sites of Known Buried ACM Rubble (NAVFAC, 2011). The report, Draft – Evaluation of Urban Fill, Coddington Point; Naval Station Newport; Newport Rhode, Island (Tetra Tech, January 2012) serves as the Study Area Screening Evaluation (SASE) for these five AOCs. These two reference documents provide the majority of the background information provided in this SAP.

During the initial discovery and discussions between the Navy and the regulatory agencies regarding these areas of concern, three other sites were discussed. These were the new chiller unit at Building 1284CHI, the new fitness center near Building 109 CP, and P-082 Un-manned AWS Support Facility Building 119 CC. Asbestos materials were encountered and handled by the Navy at these sites. Remedial actions have been conducted at these areas. The Navy is in the process of demonstrating compliance at these, and other areas, as part of its base-wide environmental management program for handling asbestos.

The extent of buried debris is unknown in some of the study areas and the adequacy of cover materials (thickness and type of soil, for instance) is also unknown in some areas. An assessment of the debris extent and cover adequacy is part of this investigation to enhance existing data. The overall conceptual site model for the areas includes the assumption that buried debris exists below each site within each parcel boundary and that the presence of ACM in the debris cannot be ruled out based on existing, known conditions. For purposes of this investigation, the parcel boundaries are shown as geographic features such as shoreline and/or constructed facilities including buildings and road.

Based on the Evaluation of Urban Fill (NAVFAC, 2011) and review of historical information with the regulatory agencies, it is possible that constituents other than ACM could be present in soil associated with the buried debris. In prior discussions, lead, mercury, PCBs, and VOCs were identified as potential constituents that could be associated with the buried debris at Coddington Point, although there are no documented releases of these substances. As such, this SAP includes the collection of soil samples for analysis of these constituents to assess for their presence and quantify their concentrations, comparing to appropriate guidance values, and making recommendations for further sampling and/or other action that may be appropriate based on the results.

The format of this SAP follows the UFP QAPP format for site investigations. It should be noted however that this is also intended to serve as the RI work plan. The focus of this SAP is on the basis for and methods to collect data to complete a remedial investigation. The data will be used to complete an RI report for review by the regulatory agencies. The data and information collected will also be used to evaluate remedial alternatives in the FS.

Should site conditions change or new information is encountered, a modification to this SAP could be issued to address site specific needs. Proposed changes to data collection efforts will not be implemented without first notifying the regulatory agencies.

CONTENTS

SAP Worksheet #1 Title and Approval Page.....	WS 1-1
SAP Worksheet #5: Project Organizational Chart	WS 5-1
SAP Worksheet #6: Communication Pathways.....	WS 6-1
SAP Worksheet #9: Project Scoping Session Participants Sheets	WS 9-1
SAP Worksheet #10: Conceptual Site Model	WS 10-1
SAP Worksheet #11: Project Quality Objectives/Systematic Planning Process Statements ...	WS 11-1
SAP Worksheet #17: Sampling Design and Rationale	WS 17-1
SAP Worksheet #14: Summary of Project Tasks	WS 14-1
SAP Worksheet #12-1: Measurement Performance Criteria – Field QC Samples for Volatile Organic Compounds	WS 12-1
SAP Worksheet #21: Project Sampling SOP References Table.....	WS 21-1
SAP Worksheet #18, 19, 20 and 30: Field Project Implementation (Field Project Instructions).....	WS 18, 19, 20 & 30-1
SAP Worksheet #15: Reference Limits and Evaluation Tables	WS 15-1
SAP Worksheet #23: Analytical SOP References Table	WS 23-1
SAP Worksheet #28-1: Laboratory QC Samples Table	WS 28-1
SAP Worksheet #34, 35, 36 Data Verification and Validation (Steps I and IIa/IIb) Process Table	WS 34, 35 & 36-1
SAP Worksheet #37: Usability Assessment.....	WS 37-1

Figures

Figure 1 – Regional Location

Figure 2 – Site Plan

Figure 3 – Conceptual Site Model of Potential Exposure Pathways

Figure 4 – Naval Supply School

Figure 5 – Combat Training Pool Building

Figure 6 – New OTC Barracks

Figure 7 – Nimitz Field

Figure 8 – Bishop’s Rock and Recreation Area

Figure 9 – Investigation Summary

Appendices

Appendix A Resolution Consultants SOPs

Appendix B Laboratory Certifications

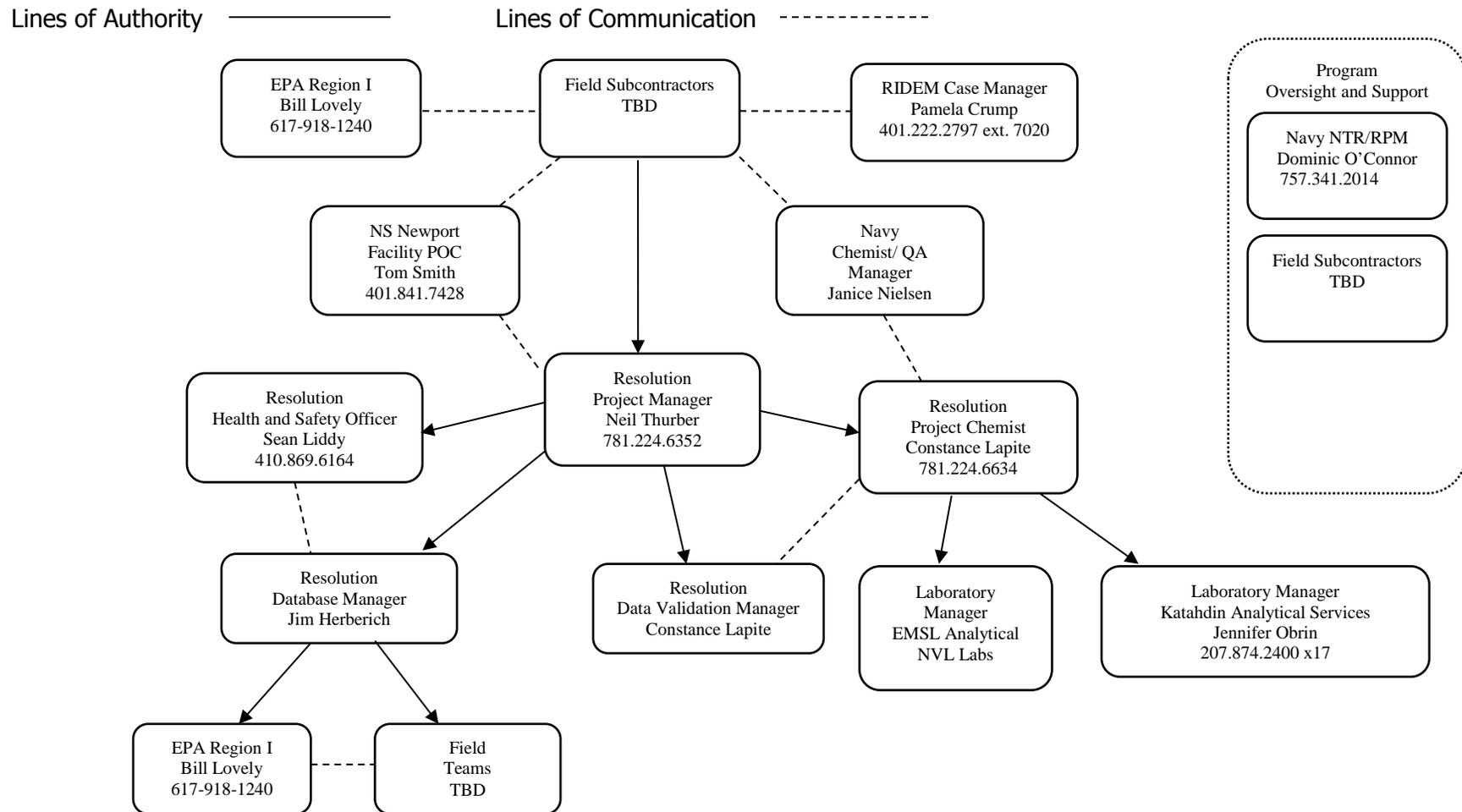
Appendix C Information related to EM/GPR survey limitations

ACRONYMS AND ABBREVIATIONS

°C	Degrees Celsius
BGS	Below Ground Surface
BSG	Below Surface Grade
CAP	Corrective Action Plan
CLEAN	Comprehensive Long-Term Environmental Action, Navy
CoC	Chain-of-Custody
COC	Contaminants of Concern
COPC	Contaminants of Potential Concern
CSM	Conceptual Site Model
CTO	Contract Task Order
DL	Detection Limit
DO	Dissolved Oxygen
DoD	Department of Defense
DQI	Data Quality Indicator
DRO	Diesel Range Organic
ELAP	Environmental Laboratory Accreditation Program
FTL	Field Team Leader
FTMR	Field Task Modification Request
GRO	Gasoline Range Organic
GPS	Global Positioning System
ICDEC	Industrial/Commercial Direct Exposure Criteria
IDW	Investigation-Derived Waste
IR	Installation Restoration
LCS	Laboratory Control Sample
LCSD	LCS Duplicate
LNAPL	Light non-aqueous phase liquid
LOD	Limit of Detection
LOE	Level of effort
LOQ	Limit of Quantitation
LUCs	Land Use Controls
MCLs	Maximum Concentration Limit
MPIs	Measurement Performance Indicators
MS/MSD	Matrix Spike/Matrix Spike Duplicate
NA	Not Applicable
NAVD	North American Vertical Datum
NAVFAC MIDLANT	Naval Facilities Engineering Command, Mid-Atlantic
NAVSTA	Naval Station
Navy	U.S. Department of the Navy
NEDD	Navy Electronic Data Deliverable
NIRIS	Naval Installation Restoration Information Solution
NTR	Navy Technical Representative
ORP	Oxidation-Reduction Potential
OU	Operable Unit
PAHs	Polycyclic Aromatic Hydrocarbons
PAL	Project Action Limit
PCE	Tetrachloroethene
PDF	Portable Document Format

PID	Photoionization Detector
PM	Project Manager
POC	Point of Contact
POL	Petroleum and oil
PPM	Parts-per-million
PQOs	Project Quality Objectives
PVC	Polyvinyl Chloride
QA/QC	Quality Assurance/Quality Control
QSM	Quality Systems Manual
Resolution	Resolution Consultants
RDEC	Residential Direct Exposure Criteria
RIDEM	Rhode Island Department of Environmental Management
RPD	Relative Percent Difference
RPM	Remedial Program Manager
SAP	Sampling and Analysis Plan
SDG	Sample Delivery Group
SIR	Site Investigation Report
SOP	Standard Operating Procedure
SOW	Statement of Work
SSO	Site Safety Officer
SVOCs	Semi-Volatile Organic Compounds
TAL	Target Analyte List
TAT	Turnaround Time
TBD	To Be Determined
TCL	Target Compound List
TOD	Total Oxidant Demand
TPH	Total Petroleum Hydrocarbons
UFP-QAPP	Uniform Federal Policy for Quality Assurance Project Plans
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
UST	Underground Storage Tank
VOCs	Volatile Organic Compounds
VOVs	Volatile Organic Vapors

SAP Worksheet #5: Project Organizational Chart



SAP Worksheet #6: Communication Pathways

[\(UFP-QAPP Manual Section 2.4.2\)](#)

The communication pathways for the SAP are shown below. Names and phone numbers are provided in the flow chart above.

Communication Drivers	Responsible Entity	Procedure (Timing, Pathway To/From, etc.)
Regulatory Agency Interface	Navy RPM	Navy RPM will interface with Regulatory Agency directly via phone or email as needed.
Field Progress Reports	Resolution FTL\SSO Resolution PM Navy RPM	The Resolution Field Team Leader (FTL) will email daily field progress reports to the Resolution Project Manager (PM). In addition, there will be phone conversation between the Resolution FTL and the Resolution PM as needed. The Resolution RPM will email the Navy RPM at a minimum weekly or as needed.
Gaining Site Access	NS Newport Facility POC Resolution PM	The Resolution TMO will coordinate directly with the Navy POC at least 48 hours prior to initiating field work in order to gain access to the site.
Obtaining Utility Clearances for Intrusive Activities	Resolution PM	The Resolution PM (or their designee) will contact Digsafe at least 72 hours prior to initiating intrusive field work activities.
Stop Work due to Safety Issues	Resolution FTL\SSO Resolution PM Resolution HSO Navy RPM	The Resolution Site Safety Officer (SSO) will verbally inform onsite personnel, including subcontractors as soon as possible. The Resolution SSO will verbally inform the Resolution PM of the Stop Work condition as well as when it is resolved. As need be, the Resolution SSO and/or PM will work with the Resolution Health & Safety Officer (HSO) and Navy RPM to resolve issues.
SAP Changes prior to Field/Laboratory Work	Resolution PM Navy RPM	The Resolution PM will notify the Navy RPM either verbally or via email of any planned amendments to the SAP. The Resolution PM will document the changes via a Field Task Modification Request (FTMR) form and a concurrence letter.
SAP/WP Changes in the Field	Resolution FTL\SSO Resolution PM Navy RPM	The Resolution FTL will verbally notify the Resolution PM as soon as practical of realizing a need for an amendment. The Resolution PM will notify the Navy RPM either verbally or via email the same day of the realized change and the changes will be documented in a scheduled impact letter to the Navy RPM.
Field Corrective Actions	Resolution FTL\SSO Resolution PM Navy RPM	The need for corrective action for field issues will be determined by the Resolution FTL. The Resolution FTL will notify the Resolution PM.

Communication Drivers	Responsible Entity	Procedure (Timing, Pathway To/From, etc.)
Sample Receipt Variances and Laboratory Quality Variances	Katahdin Lab PM EMSL PM NVL PM Resolution FTL\SSO Resolution PM Resolution Project Chemist	<p>The Laboratory PM will notify (verbally or via e-mail) the Resolution FTL immediately upon receipt of any chain of custody/sample receipt variances for clarification or direction from the Resolution FTL.</p> <p>The Resolution FTL will notify (verbally or via e-mail) the Resolution PM and project chemist within 1 business day, if corrective action is required.</p> <p>The Resolution PM or project chemist will notify (verbally or via e-mail) the Laboratory PM and the Resolution FTL within 1 business day of any required corrective action.</p>
Analytical Corrective Actions	Katahdin Lab manager EMSL PM NVL PM Resolution Project Chemist	<p>The laboratory will notify the Resolution project chemist of any analytical data anomaly within 1 business day of discovery. After the laboratory receives guidance from Resolution project chemist, the laboratory shall initiate any corrective action to prevent further anomalies.</p>
Analytical Data Quality Issues	Katahdin Lab PM EMSL PM NVL PM Resolution FTL\SSO Resolution PM Resolution Project Chemist Navy RPM	<p>The laboratory PM will notify (verbally or via e-mail) the Resolution project chemist within 1 business day of when an issue related to laboratory data is discovered. The Resolution project chemist will notify the Resolution PM within 1 business day.</p> <p>The Resolution project chemist will notify the Resolution PM verbally or via e-mail within 48 hours of validation completion that a non-routine and significant laboratory quality deficiency has been detected that could affect this project and/or other projects. The Resolution PM will verbally advise the Navy RPM within 24 hours of notification from the chemist. The Navy RPM will engage the NAVFAC LANT chemist to ensure the issues with this project can be evaluated to determine impact to other DoD projects.</p>
Reporting Data Validation Issues/ Data Validation Corrective Actions	Resolution PM Resolution Project Chemist	<p>The Resolution project chemist or data validator will perform validation as specified in Worksheets #34, 35, and 36, and will contact the laboratory as soon as possible if issues are found that require corrective action.</p> <p>If the Resolution project chemist or data validator identifies non-usable data during the data validation process that requires corrective action, the Resolution PM will coordinate with the project chemist to take corrective action appropriate for the identified deficiency to ensure the project objectives are met. Corrective action may include resampling and/or reanalyzing the affected samples, as determined by the Resolution PM.</p>

Communication Drivers	Responsible Entity	Procedure (Timing, Pathway To/From, etc.)
Notification of Non-Usable Data	Katahdin Lab PM EMSL PM NVL PM Resolution PM Resolution Project Chemist Navy RPM	<p>If the laboratory determines that any data they have generated is non-usable, the Laboratory PM will notify (verbally or via e-mail) the Resolution project chemist within 1 business day of when the issue is discovered.</p> <p>The Resolution project chemist will notify (verbally or via e-mail) Resolution PM within 1 business day of the need for corrective action, if the non-usable data is a significant issue (i.e., critical sample data). Corrective action may include resampling and/or reanalyzing the effected samples.</p> <p>If a Resolution project chemist or data validator identifies non-usable data during the data validation process, the PM will be notified verbally or via e-mail within 48 hours of validation completion that a non-routine and significant laboratory quality deficiency has resulted in non-usable data.</p> <p>The Navy RPM will contact the NAVFAC LANT chemist to report problems and resolution, and may request assistance to ensure the issues with this project can be evaluated to determine impact to other DoD projects. The Resolution PM will notify (verbally or via email) the NAVFAC NE RPM on any problems with the laboratory or analysis that could significantly affect the usability of the data or project failures that impact the ability to complete the scope of work. The NAVFAC NE RPM, may at their discretion, contact the Navy project chemist for assistance in problem resolution. Such notification will be made within 1 business day of when the issue is discovered.</p>

Notes:

RPM = Remedial project manager	QAO = Quality assurance officer
FTL/SSO = Field team leader/ Site safety officer	HSO = Health and safety officer
PM = Project manager	SAP = Sampling and analysis plan

SAP Worksheet #9: Project Scoping Session Participants Sheets

[\(UFP-QAPP Manual Section 2.5.1\)](#)

Project Name:	Coddington Point Debris Area Investigation	Site Name:	Coddington Point		
Projected Date(s) of Sampling:	Fall 2013	Site Location:	Coddington Point, NAVSTA, Newport, RI		
Project Manager:	Neil Thurber				
Date of Session:	12/19/2012				
Scoping Session Purpose:	Review of project goals and development of draft SAP				
Name	Title	Affiliation	Phone #	E-mail Address	Project Role
Timothy Reisch	Environmental Restoration Engineering Lead	NAVFAC	757.322.4619	timothy.reisch@navy.mil	Technical Advisor
Janice Nielsen	Navy Chemist	NAVFAC LANT	757.322.8339	janice.nielsen@navy.mil	Chemistry Oversight
Winoma Johnson	Northeast Environmental Business Line Lead	NAVFAC MIDLANT	757.341.2015	winoma.johnson@navy.mil	Navy Team Oversight
Mark Kauffman	Activity Coordination	Resolution	978.905.2262	mark.kauffman@aecom.com	Resolution Team Oversight
Neil Thurber	Project Manager	Resolution	781.224.6352	neil.thurber@aecom.com	Project Management and Execution

Comments/Decisions:

- Discussed the scope of the investigation.
 - For purposes of the SAP, the investigation will be an assessment of possible residual contaminants in the formerly located debris areas. This effort is to identify the presence of residuals, should they exist. The extent of residual contaminants, should they exist and require further refinement, will be accomplished as a separate effort and modification of this SAP.
 - The areas of investigation are the 5 areas identified during prior site construction efforts.
 - Asbestos sampling is not part of this SAP. Visual observations may be made, but sampling and analyses for asbestos will not occur. It is understood that asbestos, if and where present, will most likely be addressed in a future feasibility study.
 - It is understood that asbestos previously located in the debris areas were mostly disposed off-site during the associated building construction efforts. Based on the "Evaluation of Urban Fill" report, debris is present still within these locations with the possibility of asbestos remaining.

- Target Analytes.
 - Lead, mercury and PCBs are the primary target analytes for the assessment of soil associated with the buried debris.
 - In addition, VOCs will be analyzed based on prior discussions with EPA and RIDEM and the assumption that VOCs could be present as residual constituents. This discussion occurred on March 11, 2012 and included Tim Reisch (Navy), Matt DeStefano (RIDEM), and Bryan Olsen (EPA).
 - EPA and RIDEM regulatory values (e.g., EPA RSLs) will be used to derive project action limits for laboratory analyses. The lowest of available values will be used to allow a variety of data comparisons as needed. Typical laboratory Limits of Detection are deemed sufficient for VOCs and the full scan method will be used for this plan.
- Media.
 - Soil will be assessed under this SAP in the locations depicted (5 debris areas) on the draft figures.
 - If groundwater is present in the buried debris investigation areas, it will be considered for future sampling based on the results of this investigation, but is not part of this plan initially. Parameters such as groundwater depth, proximity to buried debris, and proximity to soil constituents will be collected for future use as needed.
- Sample locations.
 - Locations should match the areas where debris has been encountered.
 - At Bishop's Rock, in addition to the debris locations identified, the recreational area north of the access road should be assessed via EM/GPR surveys to determine if buried debris may be present. If so, borings may be placed in that location to confirm presence of debris.

Action Items:

- Compile information into draft SAP.

Follow up call on January 17, 2013:

- On January 17th a follow up call was held to confirm the specific objectives of this task (under this plan).
- Those present agreed that this initial phase will focus on residual constituents in shallow and subsurface soil in the buried debris areas. The soil data will be reviewed to assess additional investigation actions if warranted.
- Those present included Neil Thurber, Mark Kauffman, Tim Reisch, Jan Nielson, and Dominic O'Connor.

Project Name:	Coddington Point Debris Area Investigation	Site Name:	Coddington Point		
Projected Date(s) of Sampling:	Fall 2013	Site Location:	Coddington Point, NAVSTA, Newport, RI		
Project Manager:	Neil Thurber				
Date of Session:	7/10/13				
Scoping Session Purpose:	Review of project goals and development of investigation approach for ACM/debris/site boundaries				
Name	Title	Affiliation	Phone #	E-mail Address	Project Role
Ginny Lombardo	Remedial Project Manager	EPA	617.918.1754	Lombardo.Ginny@epa.gov	EPA oversight
Pamela Crump	Sanitary Engineer	RIDEM	401.222.2797 x7020	pamela.crump@dem.ri.gov	RIDEM oversight
Dominic O'Connor	Remedial Project Manager	Navy	757.341.2014	dominic.oconnor1@navy.mil	Navy RPM
Tom Smith	Lead & Asbestos Programs Manager	Navy	401.841.7628	thomas.j.smith3@navy.mil	Navy environmental support (NAVSTA Newport)
Cindy Castleberry	Project Engineer	Resolution	781.224.6350	cindy.castleberry@aecom.com	Project Engineer
Mark Kauffman	Activity Coordination	Resolution	978.905.2262	mark.kauffman@aecom.com	Resolution Team Oversight
Neil Thurber	Project Manager	Resolution	781.224.6352	neil.thurber@aecom.com	Project Management and Execution

Discussion Summary:

A brief review of site conditions was provided with input from Neil Thurber (NT) and Tom Smith (TS), based mostly on the accumulation of recent information and the site visit conducted July 2nd. Details are provided in the site-by-site information further below.

During the discussion of site boundaries, it was decided to modify and maintain the area of concern (AOC) boundaries for each of the debris areas. In general, the "property" boundaries of each AOC will be used for purposes of the investigation and then for remedial alternative evaluation. The boundaries may consist of physical boundaries or reduced areas if sufficient information exists that clearly shows the extent of buried debris. Navy to propose updated AOC boundaries for EPA and RIDEM to review.

Another key assumption discussed was to consider each AOC to include ACM in the subsurface by default. The default being there is debris still buried and ACM cannot be ruled out until and unless there is specific information that indicates ACM is no longer present. Future remedial alternatives will need to include either removal of ACM or maintenance of adequate cover with use limitations.

Key comments regarding the 5 buried debris areas were:

Bishops Rock

- Bishops Rock area includes the peninsula type structure (jetty) that has been recently improved with new construction. The conditions of the existing site include new gravel and topsoil/grass extending outward from the mainland. During construction, a majority of the fill with ACM debris (possibly all) was removed as noted by the Navy. The extent of removal ends with construction boundaries at the intersection with the mainland.
- Navy confirmed that the jetty area has been completed with new fill under a geotextile material with 1 foot or more of new gravel and topsoil above that.
- Navy to propose updated AOC limits for EPA and RIDEM to review and these will extend out into the vacant lot (referenced as Prichard Field North [north of Barschow Street]).
- Geophysical investigation may be needed to assess the field area for debris. Soil borings may be needed to assess cover soil types and thicknesses if debris is found as well as assessment for other constituents.

Nimitz Field Lighting

- The Nimitz Field lighting area is part of the new athletic field that consists of new vegetative support layer and grass around a rubber track and artificial turf field. The lighting area included friable thermal type insulation in the subsurface trench dug for new utilities. The exact source is unknown but may be from nearby steam or hot water piping. At least two buildings were once located in this particular area. It is assumed that ACM could still exist in the lighting area based on the visual evidence observed.
- Other ACM issues were not raised during construction of other portions of the athletic field. Navy to verify this information (as-built drawings for fields and notes on construction inspection/ACM reports).
- The boundaries of this AOC will be proposed for review but likely to include the athletic field boundaries. Sample locations may be biased towards the debris area (lighting area) with supporting information indicating buried debris and ACM were not observed during construction activities elsewhere. Otherwise, soil borings may be needed to in other locations to assess cover soil types and thicknesses.

Naval Supply School (MARDET building 1112 CP)

- This area includes new construction around existing buildings, including improved parking (asphalt) areas and an extended retaining wall. During retaining wall construction, ACM was encountered along the slope. ACM within the construction area was removed but there is no documentation to the extent of ACM beyond the construction area. ACM could exist in the subsurface around this construction area (southeast corner of the area).
- Based on visual observations during construction, ACM could exist along the eastern embankment. However, this was not verified due to the steep slope, large rocks and overgrowth that exists. As part of the RI, this slope will be assessed as much as possible, considering safety issues and the limited accessibility to this area.
- The northern portion of this area was recently graded and paved and as noted during the site walk there were no ACM encountered. Navy to verify this if as-built plans area available. If not, soil borings may be needed to assess the cover soil conditions in this portion of the area. GPR survey may be applied as well.
- Also during construction, foundations or bases of what were likely guns for target practice were encountered. Navy to verify this information and assess if it warrants additional investigation. Otherwise, soil borings may be needed in other locations to assess cover soil types and thicknesses.

Combat Training Pool

- This area includes a new building and drainage swale placed partly over former parking areas. There is new pavement and new soil and grass cover along the sides and back of the area. A drainage swale was constructed in the back as well (need to verify if this is a new feature). The report from construction activities indicated that a majority of ACM was removed but it is assumed that ACM could still exist in the subsurface.
- Navy to verify the existence of an as-built plan to show construction limits and ACM removal if available. Otherwise, AOC boundaries may include the AOCs to the north and south, the embankment to the east and the road and field to the west.
- Soil borings may be needed to assess soil cover types and thicknesses.

New OTC building

- A new building, pavement and cover soils were observed in this area during the site walk. It was noted that a geophysical survey was conducted prior to construction activities based on prior lessons learned. ACM was removed during construction.
- Navy to verify existing as-built drawings that show types and thicknesses of surface materials and ACM removed, if available. During construction, the Navy's contractor brought in new fill to raise the grade in this area to meet the drainage requirements for the new building and to support new pavement and soil/vegetation.

- Boundaries of the area likely to include the embankment to the east, road and field to the west, Combat Training Pool area to the north and property boundary to the south, unless other information is available that would indicate a smaller area of buried debris.
- Soil borings may be needed to assess soil cover types and thicknesses.

Other

- Other constituents in the debris areas were discussed. It was agreed that the general approach in the draft SAP was acceptable with some modifications. The modifications as listed in the regulatory agency comments include:
 - o Adding soil sample points for adequate coverage. Navy to proposed additional locations for EPA/RIDEM to review.
 - o Sample depths to be modified for shallow and subsurface assessment needs:
 - Shallow samples may only be necessary where there is no documentation of sufficient clean fill or structural (pavement/building) cover.
 - Shallow samples need to include 0 to 1 and 1 to 2 feet in depth at some interval (i.e. collect some 1 to 2 foot samples to meet RIDEM protocol for shallow soil; but maintain the 0 to 1 foot scheme for CERCLA risk characterization).
 - Subsurface samples may be needed at multiple intervals where there is a very deep boring and/or where there is a change in subsurface soil conditions (multiple contaminated layer of soil/fill).
 - In addition, EPA and Navy to develop a sample decision matrix for consideration before completing the next version of the work plan.
- There was a discussion related to the former pistol and rifle ranges shown on earlier site plans. These areas appear to have been active on and around the Nimitz Field area. Navy to provide additional information and an opinion on the need for further assessment.
- There was a discussion on the former gun mounts that were encountered during parking lot construction activities north of the MARDET building. Navy to provide additional information and an opinion on the need for further assessment.
- There was a discussion on the likelihood of other steam and water pipes that exist in other areas of Coddington Point that may include asbestos insulation. Verification is needed on whether these situations are considered a release or should be addressed under existing Navy asbestos abatement protocol during future maintenance or construction activities.

Action Items

- Navy to complete review of available historical information to increase level of detail related to new construction limits, cover types/thickness, ACM removal areas and quantities, and area boundaries (each area). Modified investigation boundaries will be proposed for others to review.
 - With modified boundaries, Navy to proposed additional sample locations for surface evaluation as needed and expanded assessment of other constituents (per comments on draft work plan).
 - Navy to review historic information and provide details related to the former rifle range and gun training areas. Will assess need to include further investigation.
 - EPA and Navy to coordinate on the development of sample decision logic and update the project goals (modify work sheet 11 of the SAP). Logic to include focus on objectives of sample locations, intervals and analyses.
- EPA and Navy to review procedures for utility-related ACM below the ground surface that is not considered a release.

Project Name:	Coddington Point Debris Area Investigation	Site Name:	Coddington Point		
Projected Date(s) of Sampling:	Fall 2013	Site Location:	Coddington Point, NAVSTA, Newport, RI		
Project Manager:	Neil Thurber				
Date of Session:	8/1/13				
Scoping Session Purpose:	Review of project goals and development of investigation approach for ACM/debris/site boundaries; follow up call				
Name	Title	Affiliation	Phone #	E-mail Address	Project Role
Ginny Lombardo	Remedial Project Manager	EPA	617.918.1754	Lombardo.Ginny@epa.gov	EPA oversight
Pamela Crump	Sanitary Engineer	RIDEM	401.222.2797 x7020	pamela.crump@dem.ri.gov	RIDEM oversight
Dominic O'Connor	Remedial Project Manager	Navy	757.341.2014	dominic.oconnor1@navy.mil	Navy RPM
Cindy Castleberry	Project Engineer	Resolution	781.224.6350	cindy.castleberry@aecom.com	Project Engineer
Neil Thurber	Project Manager	Resolution	781.224.6352	neil.thurber@aecom.com	Project Management and Execution

General discussion

- It is assumed that ACM is co-located with debris for purposes of the CSM. And, that debris with ACM may be present within the boundaries of each area unless information is available that indicated otherwise.
- Samples for PCOCs will be focused on areas of known debris (where current conditions may have remaining debris).
- EPA to check applicability of cover requirements for areas covered with enhanced materials such as asphalt, geotextile, concrete, etc.
- EPA to also check on relevance of cover in areas that are inaccessible (related to the steep slope embankments).
- Weight of evidence approach to documented sufficient cover and debris locations is acceptable where direct documentation is not available.
- The revised SAP will include more detail on the timing of construction and GPR and soil boring information.
- Additional review of information will be conducted to reduce the areas of impact; however, limited information is available that shows precise locations and extent of debris and ACM removal.

SAP Worksheet #10: Conceptual Site Model

[\(UFP-QAPP Manual Section 2.5.2\)](#)

Overview

Coddington Point is an area of approximately 53 acres situated within a coastal portion of the Naval Station (NAVSTA), Newport, Rhode Island. The focus of this SAP is on five study areas located on Coddington Point that have been identified a result of previous construction and investigation activities as locations with buried demolition debris. These areas also contained potential asbestos-containing materials (ACM) mixed with the construction and/or demolition (C&D) debris. Although building debris and ACM were removed during prior construction and investigation activities, there is the potential for remaining buried debris and associated ACM, as reported in the *Evaluation of Urban Fill, Coddington Point* (Tetra Tech, 2012) and *Sites of Known Buried ACM Rubble* (NAVFAC, 2011).

It is possible that constituents other than ACM could be present in soil associated with the buried debris. In prior discussions, the Navy and regulatory agencies discussed lead, mercury, PCBs, and VOCs as potential residual constituents that could be associated with the buried debris areas at Coddington Point.

Based on discussions with the regulatory agencies, the boundaries of the five study areas are considered to be the "parcel" boundaries for the purpose of this investigation. Refer to Figures 1 and 2 for the regional location and overview of Coddington Point and the five study area boundaries.

Two reference documents are available that best describe the operational history, physical characteristics, and other key elements of the conceptual site model (CSM): *Evaluation of Urban Fill, Coddington Point* (Tetra Tech, 2012) and *Sites of Known Buried ACM Rubble* (NAVFAC, 2011). These two reference documents provide the majority of background information provided in this worksheet.

Operational History

Coddington Point was purchased by the Navy in 1918 and much of the base organization was transferred to Coddington Point. During World War I, military personnel were housed in tents on Coddington Point. In 1923, approximately 200 buildings, which were part of the emergency war camps established on Coddington Point, were stripped and sold for scrap (NEECS, 1983). Between 1942 and 1943, numerous barracks were constructed on the northern portion of Coddington Point.

These barracks were subsequently demolished primarily in the mid/late 1960s to early 1970s. According to one report, it was not an uncommon construction practice to utilize solid debris as fill at the time of the building demolition (Tetra Tech, 2012). No records have been identified that document exactly how building materials were managed and disposed.

Other than the recent encounters with buried ACM and C&D debris in urban fill, no industrial activities or waste disposal operations are known to have occurred at Coddington Point, nor has a release of any other hazardous substance been reported in this area by the Navy. The area has been used primarily for Navy personnel housing, education, recreation, and dining.

Review of historical drawings does indicate the presence of a rifle range which covered a portion of what is now Nimitz Field. Further discussion regarding the rifle range is included below under Nimitz Field. Additionally, concrete gun mounts were encountered at the northern edge of the property, north of the MARDET building. This is also discussed below.

The following paragraphs describe more operational detail for each of the study areas.

Naval Supply Corps School (MARDET Building 1112CP)

The Navy Supply Corps School (MARDET Building 1112CP) is located northeast of the intersection of Meyerkord Avenue and Kollmeyer Street. The Naval Supply Corps School study area has been defined as a "parcel" boundary for the Navy Supply Corps School and is shown on Figure 4 as the area north of Kollmeyer Street and the Combat Training Pool Study Area, east of the Building 370, south of the parking area at the northeast corner of the point, and west of Coddington Cove. This area combined with the Combat Training Pool Study discussed below encompasses an area where ACM was encountered in the subsurface during construction activities in 2009.

Date/Reference	Description
1939 Aerial Photograph (see Figure 4) and 1940 and 1941 base maps (Tetra Tech, 2012)	The study area appears to be undeveloped.
1942 base map (Tetra Tech, 2012)	Building 1112 (Torpedomen and Gunner Mates School) is present.
1949, 1963, 1991, and 1995 base maps (Tetra Tech, 2012) and 1962 and 1981 Aerial Photographs (see Figure 4)	Building 1112 still present and called Fire Control and Gunnery in 1949. Several smaller buildings also appear at this time that were associated with the gunnery school. According to hand mark ups on one 1942 plan, there appears to be a small pistol range and gun platform at the northern most point. The 1963 drawing shows labels for gun mounts in this same area. Pathways and/or roads appear around the main building. Areas of the embankment adjacent to Coddington Cove may have been subject to filling (Tetra Tech, 2012). Evidence of the gun mounts are no longer present on the 1982 aerial photo.

Date/Reference	Description
<p>December 2009 (Tetra Tech, 2012 and Navy, 2011 except where otherwise noted)</p>	<p>During the late 2000s, a project to conduct interior and exterior renovation to Building 1112CP began. During excavation for construction of a retaining wall and widening of a roadway in December 2009, near the southeastern area of the building and parcel, asbestos-containing cement panels were un-earthed. The Navy's contractor developed asbestos hazardous abatement plans and removed the ACM within the limits of the construction project.</p> <p>The area where ACM was un-earthed, as indicated in the Navy's <i>Sites of Known Buried ACM Rubble</i> (NAVFAC, 2011), is shown on Figure 4.</p> <p>Civil drawings for the renovation project titled Renovations/Additions to Building 1112 for Marine Detachment (MARDET), Final Submission (H.V Collins Company, February 20, 2009) were reviewed. The drawings showed that the surface grade to the north of Building 1112CP was raised by up to 1 foot and a new concrete walkway and new pavement was installed to the north, east, and south of the building. New pavement included at least 12 inches of gravel subbase and concrete areas included at least 8 inches of gravel beneath 4 inches concrete. A drainage swale was constructed just north and east of the paved parking area north of the building. The grass drainage swale construction included 6 inches loam and seed and an erosion control blanket. Existing grassed areas disturbed by construction received loam and seed.</p>
<p>September 2011 (Tetra Tech, 2012)</p>	<p>In September 2011, geophysical survey and soil borings were conducted in the vicinity of where ACM was identified in 2009 and was combined with investigation of the Combat Training Pool area due to the close proximity. The geophysical survey covered an area east and south of Building 1112CP and continued further into the Combat Training Pool study area. No potential debris was identified within the focus area studied. The geophysical survey was limited in area by the building and steep slopes.</p> <p>In September 2011, nine soil borings were conducted (four with hand augers and five via direct push drilling). Nearest the building, 1 foot of asphalt was encountered over earthen materials done to 10 feet or greater with some glacial till noted. C&D debris was encountered in subsurface soil in two of the borings (SB-03 and SB-04), but there was no evidence of ACM. At the edge of the slope, 2 to 3 feet of materials with boulders were encountered but no debris or ACM noted.</p> <p>Two planned borings couldn't be completed due to vegetation, a steep shoreline slope, and presence of large cobbles. The shoreline slope is extremely treacherous to access.</p> <p>Two 6-inch diameter concrete remnants were observed on the ground surface within a highly vegetated portion of the embankment at the top of the slope on this site, which appeared to have significantly degraded floor tile and mastic remaining on one surface of each remnant. The approximate location is shown on Figure 4; however, during a recent site walk, these remnants were not observed.</p>
<p>2012-2013</p>	<p>GPR survey and a test pits were conducted as part of investigation for a potential wind turbine project at locations near Building 1112CP on behalf of the Navy. According to NAVSTA Newport personnel, the test pits had traces of brick, and ledge. No petroleum or other type smell was observed.</p>
<p>2012 Aerial Photograph (see Figure 4) and July 2013 site walk</p>	<p>The aerial photograph represents current site conditions. Based on visual inspection, the area has been improved with pavement, vegetated soil, and gravel surrounding the buildings. The slope to the water is very steep, heavily vegetated and covered with riprap.</p>

Based on the chronology described above, the building that currently houses the Navy Supply Corps School was part of the original development of the area in the early 1940s. Areas around the building may have been subjected to subsequent changes including possibly filling with site improvement work. Recent construction uncovered C&D debris containing ACM in an area near the southeast corner of the building and more recent investigation activities focused in that area identified sporadic C&D debris in the subsurface. The encountered debris was removed from the construction area and the area since covered with asphalt and the concrete retaining wall.

Based on visual observations during construction and the results of the limited subsurface investigation, there is the potential for buried debris and possibly ACM in the subsurface within the study area beyond what was removed. And, based on the presence of debris, other constituents in the subsurface cannot be ruled out. There is also a possibility of ACM located on the surface of the shoreline slope; however, this is a very steep and rocky slope so access is extremely limited. It is not likely that site users or trespassers could access this area and additional assessment of these conditions is warranted for the RI.

The current conditions as shown in the 2012 Aerial Photograph on Figure 4, and based on recent site visits, indicate that the entire study area, except for the embankment slope, is covered by the building, paved areas, and soil with vegetation. It is likely that the current conditions provide protection from exposure to subsurface risks.

Combat Training Pool – Building 1357CP

The Combat Training Pool (Building 1357CP) is located along Meyerkord Avenue, southeast of the intersection of Meyerkord Avenue and Kollmeyer Street, and adjacent to the MARDET building area. The Combat Training Pool study area has been defined as a “parcel” boundary for the Combat Training Pool and is shown on Figure 5 as the area north of the New OTC Barracks Study Area, east of Meyerkord Avenue, south of Kollmeyer Street, and west of Coddington Cove. This area encompasses areas where ACM was encountered in the subsurface during construction activities in 2008 as discussed further below.

Date/Reference	Description
1939 Aerial Photograph (see Figure 4) and 1940 and 1941 base maps (Tetra Tech, 2012)	Unnamed streets located in southeastern corner of the study area. The drawings show a dashed rectangular structure believed to be the planned, future underground reservoir tank. The aerial photo shows the rectangular area as free of vegetation, but it is not clear if a structure is present at that time.
1942 and 1949 base maps (Tetra Tech, 2012)	A 2,250,000-gallon underground water reservoir (Reservoir B) is located in the east portion of the study area. Streets are no longer present. Buildings 1120 (Gun Mate School) and 1220 (Torpedo School) are present along the western border. The buildings are identified as Sound Powered Phone School and Gunnery School in 1949 with walkways leading to them.

Date/Reference	Description
1963 base map (Tetra Tech, 2012) and 1962 Aerial Photograph (see Figure 4)	Buildings remain on the western portion of the site. A parking lot is located on top of the underground reservoir in the eastern portion.
1991 and 1995 base maps (Tetra Tech, 2012) and 1981 Aerial Photograph (see Figure 4)	Parking lots appear to be present on both sides of the study area in 1981. In 1991 and 1995, a parking lot is not shown on the eastern portion of the site, but the underground reservoir is still present.
2008 (Tetra Tech, 2012 and Navy, 2011, except where noted)	<p>In 2008, during excavation activities to construct the P-370 Combat Training Pool, areas of C&D debris with ACM were encountered. To address the ACM (pieces of cement panels and non-friable vinyl asbestos floor tiles) an asbestos hazardous abatement management plan was developed and implemented. The extensive site work is believed to have removed the majority of ACM; additionally, the disturbed site was covered with clean fill at completion. Confirmation that all ACM has been removed from the subsurface was not achieved.</p> <p>Civil drawings for the pool project titled Training Pool Replacement, Final Submission (Consigli, SMRT, and Fuss & O'Neil, June 20, 2008) were reviewed. The project included construction of the Combat Training Pool building and 2 small parking lots on the southern portion of the study area. Concrete sidewalks and walkways were also constructed and 4 inches of loam and seed were installed across surrounding areas. Paved areas received a minimum of 1 foot gravel borrow and concrete sidewalks received a minimum of 8 inches gravel borrow. It appears that the final grade was similar to or up to 3 feet higher than the pre-construction grade.</p>
2010-2011 (see references in description)	<p>In 2010, the abandoned underground reservoir was partially demolished and backfilled. Civil drawings for the demolition project titled Demolition of Various Utility Structures (Ewing Cole and Greenhorne & O'Mara, February 26, 2010) with as-built markups were reviewed. The drawings indicate that the reservoir had an inside height ranging from 12 - 14 feet with concrete columns every 20 feet in both directions. The concrete roof, walls, and columns were demolished to 4 feet below grade and the bottom was broken into pieces 3 feet or smaller to allow for drainage. A portion of the reservoir approximately 10 feet wide closest to the pool building was left in place. The demolished structure was backfilled with stone, geotextile fabric, followed by soil, 6 inches of topsoil, and seed. As part of the same project, minor utility work was conducted just south of the pool building and no potential ACM was reported.</p> <p>In 2011, a retention pond was constructed over the location of the former reservoir under the same project for construction of the New OTC barracks to the south. This was confirmed by review of civil drawings for the project titled P451 Officer Training Command Quarters (Absher, Tetra Tech, April 12, 2011).</p>
September 2011 (Tetra Tech, 2012)	<p>In September 2011, geophysical survey and soil borings were conducted in the vicinity of where ACM was identified in 2008 and was combined with investigation of the Navy Supply Corps School area due to the close proximity. The geophysical survey covered areas surrounding the Combat Training Pool building, with the exception of several obstacles, including a retention pond, fill piles and other construction materials (no longer present), and a metal fence and guardrail.</p> <p>A depth of about 6 feet was noted for the GPR survey range. An area was identified as possible buried materials between the building and the retention pond. NAVFAC personnel had informed Tetra Tech that part of a former underground concrete reservoir remained in the ground at that location.</p>

Date/Reference	Description
	In September 2011, fourteen soil borings were conducted around the Combat Training Pool building. C&D debris was encountered in subsurface soil in four of the borings (SB-06, SB-13, SB-19, and SB-23), but there was no evidence of ACM. A portion of what was believed to be the concrete foundation from the former reservoir was encountered at approximately 6 feet below grade in borings SB-17, SB-20, and SB-23.
2012 Aerial Photograph (see Figure 4)	The aerial photograph represents close to current site conditions. The Combat Training Pool (Building 1357CP) is present along Meyerkord Avenue and paved and landscaped areas exist around the building. A retention pond is located east of the building. The aerial photograph shows a gravel pile east of the retention pond, which is no longer present, and the area has been landscaped. These conditions were confirmed during a recent site walk (7/2/2013).

To summarize, the Combat Training Pool study area was the former location of multiple buildings, the underground storage reservoir (part of which remains), and a parking area prior to the most recent construction activities for the Combat Training Pool. The reservoir was used for water and is not considered a source of ACM or other constituents.

Based on construction observations and recent limited subsurface investigations, there is the potential for buried debris and possibly ACM in the subsurface within the study area. Also due to the presence of debris, there is a possibility of other constituents present although there is no known specific release in the area. The current conditions are that the entire study area, with the exception of the steep embankment slope, has been covered by recent construction materials, including the building, the retention pond, and paved and landscaped areas. It is likely that the current conditions provide protection from exposure to subsurface risks, which will be further evaluated during the RI.

P 451 New OTC Barracks

The New OTC Barracks Site is located along Meyerkord Avenue, northeast of the intersection of Vaughan Street and Meyerkord Avenue. The New OTC Barracks study area has been defined as a "parcel" boundary for the New OTC Barracks and is shown on Figure 6 as the area north of Building 678, east of Meyerkord Avenue, south of the Combat Training Pool study area, and west of Coddington Cove. This area encompasses areas where ACM was encountered in the subsurface during construction activities in 2008 as discussed further below.

Date/Reference	Description
1939 Aerial Photograph (see Figure 4) and 1940 and 1941 base maps (Tetra Tech, 2012)	Unnamed streets located within the study area. The drawing show a dashed rectangular structure believed to be the planned underground reservoir tank. The aerial photo shows the rectangular area as free of vegetation, but it is not clear if a structure is present.
1942 and 1949 base maps (Tetra Tech, 2012)	The prior features are gone. Buildings 1221, 1231, 1241 (barracks), 1800 (office building), 1914 (pump house), and 1933 (Mark I Trainer building) are now present.
1963 base map (Tetra Tech, 2012) and 1962 Aerial Photograph (see Figure 4)	Former building 1933 is shown as an old foundation and does not appear visible on the aerial photograph. The other five buildings remain.
1981 Aerial Photograph (see Figure 4)	Parking areas and grassy vacant areas are present. No structures appear.
1991 and 1995 base maps (Tetra Tech, 2012)	Building 1287 (surrounded by fence) is present on east side of the study area. The remainder of the study area appears unoccupied except for parking areas present in 1995.
2009 (Tetra Tech, 2012 and Navy, 2011)	<p>A geophysical survey and follow-up test pits were completed in 2009 to support the design and siting of the New OTC Barracks. The areas of potential buried rubble based on the geophysical survey are shown on Figure 6. Buried debris with ACM was reportedly verified in several test pits; therefore, provisions for encountering ACM were included in the project specifications and an asbestos management plan was required for construction.</p> <p>Soil borings were also conducted as part of the design for the New OTC Barracks. Tetra Tech reviewed the results of the soil borings, which were completed by others on behalf of the Navy, and concluded that C&D debris was encountered in 7 of 25 borings (GB-06, GB-13 through GB-15, GB-17, and GB-18; and GZ-OTC-02). Note that the "GB-" borings are shown as "BH#" on Figure 6.</p>
2011 (Tetra Tech, 2012 and Navy, 2011)	<p>In 2011, ACM was encountered in the subsurface during construction activities for the New OTC Barracks. Based on information included in Tetra Tech's 2012 report, ACM was identified sporadically in many locations across the study area during construction. An ACM abatement program was implemented by the Navy's contractor for ACM debris encountered during the course of construction activities.</p> <p>Also reported during construction were the results of both perimeter and personal monitoring (Absher, 2012). A total of only five of the 198 air samples were found to exceed the Rhode Island clean air criteria of one one-hundredth fiber per cubic centimeter (0.01 f/cc) of air; none of the air samples were found to exceed the OSHA PEL of one-tenth fiber per cubic centimeter (0.1) f/cc.</p> <p>Civil design drawings for the project titled P451 Officer Training Command Quarters (Absher, Tetra Tech, April 12, 2011) were reviewed. It appears that the surface grade was raised by 1 foot up to several feet across the majority of the study area, with the exception of the area towards the southeast corner. Nearly the entire site was covered by either the new building, various concrete and paved surfaces, and reinforced turf. Concrete and paved surfaces included a minimum of 6 inches of aggregate base and the reinforced turf system is 9 inches thick.</p>

Date/Reference	Description
2012 Aerial Photograph (see Figure 4)	The aerial photograph represents close to current site conditions (as compared to a recent site walk on July 2 nd , 2013). The New OTC Barracks covers much of the study area. Subsequent to this photograph, construction materials and equipment surrounding the building were removed and the areas were finished with landscaping and pavement. Construction work and site improvements appeared complete at the time of the site walk.

To summarize, the New OTC Barracks study area was the former location of multiple buildings and parking lots prior to recent construction activities for the New OTC Barracks. Buried debris and ACM were encountered in several locations during construction activities and C&D debris had been encountered in test pits and borings conducted prior to construction. Although the Navy's contractor reportedly implemented an ACM abatement program for ACM debris encountered during construction, there is the potential for buried debris and possibly ACM to remain in the subsurface within the study area. Hence, there is also a possibility of other constituents co-located with the debris, although there are no reported releases in this area.

The current conditions are that the entire study area, with the exception of the embankment slope, has been covered by recent construction materials, including the building, concrete, paved, and landscaped areas. It is likely that the current conditions provide protection from exposure to subsurface risks, which will be further evaluated during the RI.

Nimitz Field

Nimitz field is located near the center of the Coddington Point area. The Nimitz Field study area has been defined as the "parcel" boundary for Nimitz field and is shown on Figure 7 as the area north of Vaughan Street, east of Elliot Avenue, south of Kollmeyer Street, and west of Meyerkord Avenue. This area encompasses the new Nimitz field track and athletic field and surrounding new vegetative support layer and grass as well as the building to the south of the track. The Nimitz Field study area encompasses an area just west of the track where ACM was encountered in the subsurface as discussed further below.

Date/Reference	Description
1939 Aerial Photograph (see Figure 5)	Roads appear to traverse the southern half of the Study Area; A feature which may be a rifle range target (see 1940 base map description below) is shown in the northwest corner of the Study Area.
1940 and 1941 base maps (Tetra Tech, 2012)	Same as 1939 aerial photo except that the feature referred to above is labeled as "Targets" and appears to be part of a rifle range that covers an area extending to the southeast from the Study Area.

Date/Reference	Description
1942 and 1949 base maps (Tetra Tech, 2012)	Buildings cover the Study Area including: Building 1100 (Office Building), Building 1130 (Gunners Mate School), Building 1140 (Gunners Mate School), Building 1230 (Torpedo School), Building 1320 (Yeomen School), Building 1330 (School [SK]), Building 1420 (Radio School), Building 1520 (S.M. School), Building 1530 (O.M. School), Building 1540 (Naval Reserve Training Center), and Building 1802 (Mess Hall). A rifle range that appeared on the 1941 drawings is no longer present on the 1942 and 1949 drawings. The former area is shown replaced by buildings and roadways.
1962 Aerial Photograph (see Figure 5) and 1963 base map (Tetra Tech, 2012)	Buildings remain except Building 1802 which has been demolished and the area appears vacant.
1981 Aerial Photograph (see Figure 5) and 1991 and 1995 base maps (Tetra Tech, 2012)	No buildings appear to be present.
July 2010 (Tetra Tech, 2012 and Navy, 2011)	Fragments of friable thermal insulation (TSI) and non-friable cementitious material encountered in excavated soils from just west of the Nimitz field track surface during utility trenching for new lighting around the perimeter of the field. Removal of encountered contaminated soil and debris was performed by the Navy's contractor. The area where ACM was un-earthed, as indicated in the Navy's <i>Sites of Known Buried ACM Rubble</i> (NAVFAC, 2011), is shown on Figure 7.
2011 (Tetra Tech, 2012)	Geophysical survey and soil borings conducted in the vicinity of where ACM was identified in 2010. The geophysical survey covered an area of approximately 50 by 260 feet, to a depth of 7 feet and presumed glacial till at 6 feet bgs. No potential debris was identified. Eight soil borings were conducted. All borings were completed to a depth of 10-feet bgs with no refusal encountered; with approximately 5-7-feet of fill encountered above glacial till and depths of 1 to 1.5 feet to fill layers. C&D debris was encountered in subsurface soil in one of the borings (SB-46), but there was no evidence of ACM. The soil borings and geophysical survey area are shown on Figure 7.
2012 Aerial Photograph (see Figure 5)	The current Nimitz field track and athletic field and building to the south are present.

To summarize, the Nimitz field study area was the former location of numerous buildings with a portion used as a rifle range over 70 years ago. Buildings were removed, followed by construction and use, prior to 1981. More recently, the Nimitz field track and athletic field and building to the south were constructed. It is unlikely that any impacts from the rifle range activities would remain given the extensive construction of buildings and roads in the early 1940s followed by demolition and more recent improvements to Nimitz Field. In addition, the former presence of "targets" is no longer evident after 1941.

There is the potential for buried debris and possibly ACM in the subsurface within the study area, based on the recent unearthing of such materials during utility improvements. The current conditions as shown in the 2012 Aerial Photograph on Figure 7, and as observed during recent site walks, indicate that the entire study area has been covered by recent construction activities, including the track, athletic field, building, and surrounding walkways and vegetated areas. It is likely that the current conditions provide protection from exposure to subsurface risks, which will be further evaluated during the RI.

Bishop’s Rock Improvement Project, Recreational Area, and Ball Field

Bishop’s Rock is located at the western most end of Coddington Point and was historically an island that has been connected by a manmade causeway to Coddington Point. At the eastern end of the Bishop’s Rock area, and to the North of Barschow Street, there is an open, grassy area used for recreational purposes. To the south of Barschow Street, there is a ball field. The Bishop’s Rock study area has been defined as the entire Bishop’s Rock and causeway as well as the recreational area and ball field located east of Bishop’s Rock on either side of Barschow Street as shown on Figure 8. The study area encompasses locations where buried debris and ACM were identified as discussed further below.

Date/Reference	Description
1939 Aerial Photograph (see Figure 6) and 1940 and 1941 base maps (Tetra Tech, 2012)	<p>Bishop’s Rock is an island with a pier extending approximately 500 feet south from the southern portion of the island. No other structures present.</p> <p>The area of the current recreational field and ball field is unoccupied except for Building K-61 (Drill Hall). A seawall is present at the western end of the current ball field.</p>
1942 and 1949 base maps (Tetra Tech, 2012)	<p>The pier is present but indicated as “abandoned”. A causeway connects Coddington Point to Bishop’s Rock and appears to be shown as under construction in June 1942 and completed in December 1942. Building 1927 was constructed on Bishop’s Rock during 1942 and is present in 1949. The land extending to Bishop’s Rock appears to have widened by 1949.</p> <p>Building 1700 (office building) is present on the current recreational field. Within the area of the current ball field, Building K-61 remains and Buildings 1720, 1730 (F.C. School), 1600 (Office Building), 1721, 1731, and 1741 (Barracks) were added by 1942 with a road around them. By 1949, Buildings 1730 and 1731 were gone.</p>
1962 Aerial Photograph (see Figure 6) and 1963 base map (Tetra Tech, 2012)	<p>Bishop’s Rock appears larger and the causeway appears wider. No building appears to be present. A seawall is present on the southeastern portion of Bishop’s Rock.</p> <p>Within the area of the current recreational field, Building 1700 remains and a small structure labeled 338 is now present with a small fenced area next to it. Within the area of the current ball field, Building K-61, 1720, and 1600 remain but the other buildings have been demolished and a gravel parking area is present at the southern end.</p>

Date/Reference	Description
1981 Aerial Photograph (see Figure 6) and 1991 and 1995 base maps (Tetra Tech, 2012)	<p>Building 998 (recreational pavilion) is now present and the causeway appears to have widened further compared to the 1962 aerial photograph.</p> <p>No structures remain in the area of the current recreational field and ball field, except for Building K-61 and Building 338. The small fenced area next to Building 338 is labeled "Trans."</p>
2011 (Tetra Tech, 2012 and Navy, 2011)	<p>During preparatory site work for an improvement project of this area, shoreline rip rap repair and shallow surface excavations on the causeway, ACM (pieces of wall panels and non-friable floor tiles) was encountered in April 2011. Additional suspect ACM was encountered soon after when excavation activities for construction of a new pavilion was performed at Bishops Rock. The soil from excavated areas at which ACM was encountered was segregated from soil from other areas of excavation. These ACM contaminated soils were being managed following the work practice requirements of NESHAPs. Disposal of ACM occurred during construction activities and the entire improvement area received a cover of geotextile and one foot of clean fill among other landscape improvements.</p> <p>Construction-related information including drawings titled Bishop's Rock Landscaping Improvements (Oak Point Assoc., February 19, 2010) with 2011 as-built markups and sketches were reviewed. This information confirmed that geotextile and one foot of clean fill were placed over the entire causeway and Bishop's Rock area with the exception of the sloped stone revetment and natural stone and beach areas along the shoreline.</p>
2011 (Tetra Tech, 2012)	<p>In September 2011, a geophysical survey was conducted over the majority of Bishop's Rock and the causeway, excluding inaccessible areas and the northern part of Bishop's Rock. Metal anomalies or potential areas of interest were identified at locations shown on Figure 8. The GPR survey results were limited to less than 3 feet bgs due to the likely high conductivity in the soil.</p> <p>Soil borings were conducted within and near the areas from which buried debris and ACM were encountered during the construction activities described above. Twelve soil borings were conducted. C&D debris was encountered in one boring located on Bishop's Rock and five of the borings located on the causeway and a piece of suspected asbestos-containing transite tile was observed in one boring. The soil borings and geophysical survey area are shown on Figure 9.</p>
2012-2013	<p>GPR survey and test pits were conducted as part of investigation for a potential wind turbine project at locations near the shoreline at Bishop's Rock, the recreational field, and the ball field on behalf of the Navy and according to NAVSTA Newport personnel, no buried anomalies were identified. At the recreational field, NAVSTA Newport personnel reported that one large test pit was dug to approximately 3.5' to 4' deep. No obvious obstructions were located except for some large rocks at about the 4 foot depth mark. Traces of cobbles, brick and several of the large stones/boulders were observed. Differences in soil make-up were also observed (sand). No petroleum or other type smell was observed.</p>
2012 Aerial Photograph (see Figure 6)	<p>This photograph represents close to current site conditions including the new pavilion, but without the most recent landscape improvements over the new cover materials.</p>

To summarize, the Bishop's Rock study area was subject to extensive filling both on the former island and the entire causeway connecting the island to Coddington Point. There is the potential for buried debris and possibly ACM in the subsurface due to known land improvements and demolition activities related to former building on the fields adjacent to Bishops' Rock jetty. Due to the discovery of buried debris and ACM by the Navy in 2011 during an improvement project at Bishop's Rock, the Navy covered the entire improvement area with geotextile and a foot of clean fill among other landscape improvements. There is no knowledge of buried debris within the recreational field and ball field; however, buildings were historically present in these areas. These areas appear covered by soil and vegetation. Hence, although debris may be present in the subsurface, current conditions appear to provide protection against exposure to subsurface materials, which will be further evaluated during the RI.

During the initial discovery and discussions between the Navy and the regulatory agencies regarding these 5 areas of concern at Coddington Point, three other sites were discussed. These were the new chiller unit at Building 1284CHI, the new fitness center near Building 109 CP, and P-082 Un-manned AWS Support Facility Building 119 CC. Asbestos materials were encountered and handled by the Navy at these sites. Remedial actions have been conducted at these areas. A summary of activities are included below:

- New Chiller Unit Building 1284CHI

Pieces of ACM were discovered in September 2008 during site work preparation for the new building to house the new chiller unit. The pieces of ACM initially discovered were at the surface; later, additional pieces of ACM were found in the subsurface during the excavation. The pieces of ACM were removed and disposed. The excavated soil was stockpiled and sampled for asbestos. NAVSTA Newport Environmental, in coordination with USEPA Region I, developed a soil management plan for the reuse of the excavated soils as on-site backfill. The construction at the site is now complete.

- New Fitness Center near Building 109 CP

Construction of the New Fitness Center began in August 2009. During subsurface trenching activities to install utilities for the new building, building debris was discovered. Laboratory analyses confirmed the presence of ACM in the building debris (insulation and cementous panels). Encountered ACM during this project was removed by the contractor in accordance with a hazard abatement plan for asbestos materials. Additionally, the P-347 New Fitness Center is partially located on environmental restoration (ER) Site 9 Old Fire-Fighting Training Area (OFFTA). The construction of the building (foundation) and associated parking lot has

been incorporated into the remedy for the ER Site 9. Any remaining ACM within the footprint of the IR Site 09 is being addressed through the Record of Decision (ROD) under CERCLA; the remedy will include maintaining a remedial cover over the entire site (including ACM areas), and periodic inspection of the cover along with the implementation of land use controls.

- P-082 Un-manned AWS Support Facility Building 119 CC

During construction activities, the interior of the building was gutted and the concrete slab demolished. During the demolition of the grade-level interior slab, pieces of friable TSI containing asbestos was discovered. To address the encountered ACM, asbestos hazardous abatement plans were developed to manage and dispose of encountered ACM following the work practice requirements of NESHAP. Over-excavation into the subsurface was required to allow for the installation of new utilities, and no additional ACM was encountered in these additional excavations. The excavated area received flowable fill and a new concrete slab. No additional investigation was conducted at this location as no additional ACM was reported, and the identified asbestos hazard was mitigated by the construction activities.

Note that the Navy is in the process of demonstrating compliance at these and other areas as part of its base-wide environmental management program for handling asbestos.

Current Site Use of Coddington Point

The Coddington Point area is currently used for Naval-related education and training, operational and administrative functions, housing, and recreation. Ordnance related training does not occur at this location. Storage and processing of wastes or manufacturing of any kinds does not occur.

Terrestrial portions in the area may provide habitat for ecological receptors such as plants, soil invertebrates, and small birds and mammals. However, buildings, pavement, gravel, and maintained lawn areas are unlikely to provide suitable habitat or foraging areas for many ecological receptors.

Groundwater at the site is not currently being used for potable use, there are no drinking water wells present on site, and the site is served by the municipal water supply. Groundwater beneath Coddington Point is classified as GB by the State of Rhode Island.

Summary of Topography and Geology

The topographic profile of Coddington Point and most of NAVSTA Newport is generally flat. The ground elevation ranges from less than 10 to approximately 40 feet above sea level within the northern end of Coddington Point, with downward slopes toward the coastline.

Based on soil borings conducted around the five study areas in 2011 (Tetra Tech, 2012), specific observations regarding soil types and presence of fill material are summarized below and further described in the subsequent paragraphs.

- New soils and structures are present at the surface of most areas, including new soil, asphalt and buildings.
- Fill with debris is present in identified locations from 1 to 4 feet bgs or greater.
- Native materials are comprised mostly of sandy silts are present generally between 1 and 10 or more feet bgs.
- Glacial till is present as shallow as 5 feet bgs and it comprised mostly of sand and gravel.
- Bedrock is encountered at the surface as outcrops in some areas and can be deeper than 10 feet bgs in others.

Naval Supply School

In the area of the building, along the shoreline, there is dense vegetation and steep shoreline slope. The shoreline is covered with large rock cobbles. Based on observations made during prior soil boring advancement, upland subsurface ranges from a thickness of 2 to 3 feet to refusal to greater than 10 feet. There are bedrock outcrops in the area as well. Generally, there are layers of native materials immediately below approximately 12 inches of asphalt. Glacial till was encountered below the more shallow layers of silt, sand and gravel. C&D debris consisting of brick was encountered in a few locations at depths less than 4-feet bgs.

Combat Training Pool

Fill materials were generally encountered in the area of the Combat Training Pool building from the ground surface to the top of bedrock. Fill materials typically consisted of a mixture of silts, sands, and gravel along with some C&D debris at some locations. Bedrock, composed of phyllite, was encountered between 1 to 6 feet bgs in borings located east of Meyerkord Avenue and on the west of the Combat Training Pool building. To the north and east of the building, refusals due to bedrock occurred at depths of 8 to 14 feet bgs. Borings located just east of the Combat Training Pool building encountered the concrete foundation of a former manmade subsurface reservoir at a depth of 6 feet bgs; hence, it is presumed that debris would not be present below that foundation.

New OTC Barracks

There were no soil borings advanced during the urban fill evaluation efforts. However, due to the proximity to the Combat Training Pool, the conditions are expected to be similar. During pre-construction site assessment efforts, there were several locations reported with debris at depths as shallow as 2 feet bgs, according to the fill report. Accurate depths to bedrock were not reported; however, based on a review of prior soil borings conducted, it is expected that bedrock is generally greater than 10 feet bgs.

Nimitz Field

In borings conducted on the track side of the electrical conduit, approximately 5 to 7 feet of fill material were encountered above glacial till. In borings conducted on the west side, where the ground elevation was lower, fill was observed to a depth of approximately 1.5 to 5 feet bgs and was underlain by glacial till. Fill materials were composed of silty sands and sandy silts with no to little gravel, along with some C&D debris at one location. Glacial till was composed of sandy silts with gravel. No evidence of bedrock was encountered to a depth of 10 feet bgs (bottom of borings).

Bishop's Rock

At the western tip of Bishop's Rock, refusal was encountered at each boring location at depths of 3 to 7 feet bgs (likely bedrock). Within the borings, 1 to 6 feet of fill consisting of silt, sand, and gravel was observed. At a location closer to the mainland, several borings revealed the presence of similar fill to depths of 15 feet bgs depending on the distance upslope away from the shoreline and pier boundary. Weathered bedrock was encountered as shallow as 6 feet bgs. Debris was encountered in several borings below the surface. Wet conditions were observed between 6 feet and 15 feet in the deeper soil locations. However, it is not certain that this observation was of groundwater from upgradient flow or due to sea water intrusion.

Summary of Nature and Extent of Contamination

The planned investigation described in this SAP is intended for the identification and delineation of buried ACM debris within the identified areas of concern, assessment of existing cover materials that may act as physical barriers to ACM, and identification of other potential demolition rubble-related constituents in the soil, co-located at each of the buried debris areas. For purposes of this RI, the extent of debris and other constituents in the subsurface includes the study area boundaries. The extent may be shown to be less as additional information is obtain during the RI in the field or from additional historical documentation.

Potential sources of constituents in soil are limited at Coddington Point. This area has been used for training, education, and housing since the Navy bought the land nearly 100 years ago. Based on the Evaluation of Urban Fill (NAVFAC, 2011), it is possible that constituents other than ACM could be present in soil associated with the buried debris. The Navy and regulatory agencies have selected lead, mercury, PCBs, and VOCs as typical urban fill constituents that could be associated with the buried debris at Coddington Point. The potential sources of these constituents (based on typical urban fill) are as follows:

- Lead potentially from lead-based paint
- PCBs potentially from light ballasts, PCB-based paint, and caulking and glazing materials
- Mercury potentially from former light ballasts and switches
- VOCs, which are not considered to be associated with C&D or ACM impacts, but are included per a request from RIDEM to assess their potential presence at this site

Target Matrices

Based on the presumption that building debris exists in the areas of concern within the soil matrix, shallow soil and subsurface soil are the targeted matrices for the planned investigation. Groundwater is not a targeted matrix at this point, but may be considered for future assessment activities if warranted.

CSM Summary

Data to be collected during the planned investigation will be used to determine the presence of buried building demolition debris assumed to contain ACM, the presence of existing cover materials that may act as physical barriers to ACM, and whether the known areas of buried building demolition debris resulted in the release of other constituents. The analytical data will be used to assess potential risks to receptors from these contaminants, if present, and position each of the Coddington Point study areas for contaminant delineation and/or further evaluations. Figure 3 presents a graphical depiction of potential exposure pathways. These pathways present the potential sources, pathways and receptors that are likely to be evaluated during this investigation or subsequent investigations/evaluations.

The primary sources of contamination at Coddington Point are assumed to be building demolition components. Potential residual constituents are assumed to include PCBs, lead, and mercury (all three can be associated with building demolition debris). The investigation for VOCs is being included based on discussions with the agencies that the presence of VOCs in these areas is possible. The primary release mechanism consists of direct "discharge" of materials to soil via runoff/leaching, as well as spills/leaks. Asbestos is a known subsurface site contaminant found in

the buried building debris, the likely source of ACM in the subsurface allegedly released during repair or demolition activities.

To generalize based on the existing conceptual site model information, exposure routes possible are:

- Where conditions are insufficient to eliminate direct contact (i.e. appropriate cover materials exist), direct contact to contaminated materials and soil is possible, and leaching of contaminants to the subsurface is possible.
- Where conditions are sufficient to eliminate direct contact (i.e. appropriate cover materials exist), direct contact to contaminated materials does not exist, expect under future construction scenarios. Leaching to the subsurface is still possible.
- Exposure to subsurface conditions are assumed possible only under future construction activities. Exposure to VOCs in soils is possible via vapor intrusion scenarios.

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

[\(UFP-QAPP Manual Section 2.6.1\)](#)

The project quality objectives (PQO) for this investigation are to assess the extent of impact within identified areas of buried debris, assess the conditions of existing cover materials in those areas, and identify other constituents in soil which may be present within the buried debris areas. A secondary objective is to determine if the detection of other constituents warrant consideration of additional investigation and/or evaluation. The project quality objectives (PQOs) were developed for this investigation based on the *Guidance on Systematic Planning Using the Data Quality Objectives Process* (USEPA QA/G-4) (USEPA 2006) and are presented below.

Step 1 – Problem Statement

The planned investigation at Coddington Point is to further characterize the nature and extent of buried debris in five specific study areas. The extent of debris in each study area may not be fully delineated, may not have sufficient cover materials to eliminate potential exposure pathways, and/or may contain residual contamination other than asbestos. The specific study goals identified below are designed to address these objectives, as well as quantify potential human health and ecological risks (if any) posed by the buried debris.

Step 2 – Study Goals

Based on the project objectives outlined above, the specific study goals of the planned investigation are listed below.

- Goal 1 - Identify and delineate the buried debris in each area of concern where buried debris is suspected and where the limits of buried debris are assumed to be the limits of ACM risks.
- Goal 2 - Determine the adequacy of cover materials for protectiveness and suitability as physical barriers to ACM in the subsurface.
- Goal 3 - Assess potential impact to subsurface soil from constituents other than ACM associated with buried debris.

Step 3 – Information Inputs

Information inputs will consist of construction completion reports, environmental screening data and field samples from Coddington Point, as presented in this SAP. The following data will be collected to assess soil conditions and assess the presence of historic releases at the study areas:

- Available reports related to asbestos findings and new construction limits for work completed in the areas of buried debris.
- Subsurface geophysical assessment information.
- Debris in soil – debris located during soil boring advancement and observations.
- Soil types, depths and fill/bedrock depths.
- Surface and subsurface soil analyses – lead, mercury, PCBs, VOCs.

Step 4 – Study Boundaries

The Coddington Point sites consist of approximately 8 acres of land inclusive of the several areas of concern previously identified. Refer to Figure 1 for the regional location and other figures for the assessment locations. General spatial and temporal boundaries are described below.

Spatial Boundaries

Prior investigations at Coddington Point have identified locations of buried debris that are assumed to be possible sources of other constituents in soil in those locations. Although there have been limited removals of debris and ACM for construction purposes, the area associated with the debris represent the planned investigation areas (refer to the figures) under the assumption that debris could be found in the subsurface below each area. In discussions between the Navy and the regulatory agencies, it was agreed that the boundaries of each area would be used as the study areas unless documentation was available to indicate debris below each area is limited in extent.

The planned investigation is designed to collect potentially-impacted media data to assess the presence of such constituents and the depth of impact, if any. The depth of potential impacts is considered to be relatively shallow (less than 10 feet), based on prior investigations.

Temporal Boundaries

The temporal boundaries for this study will be the period of the actual field investigation, anticipated to occur in the fall of 2013. There are no seasonal variations anticipated to affect this investigation.

Step 5 – Analytical Approach

The analytic approach for the planned investigation is comprised of a series of “if... then...” statements.

Goal 1 - Verify the presence of buried debris within each area using a combination of historical information, geophysical data, and soil borings.

-
- If presence of buried debris is unknown in an area, assess historical aerial photos, construction records (if they exist), and/or conduct geophysical survey to locate potential debris.
 - If debris is identified in new geophysical assessment results, locations will be recorded and soil borings (Goal 3 below) will be biased to those locations.
 - If debris is present in a soil boring, the debris will be field characterized and debris type and soil type will be recorded.
 - Each soil boring location will be recorded using GPS and depths to sample locations and observations will be recorded.

Goal 2 - Identify the depth and suitability of soil or other cover within each area. Depth will be estimated by visual inspection for the absence of debris and soil type, or confirmed by prepared as-built construction drawings that may exist.

- If visual inspections, engineers' dissertations, or construction records indicate that shallow soil consists of clean fill (or appropriate equivalent cover such as pavement or a building), the area represented by the records shall be considered covered for purposes of future evaluation of remedial alternatives.
- If adequacy of cover material in an area is unknown (see above), shallow soil borings shall be used to assess cover type and thickness.
- If shallow soil (0 to 2 feet) in soil borings are free of debris, the cover will be considered clean fill for purposes of future evaluation of remedial alternatives related to ACM.
- If shallow soil in soil borings contain debris, locations will be considered for sampling for debris and ACM assessment.

For purposes of the RI, adequate cover includes cover materials listed in 40 CFR 61.151 for inactive asbestos waste sites, as a guide, or equivalent, such that proposed use of the areas will result in no visible emissions to the outside air. Equivalent covers include barriers such as 3 or more inches of asphalt, 3 or more inches of concrete, a building or other structure that cannot be accidentally unearthed.

Goal 3 - Sample subsurface soil associated with the buried debris within each area. Laboratory analysis will include VOCs, total PCBs, lead, and mercury.

- If constituents are present in site-specific environmental media, then they will be compared to relevant screening criteria used to develop the PALs. Screening criteria used for PAL development included the RIDEM Direct Exposure Criteria and GB Leachability Criteria and EPA Regional Screening Levels for Soil (see also WS 15). The lower of the values was used for each analyte as the PAL.

-
- For constituents not detected using the laboratory detection limits presented, such analytes will be considered not present for purposes of this investigation.
 - If constituents are present in soil then their distribution will be used to assess the potential impact to soils and to evaluate additional investigation locations.
 - If visual observations made during soil sampling identify other potential impacts (e.g., staining, oily substance), then additional samples may be collected and analyzed to refine the vertical extent at that location.
 - If visual observations made during soil sampling identify debris, those locations will be recorded and documented as to types and depths of debris encountered.

Step 6 – Performance Criteria

Sampling Strategy

A biased sampling design based on previously identified site impacts (the buried debris areas) will be used to place soil sampling locations.

Where geophysical results indicate the presence of debris, or where new evidence is found that might warrant sample location changes, Navy will consult with EPA and RIDEM prior to the placement and collection of unplanned samples.

Potential Sources of Error

Potential sources of error in the investigation may be divided into two main categories: sampling errors and measurement errors. A sampling error can occur when the sampling design, planning, and implementation do not provide for a representative range of heterogeneity at the site. A measurement error can occur when performance variance from laboratory instrumentation, analytical methods, and/or operator error occurs. USEPA identifies the combination of these errors as a “total study error” (USEPA, 2006). One objective of the planned investigation is to reduce the total study error so that decision-makers can be confident that the data collected accurately represent the chemical characteristics of the sites.

Managing Decision Error

The investigation will utilize decision-error minimization techniques in sampling design, sampling methodologies, and laboratory measurement of compounds of interest. Possible decision errors will be minimized during the field investigation by using the following methods:

- Evaluate available historical data and perform site reconnaissance visits as needed to identify sampling locations and site characteristics.

-
- Use standard field sampling methodologies (as discussed in Worksheets #18 and #21). Perform sampling activities in accordance with the standard operating procedures (SOPs) referenced in this SAP.
 - Use applicable analytical methods (discussed in Worksheets #23, #24, and #25) for sample analysis by a competent analytical laboratory certified by the DoD Environmental Laboratory Accreditation Program (ELAP) to reduce measurement errors.
 - Confirm analytical data to identify and control potential laboratory error and sampling error by using spikes, blanks, and replicated samples.
 - For analytical results that do not achieve desired PALs, include a discussion of alternate information inputs as part of the assessment conclusions and uncertainty analysis.

Decision errors associated with judgmental sampling are based on sample design and measurement errors. Assuming that the best possible professional judgment was used to develop the sampling plan (e.g., position sampling locations), the most important decision errors will be associated with field and laboratory techniques involved in the collection and analysis of the data.

Sampling Methods and Procedures

Possible decision errors generated by sampling errors will be minimized during the field investigation by applying standardized field sampling methodologies (to be discussed in Worksheets #18, #20, #21, and #22).

Laboratory Measurement of Compounds of Interest

Possible decision errors generated by laboratory measurement errors will be minimized by using applicable analytical methods (to be discussed Worksheets #23, #24, and #25) for sample analysis by a competent analytical laboratory evaluated and certified by the DoD ELAP.

Managing Laboratory Sampling Error

Control of potential laboratory error and sampling error will be minimized by using spikes, blanks, and duplicates. Sampling error may be introduced when the laboratory chemist selects a single portion of the field sample for laboratory analysis. Homogenizing the sample prior to selecting an aliquot for laboratory analysis will help to minimize the sampling error.

Step 7 – Obtaining the Data

The sampling design was developed to optimize resources and generate data to satisfy the PQOs. The critical objective is to obtain a quality dataset for evaluation.

Field Parameters

Field measurements will be recorded in a field logbook and/or onto field data collection sheets. Field data will be compiled and stored in project folders for subsequent use in evaluating analytical data.

Soil Sampling

For each boring proposed for this investigation, shallow (surface) soil samples (0 to 1 and 1 to 2 foot bgs) and a subsurface soil sample (within the range of 2 to 10 feet bgs) will be collected and submitted for analyses. Further details on the soil sampling are provided in Worksheet #17 and the proposed locations are depicted on Figure 9. Refer to Table 11-1 for further sampling rationale.

Analytical Laboratory Sample Management

The sample matrix, number of samples, and number and type of laboratory quality assurance and quality control (QA/QC) samples are summarized in the "Sample Details Tables" of this SAP. Details on the analytical group, sample volumes, sample container specifications, preservation requirements, and maximum holding times are identified in Worksheet #19 and #20 of this SAP.

The laboratory will provide EQUIS electronic data deliverable files, portable document format (PDF) files of the data deliverables for all project data, and a hard copy of data deliverables for all results including results from secondary subcontract laboratories. Designated samples will be used to obtain necessary subsamples for laboratory QC measurements, which includes analytical sample duplicate and sample matrix spike/matrix spike duplicate (MS/MSD). Tasks will be completed using the laboratory SOPs.

Resolution will provide data validation services and verify and evaluate the usability of the data as identified in Worksheets #31 through #37.

PDF copies of all analytical data packages will be stored on CD-ROM, archived in the NAVFAC LANT Administrative Record, and uploaded onto the Naval Installation Restoration Information Solution (NIRIS) system using the Navy Electronic Data Deliverable (NEDD) database format. All other data generated in the field and reports generated for the project will be stored as computer readable data files by Resolution and the native files will be provided to the Navy.

Table 11-1
Sampling Rationale Table
Buried Debris Locations
Coddington Point, NAVSTA, Newport, RI

Area/Sub area:	Bishop's Rock		Nimitz Field (entire field)	Naval Supply School			Combat Training Pool	New OTC Barracks
	Jetty area	Upland fields		New construction (SE area)	Riprap slope	Northern parking area		
Check/verify extent of buried debris	Completed (prior EM/GPS effort). Assume debris remains below newly placed surface cover as indicated.	Unknown. Provide EM/GPR survey to check for/locate possible buried debris where buildings once stood.	ACM not identified during track construction per Navy oversight staff. ACM found near electric conduits for lighting. Assume debris remains below track area.	Completed based on prior EM/GPS effort and confirmed with Navy engineering staff.	Unknown; requires visual inspection for ACM.	Prior site improvements did not reveal debris or ACM issues; gun mounts were observed but covered with new fill and pavement.	Completed based on prior EM/GPS effort and confirmed with Navy engineering staff.	Completed based on prior EM/GPS effort and confirmed with Navy engineering staff.
Evaluation of existing surface conditions as cover material	Favorable existing conditions (observed new construction of geotextile, gravel and soil during site walk; confirmed with Navy oversight staff).	Unknown. Evaluate via soil borings if EM/GPR survey identifies debris.	Unknown, but assumed appropriate based on construction of new track and field. Verify surface around track via soil borings.	Favorable existing conditions (observed new construction; confirmed with Navy engineering staff and as-built drawings).	Slope is inaccessible and covered with vegetation and large boulders. Footing is treacherous.	Favorable existing conditions (observed new construction; confirmed with Navy engineering staff and as-built drawings).	Favorable existing conditions (observed new construction; confirmed with Navy engineering staff and drawings).	Favorable existing conditions (observed new construction; confirmed with Navy engineering staff and drawings).
Concern for other constituents (PCOCs)	Yes, subsurface soil samples should be collected from locations of identified debris.	Yes, if debris is identified in EM/GPR survey or in soil borings. Sample shallow and subsurface soil where debris is represented.	Yes, due to prior EM/GPR results indicating buried debris in lighting area and historical uses. Sample subsurface soil where debris is represented and rifle range area.	Yes, subsurface soil samples should be collected from locations of identified debris.	Not likely based on slope and inaccessibility.	There is no prior history of debris in this location except for the former gun mounts. Sample subsurface soil where debris is represented (gun mount area).	Yes, subsurface soil samples should be collected from locations of identified debris.	Yes, subsurface soil samples should be collected from locations of identified debris.
Proposed field effort	-Soil borings for observations and subsurface sample collection for PCOCs (at debris locations)	-EM/GPR survey -Soil borings in each area for observations, and surface/subsurface sample collection for PCOCs and ACM if necessary	-Soil borings for surface conditions observations -Soil borings for observations and subsurface sample collection for PCOCs	-Soil borings for observations and subsurface sample collection for PCOCs (in debris area)	-Observe ground surface and collect suspect debris for ACM analyses.	-Soil borings for observations and subsurface sample collection for PCOCs (in debris area)	-Soil borings for observations and subsurface sample collection for PCOCs (in debris area)	-Soil borings for observations and subsurface sample collection for PCOCs (in debris area)

SAP Worksheet #17: Sampling Design and Rationale

[\(UFP-QAPP Manual Section 3.1.1\)](#)

Overview

This section describes the sampling rationale and sampling design for the collection of surface and subsurface soil samples at the five areas of concern within Coddington Point. The general approach for the planned investigation is to collect site characterization data, designed to refine the CSMs and to complete a depiction of the sources, pathways, and receptors of site contaminants. PALs have been selected based on potentially relevant regulatory screening values applicable to soil. For asbestos analyses, the laboratory detection level is proposed as the PAL since there is no specific regulatory criterion to apply. The detection level of 0.25% will be used as the PAL and to assess the presence or absence of asbestos in a sample.

A key element for this investigation is to identify possible impacts that originate from the buried debris in the five areas of concern, including potential soil impact from lead, mercury, PCBs, and VOCs. Further details regarding the specific PQOs for the planned investigation are presented in Worksheet #11, and PALs are quantified in Worksheet #15. The following paragraphs describe the general methodology and rationale for the specific sampling approach.

Field Screening

Other than making visual observations of debris, measurements will be obtained in the breathing zone of field staff during sampling activities to assess potential health risks. The organic vapor measurements will be recorded using a PID or similar device. Measurements will also be obtained at each sampling depth interval during the collection of soil samples. Air monitoring for asbestos is not planned, as long as direct push techniques are used as planned, the soil samples remain wet, and asbestos is not observed. The field screening data will be reviewed by the project team to best estimate the optimal locations (depth) for the collection of subsurface soil samples.

Soil Sampling

Approximate locations of the planned soil samples are shown on Figure 9, showing each buried debris area. These locations will be field-adjusted as necessary to accomplish the PQOs for this SAP. In addition, based upon the results of the EM/GPR survey proposed for the Bishop's Rock recreational area, soil sample locations may be added to that area. Also, upon review of the EM/GPR data, should planned boring locations require adjustment; a revised figure will be prepared for review and concurrence from the regulatory agencies prior to implementation.

The precise depths of soil samples will be selected based on visual evidence of impacts (such as the presence of building debris), organic vapor measurement, and relative depth. The specific methodology and procedures to be implemented for soil sampling are included within the SOPs provided with this SAP. Based on the field screening measurements and discussion among the project team, sample locations and depths will be selected and recorded.

The depths of soil samples will be designed to span 0 to 1 and 1 to 2 foot bgs (surface; collected for analyses) and 2-foot intervals from 2 to 10 feet (or possibly deeper if debris is found at deeper intervals), with one 4-foot interval collected for analyses, depending on field screening for VOCs and visual observations. The actual depth of soil samples may be adjusted to include a depth range smaller than 4 feet in order to target an area of with field evidence of contamination, if observed. The actual depth of soil samples may be shallower than 10 feet if groundwater or bedrock is encountered at shallower intervals. Groundwater may not be encountered in most areas except for the Bishop's Rock area. In that area, the expected depth to groundwater is 6 to 10 feet, based on prior investigations.

Soil samples will be collected and handled in accordance with SOP 3-17 and analyzed for VOCs, PCBs, lead, and mercury. These samples will be preserved in accordance to this SAP and shipped chilled to less than 6 degrees Celsius (°C). In addition to the primary samples, duplicate soil samples will be collected from proposed sampling locations in accordance with this SAP. Samples will be shipped on the day of sampling or as soon as logistically possible. All sample shipments to a designated laboratory will contain appropriate chain-of-custody (CoC) forms.

Geophysical Survey

A subsurface survey using EM and GPR techniques will be performed in the recreational areas at Bishop's Rock (north and south of Barschow Street). These areas include mostly open grounds for recreation including a ball field to the south. Both areas were once foundations for buildings that have since been demolished. Hence, buried debris may exist and this survey is intended to assess the subsurface for debris. This is a non-intrusive activity using instrumentation at the surface to detect the presence of non-native items below the ground surface. A description of the limitations of the EM and GPR techniques is included in the appendices.

Surficial Inspection

A RI-licensed asbestos inspector will inspect and search the shoreline slope along the edge of the Navy Supply School/MARDET Building for signs of ACM (Figure 9). The inspector will walk the perimeter of the area and pass within the perimeter with a maximum of 10-foot spacing between passes. Materials that are suspected to be ACM will be collected for analyses.

Table 17-1
Sampling Rationale Table
Buried Debris Locations
Coddington Point, NAVSTA, Newport, RI

Proposed Sample Locations	Media	Target Depth (ft bgs)	Analyses			Rationale
			Field observations	Pb, Hg, PCBs, VOCs	Asbestos	
OT01; OT02; OT03; OT04; OT05; OT06; OT07; OT08; CPT01; CPT02; CPT03; CPT04; CPT05; CPT06; MA01; MA02; MA03; MA04; MA05; MA06; MA07 (21 locations)	Subsurface soil	2 to 10 (or refusal)	P	P	-	Document cover thickness and type (0 to 2 feet bgs). Sample interval will be biased towards interval with apparent debris. Composite of 2 to 10 feet bgs will be sampled if debris is not observed. Additional sample will be collected if multiple debris layers are observed or other field conditions warrant sampling (staining, strong odor, etc).
NF01; NF02; NF03; NF08; NF09; NF10 (6 locations)	Subsurface soil	2 to 10 (or refusal)	P	P	-	Document cover thickness and type (0 to 2 feet bgs). Sample interval will be biased towards interval with apparent debris. Composite of 2 to 10 feet bgs will be sampled if debris is not observed. Additional sample will be collected if multiple debris layers are observed or other field conditions warrant sampling (staining, strong odor, etc).
NF04; NF05; NF06; NF07 (4 locations)	Surface soil	0 to 2 feet	P	-	S	Document cover thickness and type (0 to 2 feet bgs). Collect sample for ACM analyses if suspect debris is present in this interval. Collect sample for lab analyses if field conditions warrant sampling (staining, strong odor, etc).
BR01; BR02; BR03; BR04; BR05 (5 locations in Jetty area)	Subsurface soil	2 to 10 (or refusal)	P	P	-	Document cover thickness and type (0 to 2 feet bgs). Sample interval will be biased towards interval with apparent debris. Composite of 2 to 10 feet bgs will be sampled if debris is not observed. Additional sample will be collected if multiple debris layers are observed or other field conditions warrant sampling (staining, strong odor, etc).

Proposed Sample Locations	Media	Target Depth (ft bgs)	Analyses			Rationale
			Field observations	Pb, Hg, PCBs, VOCs	Asbestos	
BR06; BR07; BR08; BR09; BR10; BR11; BR12; BR13 (8 locations in upland fields)	Surface soil	0 to 2 feet	P	S	S	Document cover thickness and type. Collect sample for ACM analyses if debris is present in this interval. Collect sample for lab analyses if field conditions warrant sampling (staining, strong odor, etc).
BR06; BR07; BR08; BR09; BR10; BR11; BR12; BR13 (8 locations in upland fields)	Subsurface soil	2 to 10 feet (or refusal)	P	P	S	Sample interval will be biased towards interval with apparent debris. Composite of 2 to 10 feet bgs will be sampled if debris is not observed. Additional sample will be collected if multiple debris layers are observed or other field conditions warrant sampling (staining, strong odor, etc). Collect sample for ACM analyses if debris is present in this interval.

P = primary analyses

S = Secondary (based on field evidence/observations)

SAP Worksheet #14: Summary of Project Tasks

[\(UFP-QAPP Manual Section 2.8.1\)](#)

Clearing

Prior to the initiation of intrusive field work, Resolution will conduct a site visit to mark out the locations of the proposed borings. The mark out of the locations will be utilized for utility clearance (described below).

In addition, Resolution will identify any locations which will require clearing of vegetation in order to advance the chosen borings. If clearing of vegetation is necessary, Resolution will arrange for the vegetation to be cleared prior to the initiation of field activities.

Utility Clearance

Prior to the initiation of intrusive field work, utility clearance will be conducted in accordance with SOP 3-01. Data on the presence of subsurface objects will be recorded during this activity and included as part of the RI.

Subsurface Geophysical Survey

The area known as the recreational areas east of the Bishop's Rock jetty will be surveyed using EM and GPR instrumentation. The equipment will detect anomalies present in the subsurface. This will be accomplished by placing a grid across the entire area and operating the equipment in a precise, systematic procedure. Five-foot grid spacing will be used for EM and ten-foot grid spacing will be used for GPR. A qualified subcontractor will be utilized for this effort.

Drilling and Soil Sample Collection

To the extent practicable, the soil borings will be advanced utilizing direct push technology. If direct push technology is ineffective, a hollow stem auger will be utilized to complete the drilling. The borings will be advanced to a depth of approximately 10 feet at the upland boring locations, and deeper if urban fill is encountered at that depth. Final depths will be determined, based on field conditions, at the time of drilling.

Surface and subsurface soils will be observed for cover thickness, debris, and other visual evidence of contamination (staining, strong odor, etc.). Sample collection for laboratory analysis will occur at each soil boring location as shown on Table 17-1. Soil will also be inspected for visual description of soil composition. The proposed boring locations are shown on the figures. Please refer to Table 17-1 for the sampling rationale table.

All soil generated as part of activities will be returned to the bore hole at the approximate depth from which it was removed.

Quality Assurance/Quality Control

The QA/QC sample collection frequency is as follows (also shown in Worksheet 20):

- **Trip blanks** - 1 per cooler containing VOC samples
- **Equipment/Rinsate blanks** - 1 per 20 samples per sampling method and matrix
- **Field duplicates** – (single blind samples) 1 per 20 samples per method and matrix
- **MS/MSD or MS/Matrix Duplicate** - 1 per 20 samples per method and matrix

Equipment Decontamination

To the maximum extent possible, Resolution will utilize dedicated and disposable sampling equipment to avoid the potential for cross contamination of samples due to inadequate decontamination processes. The sampling equipment will include dedicated plastic scoops, disposable gloves, and laboratory supplied sample bottles.

Non-disposable or non-dedicated sampling equipment (e.g., stainless spoons, stainless bowls, etc.) will be decontaminated prior to sampling and between samples. Cleaning of equipment is performed to prevent cross-contamination between samples and to maintain a clean working environment for all personnel. Decontamination will generally consist of a water rinse station to remove gross contamination (if needed), followed by a non-phosphate detergent (e.g., Alconox) water rinse, and a rinse with de-ionized water. If equipment is to be stored or transported, it will be wrapped in aluminum foil after air-drying. If a hollow stem auger drill rig is required during the project, the auger flights will be decontaminated between each bore hole and split spoon samplers will be decontaminated after each sample collection. All decontamination water generated during decontamination of equipment will be containerized as IDW and properly disposed of, as necessary.

Investigation-Derived Waste Management

IDW generated during decontamination processes and PPE will be collected in properly labeled 55-gallon drums and temporarily stored on the site for subsequent off-site disposal as necessary. Subsequently, the containers will be characterized with laboratory analyses and properly disposed at a Navy approved disposal facility. Note that, if laboratory analytical results indicate decontamination water concentrations are below applicable standards, the water will be returned to the ground surface.

Recording Sample Locations

Resolution will utilize a portable GPS unit to record the soil boring locations. The locations will be tied into the existing base map developed for the site and/or NAVD where available. Known physical points such as building corners will be recorded as a check of the sample locations.

Laboratory Coordination, Data Management and Validation

Resolution's Project Chemist will track the samples from collections through analysis and obtain data reports from the laboratories within 21 days of sample receipt. A signed certificate of analysis will be provided in the narrative section of each laboratory data report. The laboratory will submit the data in hard copy and an electronic format.

Analytical results will be validated according to the procedures in Worksheet 36. Resolution will be provided with the hard copy and electronic version of the laboratory results and will add data validation qualifiers to both versions. The hardcopy and electronic versions will be examined for completeness and accuracy. The electronic copy will be compared to the hardcopy results by Resolution's Project Chemist and then loaded into the Resolution SharePoint site and database.

Report Preparation

Following data collection, analysis and validation, a site investigation (RI) report will be prepared, meeting the requirements set forth in EPA document OSWER 9355.3. The report elements will include the objectives of the investigations, a brief site history and a summary of historical investigations and results, a summary of field efforts conducted as part of this SAP, deviations from the SAP (if any), data tables and figures, comprehensive discussion of the data collected during these efforts. In addition, the report will include recommendations for additional assessment activities should they be warranted. If warranted, the RI report will be combined with the FS for one report. Preparation for and planning of key elements of the FS will occur with the regulatory agencies prior to initiating the FS.

SAP Worksheet #12-1: Measurement Performance Criteria – Field QC Samples for Volatile Organic Compounds

[\(UFP-QAPP Manual Section 2.6.2\)](#)

Matrix: Surface and Subsurface Soil

Analytical Group: Volatile Organic Compounds (full scan)

Concentration Level: Low

QC Sample	Analytical Group	Frequency	Data Quality Indicators (DQIs)	Measurement Performance Criteria
Trip Blank	Volatile Organic Compounds	One per cooler containing VOC Samples	Accuracy/Bias	No target compounds > 1/2 LOQ (> LOQ for common laboratory contaminants) and > 1/10 the amount measured in any sample or 1/10 the PAL, whichever is greater. Blank result must not otherwise affect sample results (see DoD QSM Box D-1).
Equipment Rinsate Blank		One per day of sampling per type of equipment used	Accuracy/Bias	No target compounds > 1/2 LOQ (> LOQ for common laboratory contaminants) and > 1/10 the amount measured in any sample or 1/10 the PAL, whichever is greater. Blank result must not otherwise affect sample results (see DoD QSM Box D-1).
Cooler Temperature Indicator		One per cooler	Accuracy/Representativeness	Temperature ≤ 6 degrees Celsius.
Field Duplicate		One per twenty samples per matrix	Precision	Relative Percent Difference (RPD) ≤ 50% if both results are ≥ 2 x LOQ
Matrix Spike/Matrix Spike Duplicate		Submitted: One per twenty samples per matrix. Analyzed: More frequent of one per twenty samples or SDG per matrix.	Accuracy/Bias/Precision	Refer to Worksheet 28-1

SAP Worksheet #12-2: Measurement Performance Criteria – Field QC Samples for PCBs Aroclors

[\(UFP-QAPP Manual Section 2.6.2\)](#)

Matrix: Surface and Subsurface Soil

Analytical Group: Polychlorinated Biphenyls (Aroclors)

Concentration Level: Low

QC Sample	Analytical Group	Frequency	Data Quality Indicators (DQIs)	Measurement Performance Criteria
Equipment Rinsate Blank	Polychlorinated Biphenyls (Aroclors)	One per day of sampling per type of equipment used	Accuracy/Bias	No target compounds > 1/2 LOQ (> LOQ for common laboratory contaminants) and > 1/10 the amount measured in any sample or 1/10 the LOQ, whichever is greater. Blank result must not otherwise affect sample results (see DoD QSM Box D-1).
Cooler Temperature Indicator		One per cooler	Accuracy/Representativeness	Temperature ≤ 6 degrees Celsius.
Field Duplicate		One per twenty samples per matrix	Precision	RPD ≤ 50% if both results are ≥ 2 x LOQ
Matrix Spike/Matrix Spike Duplicate		Submitted: One per twenty samples per matrix. Analyzed: More frequent of one per twenty samples or SDG per matrix.	Accuracy/Bias/Precision	Refer to Worksheet 28-2

SAP Worksheet #12-3 Measurement Performance Criteria – Field QC Samples for Lead

[\(UFP-QAPP Manual Section 2.6.2\)](#)

Matrix: Soil

Analytical Group: Lead (ICP-AES)

Concentration Level: Low

QC Sample	Analytical Group	Frequency	Data Quality Indicators (DQIs)	Measurement Performance Criteria
Equipment Rinsate Blank	Lead (ICP-AES)	One per day of sampling per type of equipment used	Accuracy/Bias	No target metals > 1/2 LOQ (> LOQ for common laboratory contaminants) and > 1/10 the amount measured in any sample or 1/10 the PAL, whichever is greater. For negative blanks, absolute value must be < LOD. Blank result must not otherwise affect sample results (see DoD QSM Box D-1).
Field Duplicate		One per twenty samples per matrix	Precision	RPD ≤ 50% if both results are ≥ 5 x LOQ. Diff ≤ LOQ if values are < 5x LOQ
Matrix Spike		Submitted: One per twenty samples per matrix. Analyzed: Most frequent of one per twenty samples or SDG per matrix, or one per prep batch per matrix.	Accuracy/Bias	Refer to Worksheet 28-3

SAP Worksheet #12-4 Measurement Performance Criteria – Field QC Samples for Mercury

[\(UFP-QAPP Manual Section 2.6.2\)](#)

Matrix: Soil

Analytical Group: Mercury (CVAA)

Concentration Level: Low

QC Sample	Analytical Group	Frequency	Data Quality Indicators (DQIs)	Measurement Performance Criteria
Equipment Rinsate Blank	Mercury (CVAA)	One per day of sampling per type of equipment used	Accuracy/Bias	No mercury > 1/2 LOQ and > 1/10 the amount measured in any sample or 1/10 the PAL, whichever is greater. For negative blanks, absolute value < LOD. Blank result must not otherwise affect sample results (see DoD QSM Box D-1).
Cooler Temperature Indicator		One per cooler	Accuracy/Representativeness	Temperature ≤ 6 degrees Celsius.
Field Duplicate		One per twenty samples per matrix	Precision	RPD ≤ 50% if both results are ≥ 5 x LOQ. Diff ≤ LOQ if values are < 5x LOQ
Matrix Spike		Submitted: One per twenty samples per matrix. Analyzed: Most frequent of one per twenty samples or SDG per matrix, or one per prep batch per matrix.	Accuracy/Bias	Refer to Worksheet 28-4

SAP Worksheet #12-5 Measurement Performance Criteria – Field QC Samples for ACM

[\(UFP-QAPP Manual Section 2.6.2\)](#)

Matrix: Soil

Analytical Group: Asbestos

Concentration Level: Low

QC Sample	Analytical Group	Frequency	Data Quality Indicators (DQIs)	Measurement Performance Criteria
Equipment Rinsate Blank	Asbestos fibers	One per day of sampling	Accuracy/Bias	<0.25%
Cooler Temperature Indicator		One per cooler	Accuracy/Representativeness	Temperature ≤ 6 degrees Celsius.
Field Duplicate		1 per 20 samples	Precision	RPD ≤ 100%

SAP Worksheet #12-6 Measurement Performance Criteria – Field QC Samples for ACM

[\(UFP-QAPP Manual Section 2.6.2\)](#)

Matrix: Solid (Debris)

Analytical Group: Asbestos

Concentration Level: Low

QC Sample	Analytical Group	Frequency	Data Quality Indicators (DQIs)	Measurement Performance Criteria
Equipment Rinsate Blank	Asbestos fibers	One per day of sampling	Accuracy/Bias	<0.25%
Cooler Temperature Indicator		One per cooler	Accuracy/Representativeness	Temperature ≤ 6 degrees Celsius.
Field Duplicate		1 per 20 samples	Precision	RPD ≤ 100%

SAP Worksheet #12: Notes

[\(UFP-QAPP Manual Section 2.6.2\)](#)

AES- Atomic Emission Spectrometry

CVAA – Cold Vapor Atomic Adsorption

DoD QSM – Department of Defense Quality Systems Manual

DQI – Data Quality Indicator

ICP- Inductively Coupled Plasma

LOD – Limit of Detection

LOQ – Limit of Quantitation

NA – Not Applicable

PAL – Project Action Limit

QC- Quality Control

PCB – Polychlorinated Biphenyl

RPD – Relative Percent Difference

SDG – Sample Delivery Group

VOC – Volatile Organic Compound

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
3-01	Utility Clearance	Resolution	Ground Penetrating Radar, Air Knife	N	
3-02	Log Books	Resolution		N	
3-03	Record Keeping, Sample Labeling, and Chain-of-Custody	Resolution		N	
3-04	Sampling Handling, Storage and Shipping	Resolution		N	
3-05	IDW Management	Resolution		N	
3-06	Equipment Decontamination	Resolution		N	
3-07	Land Surveying	Resolution	GPS	N	
3-16	Soil and Rock Classification	Resolution		N	
3-19	Headspace Screening for Total VOCs	Resolution	PID	N	
3-20	Operation and Calibration of a PID	Resolution	PID	N	
TBD	Asbestos inspection of ground surface and debris	TBD	TBD		

TBD – to be included in final or submitted separately when subcontractor is procured and supplies the information required.

SAP Worksheet #18, 19, 20 and 30: Field Project Implementation (Field Project Instructions)

[\(UFP-QAPP Manual Sections 3.1.1 and 3.5.2.3\)](#)

Sample Details-Surface and Subsurface Soil

	Analysis Group	Volatile Organic Compounds	PCB (Aroclors)	Lead (ICP-AES)	Mercury (CVAA)	Asbestos
CTO WE30 Sampling and Analysis Plan – Coddington Point Buried Debris Areas Of Concern Soil Sampling Summer 2013	Preparation and Analytical Method	SW-846 5035, 8260B	SW846 3550C, 3540C or 3546 8082A	SW846 3050B, 6010C	SW-846 7471B	Soil: EPA 600/R-93-116 Solid/Debris: CARB 435
	Analytical Laboratory/ Analytical SOP Reference	Katahdin Analytical Services / CA-202	Katahdin Analytical Services / CA-329	Katahdin Analytical Services / CA-608	Katahdin Analytical Services / CA-611	NVL Labs / 33.300.13 EMSL Analytical / CARB 435 - PLM SOP
	Data Package Turnaround Time	21 Calendar day	21 Calendar day	21 Calendar day	21 Calendar day	21 Calendar day
Katahdin Analytical Services, Inc. (Jennifer Obrin) (207.874.2400 x17) EMSL Analytical, Inc. (Chris Nardozzi) (856.303.3438) NVL Labs, Inc. (Shaista Khan) (800.685.5227)	Container Type/ Volume required (if different than container volume)²	Two 40-milliliter (ml) VOA vials One 40-ml VOA vial One 2-ounce(2-oz) wide-mouth jar for percent moisture	One 4-oz amber glass wide-mouth jar	One 4-oz HDPE wide-mouth jar		One 8-oz HDPE wide-mouth jar
	Preservative²	5 ml reagent water, Freeze to ≤ -7 °C; store in the dark 5 ml methanol; Cool to ≤ 6 °C; store in the dark Cool to ≤ 6 °C; store in the dark	Cool to ≤ 6 °C; store in the dark	None	Cool to ≤ 6 °C	Protect from light
	Holding Time (Preparation/ Analysis)²	48 hours to freezing at --7°C, 14 days to analysis 14 days to analysis NA	40 days to analysis	6 months to analysis	28 days to analysis	None

Site	Matrix	Station ID	Sample ID	Coordinates (optional)		Depth/ Sampling Interval	Volatile Organic Compounds	PCB (Aroclors)	Lead (ICP-AES)	Mercury (CVAA)	Asbestos
				X	Y						
Naval Supply School	Subsurface Soil	MA01	MA01-BD-ED	Refer to Figure 9	4 ft interval from 2-10 ft bgs	X	X	X	X		
		MA02	MA02-BD-ED			X	X	X	X		
		MA03	MA03-BD-ED			X	X	X	X		
		MA04	MA04-BD-ED			X	X	X	X		
		MA05	MA05-BD-ED			X	X	X	X		
		MA06	MA06-BD-ED			X	X	X	X		
		MA07	MA07-BD-ED			X	X	X	X		
Combat Training Pool	Subsurface Soil	CTP01	CTP01-BD-ED	Refer to Figure 9	4 ft interval from 2-10 ft bgs	X	X	X	X		
		CTP02	CTP02-BD-ED			X	X	X	X		
		CTP03	CTP03-BD-ED			X	X	X	X		
		CTP04	CTP04-BD-ED			X	X	X	X		
		CTP05	CTP05-BD-ED			X	X	X	X		
		CTP06	CTP06-BD-ED			X	X	X	X		
New OTC Building	Subsurface Soil	OT01	OT01-BD-ED	Refer to Figure 9	4 ft interval from 2-10 ft bgs	X	X	X	X		
		OT02	OT02-BD-ED			X	X	X	X		
		OT03	OT03-BD-ED			X	X	X	X		
		OT04	OT04-BD-ED			X	X	X	X		
		OT05	OT05-BD-ED			X	X	X	X		
		OT06	OT06-BD-ED			X	X	X	X		
		OT07	OT07-BD-ED			X	X	X	X		
		OT08	OT08-BD-ED			X	X	X	X		
Nimitz Field Debris Area	Surface Soil	NF04	NF04-BD-ED	Refer to Figure 9	0-1 ft bgs and 1-2 ft bgs					X (2) ³	
		NF05	NF05-BD-ED							X (2) ³	
		NF06	NF06-BD-ED							X (2) ³	
		NF07	NF07-BD-ED							X (2) ³	
	Subsurface Soil	NF01	NF01-BD-ED		4 ft interval from 2-10 ft bgs	X	X	X	X		
		NF02	NF02-BD-ED			X	X	X	X		
		NF03	NF03-BD-ED			X	X	X	X		
		NF08	NF08-BD-ED			X	X	X	X		
		NF09	NF09-BD-ED			X	X	X	X		
		NF10	NF10-BD-ED			X	X	X	X		

Site	Matrix	Station ID	Sample ID	Coordinates (optional)		Depth/ Sampling Interval	Volatile Organic Compounds	PCB (Aroclors)	Lead (ICP-AES)	Mercury (CVAA)	Asbestos
				X	Y						
Bishop's Rock Debris Area – Jetty	Subsurface Soil	BR01	BR01-BD-ED	Refer to Figure 9		4 ft interval from 2-10 ft bgs	X	X	X	X	
		BR02	BR02-BD-ED				X	X	X	X	
		BR03	BR03-BD-ED				X	X	X	X	
		BR04	BR04-BD-ED				X	X	X	X	
		BR05	BR05-BD-ED				X	X	X	X	
Bishop's Rock Debris Area – Upland Fields	Surface Soil	BR06	BR06-BD-ED	Refer to Figure 9		0-1 ft bgs and 1-2 ft bgs	X (2) ³	X (2) ³	X (2) ³	X (2) ³	X (2) ³
		BR07	BR07-BD-ED				X (2) ³	X (2) ³	X (2) ³	X (2) ³	X (2) ³
		BR08	BR08-BD-ED				X (2) ³	X (2) ³	X (2) ³	X (2) ³	X (2) ³
		BR09	BR09-BD-ED				X (2) ³	X (2) ³	X (2) ³	X (2) ³	X (2) ³
		BR10	BR10-BD-ED				X (2) ³	X (2) ³	X (2) ³	X (2) ³	X (2) ³
		BR11	BR11-BD-ED				X (2) ³	X (2) ³	X (2) ³	X (2) ³	X (2) ³
		BR12	BR12-BD-ED				X (2) ³	X (2) ³	X (2) ³	X (2) ³	X (2) ³
	BR13	BR13-BD-ED	X (2) ³			X (2) ³	X (2) ³	X (2) ³	X (2) ³		
	Subsurface Soil	BR06	BR06-BD-ED			X	X	X	X	X ³	
		BR07	BR07-BD-ED			X	X	X	X	X ³	
		BR08	BR08-BD-ED			X	X	X	X	X ³	
		BR09	BR09-BD-ED			X	X	X	X	X ³	
		BR10	BR10-BD-ED			X	X	X	X	X ³	
BR11		BR11-BD-ED	X	X	X	X	X ³				
BR12	BR12-BD-ED	X	X	X	X	X ³					
BR13	BR13-BD-ED	X	X	X	X	X ³					
Field QC Samples ¹											
TBD	Field Duplicate	TBD	FDSB01-MMDDYY	Same as parent sample		Same as parent sample	X	X	X	X	X
TBD		TBD	FDSB02-MMDDYY				X	X	X	X	X
TBD		TBD	FDSB03-MMDDYY				X	X	X	X	
TBD	MS/MSD or MS/MD	TBD	Same as parent sample	Same as parent sample		Same as parent sample	X	X	X	X	
TBD		TBD					X	X	X	X	
TBD		TBD					X	X	X	X	
	Equipment Blank ²		EBSB01-MMDDYY				X	X	X	X	
			EBSB02-MMDDYY				X	X	X	X	
			EBSB3-MMDDYY				X	X	X	X	
	Trip Blank		TB01-MMDDYY				X				

Site	Matrix	Station ID	Sample ID	Coordinates (optional)		Depth/ Sampling Interval	Volatile Organic Compounds	PCB (Aroclors)	Lead (ICP-AES)	Mercury (CVAA)	Asbestos
				X	Y						
			TB02-MMDDYY				X				
			TB03-MMDDYY				X				
						Total No. of Samples to the Laboratory	56 samples 3 FDs 3 MS/MSD 3 EBs 3 TBs	56 samples 3 FDs 3 MS/MSD 3 EBs	56 samples 3 FDs 3 MS/MD 3 EBs	56 samples 3 FDs 3 MS/MD 3 EBs	32 samples 2 FDs 3 EBs

- Frequency of QA/QC sample collection:
 - Frequency presented assumes that surface and subsurface soil are the same matrix.
 - Field Duplicate- One per 20 field samples
 - MS/MD/MSD- One pair per 20 field samples (including field duplicate samples)
 - Trip Blank- One per cooler to the laboratory containing volatiles (numbers presented assume 3 sampling days for VOCs, 1 cooler per day)
 - Equipment Blank- One per day of sampling or 20 field samples, whichever is more frequent (numbers presented assume 3 sampling days, one type of equipment)
- The container, preservation, and holding time information for the aqueous equipment blanks is as follows:
 - Volatile Organic Compounds: Three 40-ml VOA vials; HCl to pH < 2, Cool to ≤ 6 °C, store in the dark; 14 days to analysis.
 - Polychlorinated Biphenyl (Aroclors): Two 1-L wide-mouth amber glass bottles; Cool to ≤ 6 °C, store in the dark; 7 days to extraction, 40 days to analysis
 - Lead and Mercury: One 250-ml wide-mouth HDPE bottle; HNO₃ to pH<2; 6 months to analysis (lead), 28 days to analysis (mercury)
- Sample collection is dependent on field evidence/observations. Refer to Table 17-1.

SAP Worksheet #15: Reference Limits and Evaluation Tables

[\(UFP-QAPP Manual Section 2.8.1\)](#)

Buried Debris Areas of Concern

Naval Station Newport, Rhode Island

Matrix	Method	Analyte	CAS RN	Units	Project AL and Reference ¹		Project QL Goal ¹	Laboratory Limits ⁶		
					Project AL	Reference ^{2,3}		LOQ	LOD	DL
SO	8260	1,1,1,2-Tetrachloroethane	630-20-6	mg/kg	1.9	EPA RSL	0.63	0.005	0.0025	0.0007
SO	8260	1,1,1-Trichloroethane	71-55-6	mg/kg	160	RIDEM GB LC	53	0.005	0.0025	0.00042
SO	8260	1,1,2,2-Tetrachloroethane	79-34-5	mg/kg	0.56	EPA RSL	0.19	0.005	0.0025	0.00084
SO	8260	1,1,2-Trichloroethane	79-00-5	mg/kg	0.16	EPA RSL	0.053	0.005	0.0025	0.00097
SO	8260	1,1-Dichloroethane	75-34-3	mg/kg	3.3	EPA RSL	1.1	0.005	0.0025	0.0017
SO	8260	1,1-Dichloroethene	75-35-4	mg/kg	0.2	RIDEM DEC	0.067	0.005	0.0025	0.00093
SO	8260	1,1-Dichloropropene	563-58-6	mg/kg	1.7	EPA RSL	0.57	0.005	0.0025	0.00091
SO	8260	1,2,3-Trichlorobenzene	87-61-6	mg/kg	4.9	EPA RSL	1.6	0.005	0.0025	0.00076
SO	8260	1,2,3-Trichloropropane	96-18-4	mg/kg	0.005	EPA RSL	0.002	0.005	0.0025	0.0012
SO	8260	1,2,4-Trichlorobenzene	120-82-1	mg/kg	6.2	EPA RSL	2.1	0.005	0.0025	0.00079
SO	8260	1,2,4-Trimethylbenzene	95-63-6	mg/kg	6.2	EPA RSL	2.1	0.005	0.0025	0.00087
SO	8260	1,2-Dibromo-3-chloropropane	96-12-8	mg/kg	0.0054	EPA RSL	0.0018	0.005	0.0025	0.0015
SO	8260	1,2-Dibromoethane	106-93-4	mg/kg	0.01	RIDEM DEC	0.003	0.005	0.0025	0.0012
SO	8260	1,2-Dichlorobenzene	95-50-1	mg/kg	190	EPA RSL	63	0.005	0.0025	0.00078
SO	8260	1,2-Dichloroethane	107-06-2	mg/kg	0.43	EPA RSL	0.14	0.005	0.0025	0.001
SO	8260	1,2-Dichloropropane	78-87-5	mg/kg	0.94	EPA RSL	0.31	0.005	0.0025	0.0014
SO	8260	1,3,5-Trimethylbenzene	108-67-8	mg/kg	78	EPA RSL	26	0.005	0.0025	0.00067
SO	8260	1,3-Dichlorobenzene	541-73-1	mg/kg	2.4	EPA RSL	0.80	0.005	0.0025	0.00062
SO	8260	1,3-Dichloropropane	142-28-9	mg/kg	160	EPA RSL	53	0.005	0.0025	0.00094
SO	8260	1,4-Dichlorobenzene	106-46-7	mg/kg	2.4	EPA RSL	0.80	0.005	0.0025	0.00044
SO	8260	2,2-Dichloropropane	594-20-7	mg/kg	0.94	EPA RSL	0.31	0.005	0.0025	0.0005
SO	8260	2-Butanone	78-93-3	mg/kg	2800	EPA RSL	933	0.025	0.0125	0.0059
SO	8260	2-Chlorotoluene	95-49-8	mg/kg	160	EPA RSL	53	0.005	0.0025	0.0011
SO	8260	2-Hexanone	591-78-6	mg/kg	21	EPA RSL	7.0	0.025	0.0125	0.0048
SO	8260	4-Chlorotoluene	106-43-4	mg/kg	160	EPA RSL	53	0.005	0.0025	0.00049
SO	8260	4-Methyl-2-pentanone	108-10-1	mg/kg	530	EPA RSL	177	0.025	0.0125	0.0059
SO	8260	Acetone	67-64-1	mg/kg	6100	EPA RSL	2033	0.025	0.0125	0.0051
SO	8260	Benzene	71-43-2	mg/kg	1.1	EPA RSL	0.37	0.005	0.0025	0.00092
SO	8260	Bromobenzene	108-86-1	mg/kg	30	EPA RSL	10	0.005	0.0025	0.00074
SO	8260	Bromochloromethane	74-97-5	mg/kg	16	EPA RSL	5.3	0.005	0.0025	0.00091
SO	8260	Bromodichloromethane	75-27-4	mg/kg	0.27	EPA RSL	0.090	0.005	0.0025	0.0006

Matrix	Method	Analyte	CAS RN	Units	Project AL and Reference ¹		Project QL Goal ¹	Laboratory Limits ⁶		
					Project AL	Reference ^{2,3}		LOQ	LOD	DL
SO	8260	Bromoform	75-25-2	mg/kg	62	EPA RSL	21	0.005	0.0025	0.0007
SO	8260	Bromomethane	74-83-9	mg/kg	0.73	EPA RSL	0.24	0.01	0.005	0.0011
SO	8260	Carbon Disulfide	75-15-0	mg/kg	82	EPA RSL	27	0.005	0.0025	0.00078
SO	8260	Carbon tetrachloride	56-23-5	mg/kg	0.61	EPA RSL	0.20	0.005	0.0025	0.0013
SO	8260	Chlorobenzene	108-90-7	mg/kg	29	EPA RSL	9.7	0.005	0.0025	0.00051
SO	8260	Chlorodibromomethane	124-48-1	mg/kg	0.68	EPA RSL	0.23	0.005	0.0025	0.001
SO	8260	Chloroethane	75-00-3	mg/kg	1500	EPA RSL	500	0.01	0.005	0.0013
SO	8260	Chloroform	67-66-3	mg/kg	0.29	EPA RSL	0.097	0.005	0.0025	0.00035
SO	8260	Chloromethane	74-87-3	mg/kg	12	EPA RSL	4	0.01	0.005	0.0014
SO	8260	cis-1,2-Dichloroethene	156-59-2	mg/kg	16	EPA RSL	5.3	0.005	0.0025	0.00091
SO	8260	cis-1,3-Dichloropropene	10061-01-5	mg/kg	1.7	EPA RSL	0.57	0.005	0.0025	0.00072
SO	8260	Dibromomethane	74-95-3	mg/kg	2.5	EPA RSL	0.83	0.005	0.0025	0.00051
SO	8260	Dichlorodifluoromethane	75-71-8	mg/kg	9.4	EPA RSL	3.1	0.01	0.005	0.00092
SO	8260	Ethylbenzene	100-41-4	mg/kg	5.4	EPA RSL	1.8	0.005	0.0025	0.00065
SO	8260	Hexachlorobutadiene	87-68-3	mg/kg	6.1	EPA RSL	2.0	0.005	0.0025	0.00074
SO	8260	Isopropylbenzene	98-82-8	mg/kg	27	RIDEM DEC	9.0	0.005	0.0025	0.00092
SO	8260	Methyl tert-butyl ether	1634-04-4	mg/kg	43	EPA RSL	14	0.005	0.0025	0.0011
SO	8260	Methylene chloride	75-09-2	mg/kg	36	EPA RSL	12	0.025	0.0125	0.0079
SO	8260	Naphthalene	91-20-3	mg/kg	3.6	EPA RSL	1.2	0.005	0.0025	0.00088
SO	8260	n-Butylbenzene	104-51-8	mg/kg	390	EPA RSL	130	0.005	0.0025	0.00092
SO	8260	n-Propylbenzene	103-65-1	mg/kg	340	EPA RSL	113	0.005	0.0025	0.00083
SO	8260	p-Isopropyltoluene	99-87-6	mg/kg	210	EPA RSL	70	0.005	0.0025	0.00076
SO	8260	sec-Butylbenzene	135-98-8	mg/kg	780	EPA RSL	130	0.005	0.0025	0.00091
SO	8260	Styrene	100-42-5	mg/kg	13	RIDEM DEC	4.3	0.005	0.0025	0.00051
SO	8260	tert-Butyl-Alcohol	75-65-0	mg/kg	NA		NA	0.025	0.0125	0.011
SO	8260	tert-Butylbenzene	98-06-6	mg/kg	780	EPA RSL	130	0.005	0.0025	0.0009
SO	8260	Tetrachloroethene	127-18-4	mg/kg	4.2	RIDEM LC	1.4	0.005	0.0025	0.0012
SO	8260	Toluene	108-88-3	mg/kg	54	RIDEM LC	18	0.005	0.0025	0.0014
SO	8260	trans-1,2-Dichloroethene	156-60-5	mg/kg	15	EPA RSL	5.0	0.005	0.0025	0.00071
SO	8260	trans-1,3-Dichloropropene	10061-02-6	mg/kg	1.7	EPA RSL	0.57	0.005	0.0025	0.00086
SO	8260	Trichloroethene	79-01-6	mg/kg	0.44	EPA RSL	0.15	0.005	0.0025	0.00059
SO	8260	Trichlorofluoromethane	75-69-4	mg/kg	79	EPA RSL	26	0.01	0.005	0.00091
SO	8260	Vinyl chloride	75-01-4	mg/kg	0.02	RIDEM DEC	0.007	0.01	0.005	0.00087
SO	8260	m&p-Xylenes ⁴	108-38-3/ 106-42-3	mg/kg	63	EPA RSL	21	0.01	0.005	0.0017
SO	8260	o-Xylenes ⁴	95-47-6	mg/kg	63	EPA RSL	21	0.005	0.0025	0.0013
SO	8082	Aroclor-1016	12674-11-2	mg/kg	0.39	EPA RSL	0.13	0.017	0.0085	0.006
SO	8082	Aroclor-1221	11104-28-2	mg/kg	0.14	EPA RSL	0.047	0.017	0.0085	0.0079

Matrix	Method	Analyte	CAS RN	Units	Project AL and Reference ¹		Project QL Goal ¹	Laboratory Limits ⁶		
					Project AL	Reference ^{2,3}		LOQ	LOD	DL
SO	8082	Aroclor-1232	11141-16-5	mg/kg	0.14	EPA RSL	0.047	0.017	0.01	0.0093
SO	8082	Aroclor-1242	53469-21-9	mg/kg	0.22	EPA RSL	0.073	0.017	0.0085	0.0058
SO	8082	Aroclor-1248	12672-29-6	mg/kg	0.22	EPA RSL	0.073	0.017	0.0085	0.0061
SO	8082	Aroclor-1254	11097-69-1	mg/kg	0.11	EPA RSL	0.037	0.017	0.0085	0.0047
SO	8082	Aroclor-1260	11096-82-5	mg/kg	0.22	EPA RSL	0.073	0.017	0.0085	0.006
SO	8082	Aroclor-1262	37324-23-5	mg/kg	0.11	EPA RSL	0.037	0.017	0.0085	0.0025
SO	8082	Aroclor-1268	11100-14-4	mg/kg	0.11	EPA RSL	0.037	0.017	0.0085	0.0025
SO	8082	Total PCBs		mg/kg	0.11	EPA RSL	0.037	0.153	0.0765	0.0025
SO	6010	Lead	7439-92-1	mg/kg	150	RIDEM DEC	50	0.5	0.4	0.09
SO	7471	Mercury	7439-97-6	mg/kg	1	EPA RSL	0.33	0.033	0.017	0.0052
SO	CARB435	Asbestos	1332-21-4	%	1	38 CFR 8820 ⁷	0.25%	0.25%	0.25%	0.25%
SOLID	EPA 600	Asbestos	1332-21-4	%	1	38 CFR 8820 ⁷	0.25%	0.25%	0.25%	0.25%

Notes:

- (1) Selected Project AL is the lower of the RIDEM DEC, RIDEM GB LC, and EPA RSL for each analyte. Project Quantitation Goal is calculated as on third of the Project AL
 - (2) RIDEM Rules and Regulations for the Investigation and Remediation of Hazardous Material Releases, 31 March 1993 as amended August 1996, February 2004, and November 2011
DECs for residential soils are presented for surface and subsurface soil. DEC presented for each Aroclor and Total PCBs is the DEC for PCBs.
Groundwater beneath Coddington Point is classified GB by the State of Rhode Island.
 - (3) May 2013 EPA Regional Screening Levels (RSLs); c = carcinogen; L= lead; nc = noncarcinogen (adjusted to a hazard quotient of 0.1)
Surrogates used for EPA RSLs for soils are as follows:
1,3-dichloropropene used for 1,1-dichloropropene, cis-1,3-dichloropropene, and trans-1,3-dichloropropene
1,4-Dichlorobenzene used for 1,3-dichlorobenzene
1,2-dichloropropane used for 2,2-dichloropropane
Isopropylbenzene (cumene) used for p-isopropyltoluene
Lowest RSL of all aroclor groups used for Aroclor-1262, 1268 and Total PCBs
 - (4) Project AL and QL Goals presented are for total xylenes.
 - (5) RIDEM DEC presented is for "Trihalomethanes (total)."
 - (6) In the absence of a detect, the analyte will be considered not present.
 - (7) National Emissions Standards For Hazardous Air Pollutants (EPA, April 1973)
- Shading** The laboratory limit shown is above the Project QL Goal.

Abbreviations:

AL - action limit
c – carcinogenic
DEC - Direct Exposure Criteria
DL - Detection Limit

EPA - U.S. Environmental Protection Agency
L – lead
LC – Leachability Criteria
LOD - Limit of Detection
LOQ - Limit of Quantitation

mg/kg - milligram per kilogram
Min – minimum
n - non-carcinogenic
QL - quantitation limit
RIDEM - State of Rhode Island and Providence Plantations Department of Environmental Management
RN - reference number
RSL = Regional Screening Level
SO – Soil
ug/L - microgram per liter

SAP Worksheet #23-1: Analytical SOP References Table

Laboratory Name and Address: Katahdin Analytical Services, Inc.¹

Point of Contact Name: Jennifer Obrin

Phone Number: 207.874.2400 x17

Lab SOP Number	Title, Revision Date, and Number	Definitive or Screening Data	Matrix and Analytical Group	Instrument	Variance to QSM (Y/N)	Modified for Project Work? (Y/N)
CA-202	Analysis of VOAs by Purge and Trap GC/MS: SW-846 Method 8260, 03/12, Revision 13.	Definitive	Soil / VOCs	GC/MS	N	N
CA-214	Closed-System Purge-And-Trap And Extraction For Volatile Organics In Soil And Waste Samples Using SW846 Method 5035, 03/12, Revision 6.	Definitive	Soil / VOCs	Not applicable (extraction)	N	N
CA-329	Analysis Of PCBs As Total Aroclors By Gas Chromatography/Electron Capture Detector (GC/ECD): SW-846 Method 8082, 07/11, Revision 12.	Definitive	Soil / PCBs	GC/ECD	N	N
CA-500	Preparation Of Sediment/Soil Samples By Sonication Using Method 3550 For Subsequent Pesticides/PCBs Analysis, 03/12, Revision 8.	Definitive	Soil / PCBs	Not applicable (extraction)	N	N
CA-524	Preparation Of Sediment/Soil Samples By Soxhlet Extraction Using Method 3540 For Pesticide/PCB Analysis, 04/12, Revision 8.	Definitive	Soil / PCBs	Not applicable (extraction)	N	N

Lab SOP Number	Title, Revision Date, and Number	Definitive or Screening Data	Matrix and Analytical Group	Instrument	Variance to QSM (Y/N)	Modified for Project Work? (Y/N)
CA-549	Preparation of Sediment/Soil Samples by Microwave Using Method 3546 for Subsequent Diesel Range Organics (DRO), Total Petroleum Hydrocarbons (TPH), Pesticides, PCBs, or Semi-Volatiles Analysis, 03/12, Revision 0.	Definitive	Soil / PCBs	Not applicable (extraction)	N	N
CA-605	Acid Digestion of Solid Samples by USEPA Method 3050 for Metals by ICP-AES and GFAA, 09/10, Revision 5.	Definitive	Soil / Lead	Not applicable (digestion)	N	N
CA-608	Trace Metals Analysis By ICP-AES Using EPA Method 6010, 04/12, Revision 13.	Definitive	Soil/ Lead	Inductively Coupled Plasma (ICP) – Atomic Emission Spectroscopy (AES)	N	N
CA-611	Digestion and Analysis of Solid Samples for Mercury by USEPA Method 7471, 04/12, Revision 9.	Definitive	Soil / Mercury	Mercury Analyzer	N	N

Notes:

1. The laboratory holds current DoD ELAP accreditation for all definitive analyses presented. Certificates of current DoD ELAP certification are presented in the attachments.

SAP Worksheet #23-2: Analytical SOP References Table

Laboratory Name and Address: NVL Laboratories, Inc.²

Point of Contact Name: Shaista Kahn

Phone Number: 800.685.5227

Lab SOP Number	Title, Revision Date, and Number	Definitive or Screening Data	Matrix and Analytical Group	Instrument	Variance to QSM (Y/N)	Modified for Project Work? (Y/N)
33.300.13	Standard Operating procedure for Analysis of Asbestos in Friable Building materials by Polarized Light Microscopy (November 12, 2012)	Definitive	Solid (Debris) ` Asbestos	PLM	N	N

Notes:

1. The laboratory holds current NVLAP and DoD ELAP accreditation for all definitive analyses presented. Certificates of current certification are presented in the attachments.

SAP Worksheet #23-3: Analytical SOP References Table

Laboratory Name and Address: EMSL Analytical, Inc.²

Point of Contact Name: Chris Nardozzi

Phone Number: 856.303.3438

Lab SOP Number	Title, Revision Date, and Number	Definitive or Screening Data	Matrix and Analytical Group	Instrument	Variance to QSM (Y/N)	Modified for Project Work? (Y/N)
CARB 435 - PLM SOP	CARB Method 435 Asbestos Analysis of Bulk Material by PLM (Rev 3.4, September 6, 2013)	Definitive	Soil / Asbestos	PLM	N	N

Notes:

1. The laboratory holds current NVLAP and Rhode Island Department of Health accreditation for all definitive analyses presented. Certificates of current certification are presented in the attachments.

SAP Worksheet #28-1: Laboratory QC Samples Table

[\(UFP-QAPP Manual Section 3.4\)](#)

Matrix: Surface and Subsurface Soil

Analytical Group: Volatile Organic Compounds (Full Scan)

Analytical Method/ SOP Reference: SW846 8260B / CA-202

QC Sample:	Frequency & Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	DQI	Measurement Performance Criteria
Method Blank	One per preparation batch of twenty or fewer samples of similar matrix.	No target compounds > 1/2 LOQ (> LOQ for common laboratory contaminants) and > 1/10 the amount measured in any sample or 1/10 the PAL, whichever is greater. Blank result must not otherwise affect sample results (see DoD QSM Box D-1).	Correct the problem. Report sample results that are <LOD or >10x the blank concentration. Re-prepare and reanalyze the method blank and all associated samples with results > LOD and < 10x the contaminated blank result.	Analyst, Laboratory Department Manager, and Data Validator	Bias/Contamination	Same as Method/SOP QC Acceptance Limits.
Surrogate	Four per sample: Dibromofluoromethane 1,2-Dichloroethane-d4 Toluene-d8 4-Bromofluorobenzene	%R must be within DoD QSM limits, if available; otherwise, within laboratory's statistically-derived QC limits.	For QC and field samples, correct problem then re-prepare and reanalyze all failed samples for failed surrogates in the associated preparatory batch, if sufficient sample material is available. If obvious chromatographic interference with surrogate is present, reanalysis may not be necessary. Contact Client if samples cannot be reanalyzed within hold time.	Analyst, Laboratory Department Manager, and Data Validator	Accuracy/Bias	Same as Method/SOP QC Acceptance Limits.

QC Sample:	Frequency & Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	DQI	Measurement Performance Criteria
LCS	One per preparation batch of twenty or fewer samples of similar matrix.	%R must be within DoD QSM limits, if available; otherwise, within laboratory's statistically-derived QC limits. otherwise, within laboratory's statistically-derived QC limits (Refer to Worksheet #28-1a). Allow for the number of marginal exceedances presented in DoD QSM Table G-1.	Correct problem, then re-prepare and reanalyze the LCS and all samples in the associated preparatory batch for failed analytes, if sufficient sample material is available. Contact Client if samples cannot be reanalyzed within hold time.	Analyst, Laboratory Department Manager, and Data Validator	Accuracy/ Bias	Same as Method/SOP QC Acceptance Limits.
MS/MSD	One per Sample Delivery Group or every 20 samples.	%R should be within the same limits as for the LCS. RPD should be ≤ 30%.	Corrective actions will not be taken for samples when recoveries are outside limits if likely due to matrix; otherwise contact client.	Analyst, Laboratory Department Manager, and Data Validator	Precision/Accuracy/ Bias	Same as Method/SOP QC Acceptance Limits.
Internal Standard	Four per sample: Pentafluorobenzene Chlorobenzene-d5 1,4-dichlorobenzene-d4 1,4-Difluorobenzene	Retention times for internal standards must be ± 30 seconds and the responses within - 50% to +100% of the ICAL midpoint standard.	Inspect mass spectrometer or gas chromatograph for malfunctions; mandatory reanalysis of samples analyzed while system was malfunctioning.	Analyst, Laboratory Department Manager, and Data Validator	Accuracy/ Bias	Same as Method/SOP QC Acceptance Limits.
Results between DL and LOQ	Not applicable	Apply "J" qualifier to results between DL and LOQ.	Not applicable	Analyst, Laboratory Department Manager, and Data Validator	Accuracy	Same as QC Acceptance Limits.

SAP Worksheet #28-1a: Laboratory QC Samples Table

[\(UFP-QAPP Manual Section 3.4\)](#)

Matrix: Surface and Subsurface Soil

Analytical Group: Volatile Organic Compounds (Full Scan)*

Analytical Method/ SOP Reference: SW846 8260B / CA-202

Analyte	CAS Number	Recovery Limits	
		Lower	Upper
Methyl tert-butyl ether	1634-04-4	81	125
Tert-Butyl Alcohol	75-65-0	62	148

*Included for those compounds for which limits are not presented for this matrix in the DoD QSM v4.2.

SAP Worksheet #28-2: Laboratory QC Samples Table

[\(UFP-QAPP Manual Section 3.4\)](#)

Matrix: Surface and Subsurface Soil

Analytical Group: Polychlorinated Biphenyls (Aroclors)

Analytical Method/ SOP Reference: SW846 8082A / CA-329

QC Sample:	Frequency & Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	DQI	Measurement Performance Criteria
Method Blank	One per preparation batch of 20 or fewer samples of similar matrix.	No target compounds > 1/2 LOQ and > 1/10 the amount measured in any sample or 1/10 the PAL, whichever is greater. Blank result must not otherwise affect sample results (see DoD QSM Box D-1).	Correct the problem. Report sample results that are <LOD or >10x the blank concentration. Re-prepare and reanalyze the method blank and all associated samples with results > LOD and < 10x the contaminated blank result. Contact Client if samples cannot be re-prepared within hold time.	Analyst, Laboratory Department Manager and Data Validator	Bias/ contamination	Same as Method/SOP QC Acceptance Limits
Surrogates	Two per sample: Decachloro-biphenyl Tetrachloro-m-xylene.	%R must be within DoD QSM limits, if available; otherwise, within laboratory's statistically-derived or nominal QC limits.	For QC and field samples, correct problem then re-prepare and reanalyze all failed samples for failed surrogates in the associated preparatory batch, if sufficient sample material is available. If obvious chromatographic interference with surrogate is present, reanalysis may not be necessary. Contact Client if samples cannot be re-prepared within hold time.	Analyst, Laboratory Department Manager, and Data Validator	Accuracy/Bias	Same as Method/SOP QC Acceptance Limits.

QC Sample:	Frequency & Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	DQI	Measurement Performance Criteria
LCS	One per preparation batch of 20 or fewer samples of similar matrix.	%R must be within DoD QSM limits, if available; otherwise, within laboratory's statistically-derived QC limits (Refer to Worksheet #28-2a). Allow for the number of marginal exceedances presented in DoD QSM Table G-1.	Correct problem, then re-prepare and reanalyze the LCS and all samples in the associated preparatory batch for failed analytes, if sufficient sample material is available. Contact Client if samples cannot be re-prepared within hold time.	Analyst, Laboratory Department Manager, and Data Validator	Accuracy/ Bias	Same as Method/SOP QC Acceptance Limits.
MS/MSD	One per SDG or every 20 samples.	%R should be within the same limits as for the LCS. RPD should be \leq 30%.	Corrective actions will not be taken for samples when recoveries are outside limits if likely due to matrix, otherwise contact client.	Analyst, Laboratory Department Manager, and Data Validator	Precision/ Accuracy/ Bias	Same as Method/SOP QC Acceptance Limits.
Second Column Confirmation	All positive results must be confirmed.	Results between primary and second column must be $RPD \leq 40\%$.	None. Apply qualifier if $RPD > 40\%$ and discuss in the case narrative. The higher of the two results will be reported unless matrix interference is apparent.	Analyst, Laboratory Department Manager, and Data Validator	Precision	Same as Method/SOP QC Acceptance Limits.
Results between DL and LOQ	NA	Apply "J" qualifier to results between DL and LOQ.	NA	Analyst, Laboratory Department Manager, and Data Validator	Accuracy	Same as QC Acceptance Limits.

SAP Worksheet #28-2a: Laboratory QC Samples Table

[\(UFP-QAPP Manual Section 3.4\)](#)

Matrix: Surface and Subsurface Soil

Analytical Group: Polychlorinated Biphenyls (Aroclors)*

Analytical Method/ SOP Reference: SW846 8082A / CA-329

Analyte	CAS Number	Recovery Limits	
		Lower	Upper
Tetrachloro-m-xylene	877-09-8	56	115

*Included for additional surrogate for which limits are not presented for this matrix in the DoD QSM v4.2.

SAP Worksheet #28-3: Laboratory QC Samples Table

[\(UFP-QAPP Manual Section 3.4\)](#)

Matrix: Surface and Subsurface Soil

Analytical Group: Lead (ICP-AES)

Analytical Method/ SOP Reference: SW846 6010C / CA-608

QC Sample:	Frequency & Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	DQI	Measurement Performance Criteria
Method Blank	One per digestion batch of 20 or fewer samples of similar matrix.	No target metals > 1/2 LOQ (> LOQ for common laboratory contaminants) and > 1/10 the amount measured in any sample or 1/10 the PAL, whichever is greater. For negative blanks, absolute value must be < LOD. Blank result must not otherwise affect sample results (see DoD QSM Box D-1).	Correct the problem. Report sample results that are <LOD or >10x the blank concentration. Re-prepare and reanalyze the method blank and all associated samples with results > LOD and < 10x the contaminated blank result.	Analyst, Laboratory Department Manager and Data Validator	Bias/contamination	Same as Method/SOP QC Acceptance Limits.
LCS	One per digestion batch of 20 or fewer samples of similar matrix (varies by lot).	%R must be within DoD QSM limits, allowing for the marginal exceedances presented in DoD QSM Table G-1.	Re-digest and reanalyze all associated samples for affected analyte.	Analyst, Laboratory Department Manager, and Data Validator	Accuracy/Bias/Contamination	Same as Method/SOP QC Acceptance Limits.
MS	One per digestion batch or SDG or every 20 samples.	%R should be within the DoD QSM limits for LCS, if sample < 4x spike added.	Flag results for affected analytes for all associated samples with "N."	Analyst, Laboratory Department Manager, and Data Validator	Accuracy/Bias	Same as Method/SOP QC Acceptance Limits for LCS.

QC Sample:	Frequency & Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	DQI	Measurement Performance Criteria
Post-digestion Spike	When dilution test fails or analyte concentration in all samples < 50x LOD	%R within 75-125%.	Run associated samples by method of standard addition or flag results.	Analyst, Laboratory Department Manager, and Data Validator	Accuracy/Bias	Same as Method/SOP QC Acceptance Limits.
Laboratory Duplicate	One per digestion batch or SDG or every 20 samples.	Project-specific criteria: If values are $\geq 5x$ LOQ, RPD should be $\leq 20\%$. If values are < 5x LOQ, Absolute Difference should be \leq LOQ.	Flag results for affected analytes for all associated samples.	Analyst, Laboratory Department Manager, and Data Validator	Precision	RPD < 20%
ICP Serial Dilution	One per preparation batch of 20 or fewer samples of similar matrix.	If original sample result is at least 50x LOQ, 5-fold dilution must agree within $\pm 10\%$ of the original result.	Flag results for affected analytes for all associated samples with "E."	Analyst, Laboratory Department Manager, and Data Validator	Accuracy/Bias	Same as Method/SOP QC Acceptance Limits.
Results between DL and LOQ	NA	Apply "J" qualifier to results between DL and LOQ.	NA	Analyst, Laboratory Department Manager, and Data Validator	Accuracy	Same as QC Acceptance Limits.

SAP Worksheet #28-4: Laboratory QC Samples Table

[\(UFP-QAPP Manual Section 3.4\)](#)

Matrix: Surface and Subsurface Soil

Analytical Group: Mercury (CVAA)

Analytical Method/ SOP Reference: SW846 7471B / CA-611

QC Sample:	Frequency & Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	DQI	Measurement Performance Criteria
Method Blank	One per digestion batch of 20 or fewer samples of similar matrix.	No mercury > 1/2 LOQ and > 1/10 the amount measured in any sample or 1/10 the PAL, whichever is greater. For negative blanks, absolute value < LOD. Blank result must not otherwise affect sample results (see DoD QSM Box D-1).	Correct the problem. Report sample results that are <LOD or >10x the blank concentration. Re-prepare and reanalyze the method blank and all associated samples with results > LOD and < 10x the contaminated blank result.	Analyst, Laboratory Department Manager and Data Validator	Bias/contamination	Same as Method/SOP QC Acceptance Limits.
LCS	One per digestion batch of 20 or fewer samples of similar matrix.	Water and Sediment: %R must be within 80-120%.	Re-digest and reanalyze all associated samples for affected analyte.	Analyst, Laboratory Department Manager, and Data Validator	Accuracy/Bias/Contamination	Same as Method/SOP QC Acceptance Limits.
MS	One per digestion batch or SDG or every 20 samples.	%R should be within 80-120% if sample < 4x spike added.	Flag results for affected analytes for all associated samples with "N."	Analyst, Laboratory Department Manager, and Data Validator	Accuracy/Bias	Same as Method/SOP QC Acceptance Limits for LCS.
Laboratory Duplicate	One per digestion batch or SDG or every 20 samples.	Project-specific criteria: If values are ≥ 5x LOQ, RPD should be ≤ 20%. If values are < 5x LOQ, Absolute Difference should be ≤ LOQ.	Flag results for affected analytes for all associated samples.	Analyst, Laboratory Department Manager, and Data Validator	Precision	RPD < 20%
Results between DL and LOQ	NA	Apply "J" qualifier to results between DL and LOQ	NA	Analyst, Supervisor	Accuracy	Same as QC Acceptance Limits.

SAP Worksheet #28-5: Laboratory QC Samples Table

[\(UFP-QAPP Manual Section 3.4\)](#)

Matrix: Soil

Analytical Group: Asbestos

Analytical Method / SOP Reference: CARB 435 – PLM SOP

QC Sample:	Frequency & Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	DQI	Measurement Performance Criteria
Method Blank	10% of submitted samples	< 0.25%	Determine the source of the contamination. Clean equipment; prepare and analyze new blank.	Analyst Data Validator	Accuracy/Bias (Contamination)	< 0.25%
Process Blanks	When contamination is suspected	< 0.25%	Determine the source of the contamination. Clean equipment; prepare and analyze new blank.	Analyst Data Validator	Accuracy/Bias (Contamination)	< 0.25%
Intra-analyst Reanalysis	2% of samples analyzed per day	RPD < 100%	Reanalyze the sample Second analyst performs another reanalysis.	Analyst QA Manager	Accuracy/Bias Precision	RPD < 100%
Inter-analyst Quality Assurance	7% of samples analyzed per day	RPD < 100%	Prepare new slide and reanalyze.	Analyst QA Manager	Accuracy/Bias Precision	RPD < 100%
Inter-laboratory Quality Assurance	Quarterly	2x standard deviation	Recheck the sample. Second analyst performs another reanalysis.	Analyst QA Manager	Accuracy	2x standard deviation
Reference Sample	Daily	Must meet established acceptance criteria	Reanalyze	Analyst Data Validator	Accuracy/Bias	Must meet established acceptance criteria

SAP Worksheet #28-6: Laboratory QC Samples Table

[\(UFP-QAPP Manual Section 3.4\)](#)

Matrix: Solid (Debris)

Analytical Group: Asbestos

Analytical Method/ SOP Reference: 33.300.13

QC Sample:	Frequency & Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	DQI	Measurement Performance Criteria
Method Blank	10% of submitted samples	< 0.25%	Determine the source of the contamination. Clean equipment; prepare and analyze new blank.	Analyst Data Validator	Accuracy/Bias (Contamination)	< 0.25%
Process Blanks	When contamination is suspected	< 0.25%	Determine the source of the contamination. Clean equipment; prepare and analyze new blank.	Analyst Data Validator	Accuracy/Bias (Contamination)	< 0.25%
Intra-analyst Reanalysis	2% of samples analyzed per day	RPD < 100%	Reanalyze the sample Second analyst performs another reanalysis.	Analyst QA Manager	Accuracy/Bias Precision	RPD < 100%
Inter-analyst Quality Assurance	7% of samples analyzed per day	RPD < 100%	Prepare new slide and reanalyze.	Analyst QA Manager	Accuracy/Bias Precision	RPD < 100%
Inter-laboratory Quality Assurance	Quarterly	2x standard deviation	Recheck the sample. Second analyst performs another reanalysis.	Analyst QA Manager	Accuracy	2x standard deviation
Reference Sample	Daily	Must meet established acceptance criteria	Reanalyze	Analyst Data Validator	Accuracy/Bias	Must meet established acceptance criteria

**SAP Worksheet #34, 35, 36 Data Verification and Validation (Steps I and IIa/IIb)
 Process Table**

Data Review Input	Description	Responsible for Verification (name, organization)	Step I / IIa / IIb ¹	Internal/ External
Chain-of-Custody Forms	The Resolution Field Team Leader or designee will review and sign each chain-of-custody form to verify that all samples listed are included in the shipment to the laboratory and the sample information is accurate. The chain-of-custody forms will be signed by the sampler and a copy will be retained for the project file, the Resolution Project Manager, and the Subcontract Data Validator.	Field Team Leader and Field Crew, Resolution	I	External
Chain-of-Custody Forms	The Laboratory Sample Custodian will review the sample shipment for completeness and integrity and will sign accepting the shipment.	Laboratory Sample Custodian	I	Internal
Chain-of-Custody Forms	The data validator will check that the chain-of-custody form was signed and dated by the Resolution SS or designee relinquishing the samples and also by the Laboratory Sample Custodian receiving the samples for analyses. The data validator will Confirm that the custody and integrity of the samples were maintained from collection to analysis and that custody records are complete and any deviations are recorded.	Data Validator, Resolution	I	External
Field SOPs/Field Logs/Sample Collection	Confirm that all sampling SOPs were followed. Verify that deviations have been documented and performance criteria have been achieved, that samples were correctly identified, that sampling location coordinates are accurate, and that documentation establishes an unbroken chain of custody from sample collection to report generation. Verify that the correct sampling and analytical procedures were applied. Verify that the SAP was followed as written and that any deviations are documented.	Project Manager, Field Team Leader, or designee, Resolution	IIa	External
Field Screening Data (Field Analyses)	Field screening results will be reviewed for completeness and to confirm that analyses were performed in accordance with the applicable SOPs. Data will be reviewed to determine whether calibration and quality control requirements specified in the applicable SOPs were met. Results for which these criteria were not met will be noted in the report when the results are presented.	Project Manager, Field Team Leader, or designee, Resolution	IIa	External

Data Review Input	Description	Responsible for Verification (name, organization)	Step I / IIa / IIb ¹	Internal/ External
Sample Tables	Proposed samples verified to have been collected.	Field Team Leader and Field Crew, Resolution	IIa	External
Sample Log Sheets	Log sheets completed as samples are collected in the field are verified for completeness and are maintained at the project office.	Project Manager, Field Team Leader, or designee, Resolution	IIa	External
Field QC Samples	Verify that field QC samples listed in Worksheet #12 were collected as required.	Field Team Leader or designee, Resolution	IIa	External
Sample Coordinates	Sample locations will be validated to be correct and in accordance with the SAP (compare map of proposed locations to map of actual locations).	Project Manager, Field Team Leader, or designee, Resolution	IIa	External
Analytical SOPs	Confirm that all laboratory SOPs were followed. Verify that the correct analytical methods/SOPs were applied.	Laboratory Quality Assurance Manager	IIa	Internal
Documentation of Method QC Results	Establish that all method QC samples were analyzed and in control as listed in the analytical SOPs. If method QA is not in control, the Laboratory Quality Assurance Manager will contact Resolution for guidance prior to report preparation.	Laboratory Quality Assurance Manager	IIa	Internal
Analytical Data Packages	All analytical data packages will be verified internally for completeness by the laboratory performing the work. The Laboratory Quality Assurance Manager will sign the case narrative for each data package.	Laboratory Quality Assurance Manager	IIa	Internal
Analytical Data Packages	Verify that the data package contains all the elements required by the laboratory Master Services Agreement and laboratory work order. Missing information will be requested from the laboratory, and data validation (if applicable) will be suspended until missing data are received.	Data Validator, Resolution	IIa	External
Documentation of Analytical Reports for Completeness	Confirm that the required analytical samples have been collected, appropriate sample identifications have been used, and correct analytical methods have been applied. Data Validator will verify that elements of the data package required for validation are present, and if not, the laboratory will be contacted and the missing information will be requested. Validation will be performed as described below per Worksheet #36. Verify all data have been transferred correctly and completely to the final SQL database.	Data Validator, Resolution	IIa	External
Electronic Data Deliverables	The electronic data will be compared to the chain-of-custody form and hard copy data package to verify accuracy and completeness.	Data Validator, Resolution	IIa	External

Data Review Input	Description	Responsible for Verification (name, organization)	Step I / IIa / IIb ¹	Internal/ External
Analytical Data Packages	For the fixed-laboratory data, limited data validation (similar to an EPA Level II validation) will be performed using criteria for the methods listed in Worksheet #'s 12, 15, and 28, the DoD QSM v 4.2, laboratory work order, and laboratory SOPs. If not addressed in the worksheets or DoD QSM, the logic outlined in the <i>Region I, USEPA-New England Data Validation Functional Guidelines For Evaluating Environmental Analyses</i> (December 1996), <i>USEPA National Functional Guidelines for Superfund Organic Methods Data Review</i> (June 2008), and <i>USEPA National Functional Guidelines for Inorganic Methods Data Review</i> (January 2010) will be used to apply qualifiers to data. Note that the <i>USEPA Contract Laboratory Program National Functional Guidelines For Organic Data Review</i> (February 1994) will be applied to the VOC data for measurement performance indicators, such as surrogates, that are not addressed by the most recent USEPA validation guidelines.	Data Validator, Resolution	IIb	External
Analytical Data Packages (in addition to Level III Validation)	<u>Data Results:</u> Verify that the summary form results are consistent with those presented on the EDD. <u>Project Quantitation Limits for Sensitivity:</u> Verify that the LOQs and LODs listed in Worksheet # 15 were achieved.	Data Validator, Resolution	IIa/IIb	External
Data Validation Report	Summarize deviations from methods, procedures, or contracts. Qualify data results based on method or QC deviation and explain all data qualifications. Print a copy of the project database, qualified data depicting data qualifiers, and data qualifiers codes that summarize the reason for data qualifications. Determine if the data met the MPCs and determine the impact of any deviations on the technical usability of the data.	Data Validator, Resolution	IIa/IIb	External
Project Action Limits	Discuss the impact of matrix interferences or sample dilutions performed, because of the high concentration of one or more contaminants, on the other target compounds reported as not detected. Document this usability issue and inform the Resolution Project Manager.	Resolution Project Chemist	IIa/IIb	External

Data Review Input	Description	Responsible for Verification (name, organization)	Step I / IIa / IIb ¹	Internal/ External
SAP QC Sample Documentation	Verify that all QC samples specified in the SAP were collected and analyzed and that the associated results were within prescribed SAP acceptance limits. Verify that QC samples and standards prescribed in analytical SOPs were analyzed and within the prescribed control limits. If any significant QC deviations occur, the Laboratory Quality Assurance Manager shall have contacted the Resolution Project Chemist or Project Manager.	Data Validator, Resolution	IIa/IIb	External
Analytical Data Deviations	Determine the impact of any deviation from sampling or analytical methods, SOP requirements, and matrix interferences on the analytical results.	Data Validator, Resolution	IIa/IIb	External

Notes:

1 IIa=compliance with methods, procedures, and contracts [see Table 10, page 117, UFP-QAPP manual, V.1, March 2005.]

IIb=comparison with measurement performance criteria in the SAP [see Table 11, page 118, UFP-QAPP manual, V.1, March 2005]

SAP Worksheet #37: Usability Assessment

[\(UFP-QAPP Manual Section 5.2.3\)](#)

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

Resolution will validate the fixed-laboratory data for all definitive analyses conducted. Validation will be conducted in accordance with the protocols described in Worksheets #34-36. These procedures are consistent with USEPA National Data Validation Functional Guidelines. The Project Chemist, in conjunction with the project team, will determine whether the analytical data meet the requirements to support the investigation. The results of laboratory measurements will be compared to the data quality objectives described in Worksheet #11.

Describe the evaluative procedures used to assess overall measurement error associated with the project

During the data validation process the validator will use information confirming sample identification, sample preparation, analysis within holding time, and results of QC samples designed to assess blank contamination, analytical precision, and accuracy to identify any limitations in data use and, if known, data bias. The validator will apply qualifiers as needed to reflect any limitations on the use of specific data points and prepare a report detailing the information reviewed, data limitations, and overall usability. Patterns of data use limitations or anomalies which become apparent during the validation process or during use will be reviewed with the Project Chemist and the appropriate laboratory. Data that do not meet the quality acceptance limits of Worksheet #28, or quality levels of Worksheet #15, or analytical performance criteria specified in Worksheet #12 will be identified in the database so data users are aware of any limitations associated with data usability. Details of the problems identified during data validation and the bias in the data will be provided in the associated validation memorandum.

Identify the personnel responsible for performing the usability assessment

Data validation will be coordinated by the Resolution Project Chemist and will be conducted by the Resolution data validation staff. Data usability will be assessed by the Resolution Project Manager with the assistance of the Resolution Project Chemist.

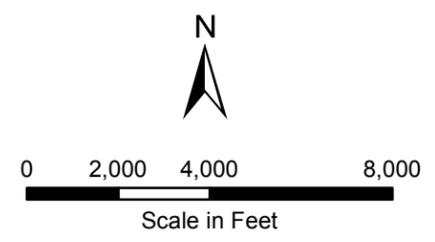
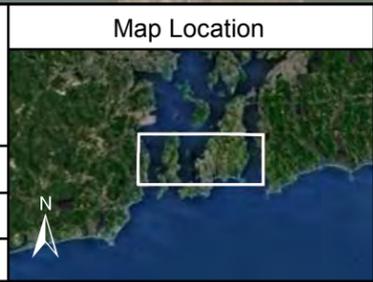
Describe the documentation that will be generated during usability assessment and how usability assessment results will be presented so that they identify trends, relationships (correlations), and anomalies

The documentation generated during data validation will include a memorandum that describes the information reviewed, the results of this review, and a recommendation on data usability and limitations of specific data points. The memorandum provides information on the samples included in the review and the date they were collected, the condition of samples when received at the laboratory and any discrepancies noted during the receiving process, verification of sample preparation and analysis within the method specified holding time, review of associated QC analyses including blanks, LCSs, MSs, and field and/or laboratory duplicates. As a result of this review standard qualifiers are entered into the database so that data users can readily identify any limitations associated with a specific data point.

Figures




**RESOLUTION
CONSULTANTS**
Drawn: BC 08/28/2013
Approved: NT 08/28/2013
Project #: 60277548



**FIGURE 1
REGIONAL LOCATION**

**CODDINGTON POINT
NAVSTA NEWPORT, RHODE ISLAND**




RESOLUTION CONSULTANTS
 Drawn: BC 08/28/2013
 Approved: NT 08/28/2013
 Project #: 60277548

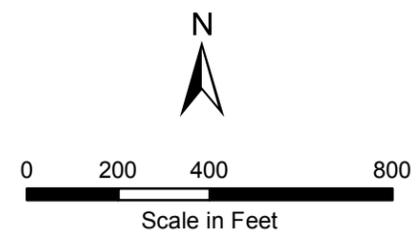
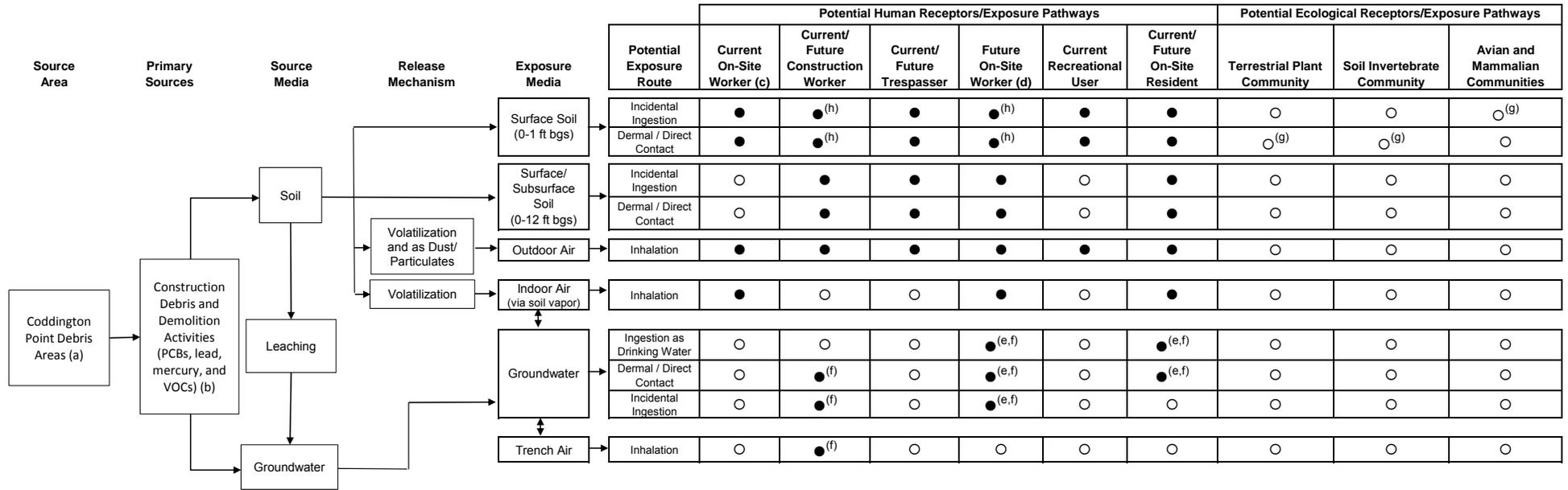


FIGURE 2
SITE PLAN

CODDINGTON POINT
NAVSTA NEWPORT, RHODE ISLAND

Figure 3
Conceptual Site Model of Potential Exposure Pathways
Debris Areas
Coddington Point
NAVSTA, Newport, RI



Notes:
 ● Potentially complete pathway.
 ○ Pathway considered to be incomplete or insignificant.
 ft bgs - feet below ground surface.

- (a) Includes Naval Supply School (MARDET Building 1112CP), Combat Training Pool (Building 1357CP), P 451 New OTC Barracks, Nimitz Field (lighting area), and Bishop's Rock (improvement project area).
- (b) Asbestos-containing materials (ACM) exist in the debris. However, ACM will not be evaluated as part of this investigation. VOCs are included per a request from RIDEM.
- (c) Includes maintenance staff and Naval staff spending breaks outside.
- (d) Assumes a default worker scenario if current worker scenario is limited.
- (e) Pathway only complete if well installed in the future.
- (f) Groundwater to be evaluated if encountered. Inhalation of excavation trench air will only be evaluated where volatiles in groundwater are identified as COPCs. Drinking water scenarios only to be evaluated if groundwater determined to be potable.
- (g) It does not appear that ecological exposure pathways are complete. This may be adjusted following further on-site evaluation.
- (h) Surface soil evaluated as part of combined surface and subsurface soil evaluation.



Legend

- Study Area Boundary
- Areas where ACM was Encountered during Construction Activities (NAVFAC, 2011)
- 2011 Geophysical Survey Area (Tetra Tech, 2012)
- 2009 Geophysical Survey Area (Tetra Tech, 2012)
- Potential Buried Debris Identified from Geophysical Survey (Tetra Tech 2012)
- Former Water Storage Reservoir as Identified from Geophysical Survey (Tetra Tech, 2012)
- 2011 Soil Boring (Tetra Tech, 2012)
- ⊙ Debris Observed in 2011 Soil Boring (Tetra Tech, 2012)

2012
 0 90 180
 Scale in Feet



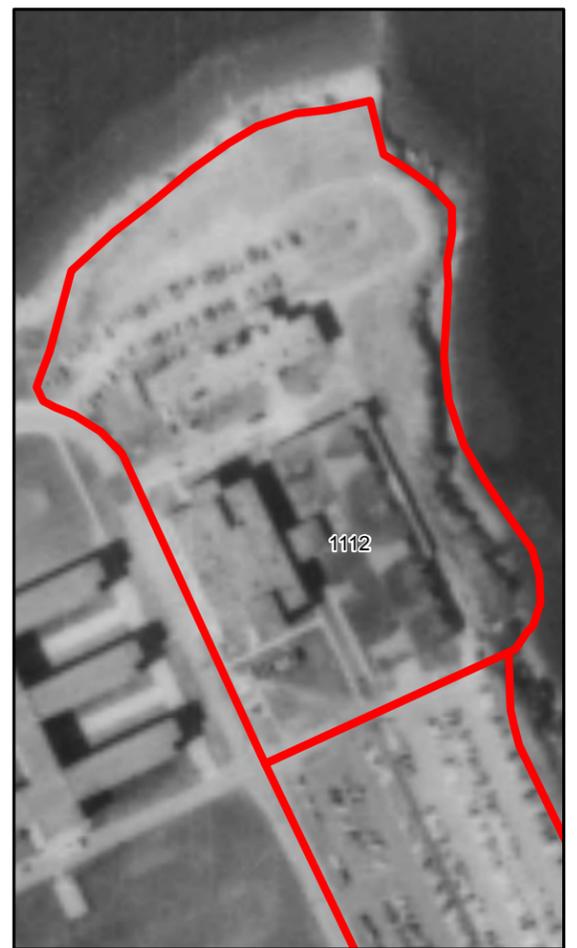
1939

0 100 200
 Scale in Feet



1962

0 100 200
 Scale in Feet



1981

0 100 200
 Scale in Feet


RESOLUTION CONSULTANTS
 Drawn: JB 08/28/2013
 Approved: MK 08/28/2013
 Project #: 60277548

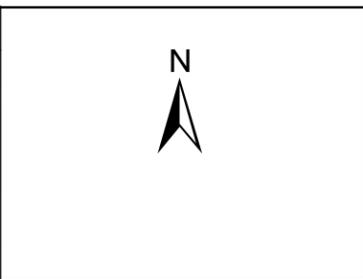


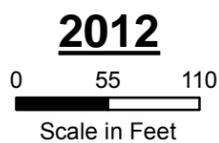
FIGURE 4
 NAVY SUPPLY CORPS SCHOOL BUILDING 1112CP

 CODDINGTON POINT
 NAVSTA NEWPORT, RHODE ISLAND



Legend

- Study Area Boundary
- Areas where ACM was Encountered during Construction Activities (NAVFAC, 2011)
- 2011 Geophysical Survey Area (Tetra Tech, 2012)
- 2009 Geophysical Survey Area (Tetra Tech, 2012)
- Potential Buried Debris Identified from Geophysical Survey (Tetra Tech 2012)



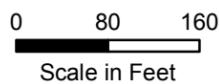
- Former Water Storage Reservoir as Identified from Geophysical Survey (Tetra Tech, 2012)
- 2011 Soil Boring (Tetra Tech, 2012)
- ⊙ Debris Observed in 2011 Soil Boring (Tetra Tech, 2012)



1939



1962



1981



Drawn: JB 08/28/2013
 Approved: MK 08/28/2013
 Project #: 60277548

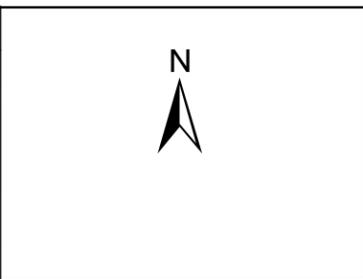


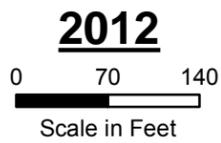
FIGURE 5
COMBAT TRAINING POOL BUILDING 1357CP

CODDINGTON POINT
 NAVSTA NEWPORT, RHODE ISLAND



Legend

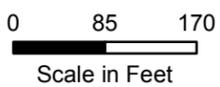
- Study Area Boundary
- Areas where ACM was Encountered during Construction Activities (NAVFAC, 2011)
- 2011 Geophysical Survey Area (Tetra Tech, 2012)
- 2009 Geophysical Survey Area (Tetra Tech, 2012)
- Potential Buried Debris Identified from Geophysical Survey (Tetra Tech 2012)



- Former Water Storage Reservoir as Identified from Geophysical Survey (Tetra Tech, 2012)
- 2011 Soil Boring (Tetra Tech, 2012)
- ⊙ Debris Observed in 2011 Soil Boring (Tetra Tech, 2012)



1939



1962



1981




Drawn: JB 08/28/2013
 Approved: MK 08/28/2013
 Project #: 60277548

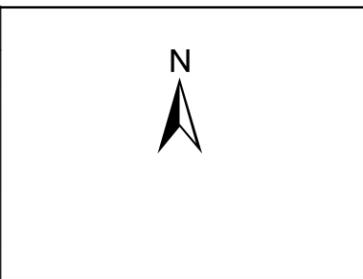
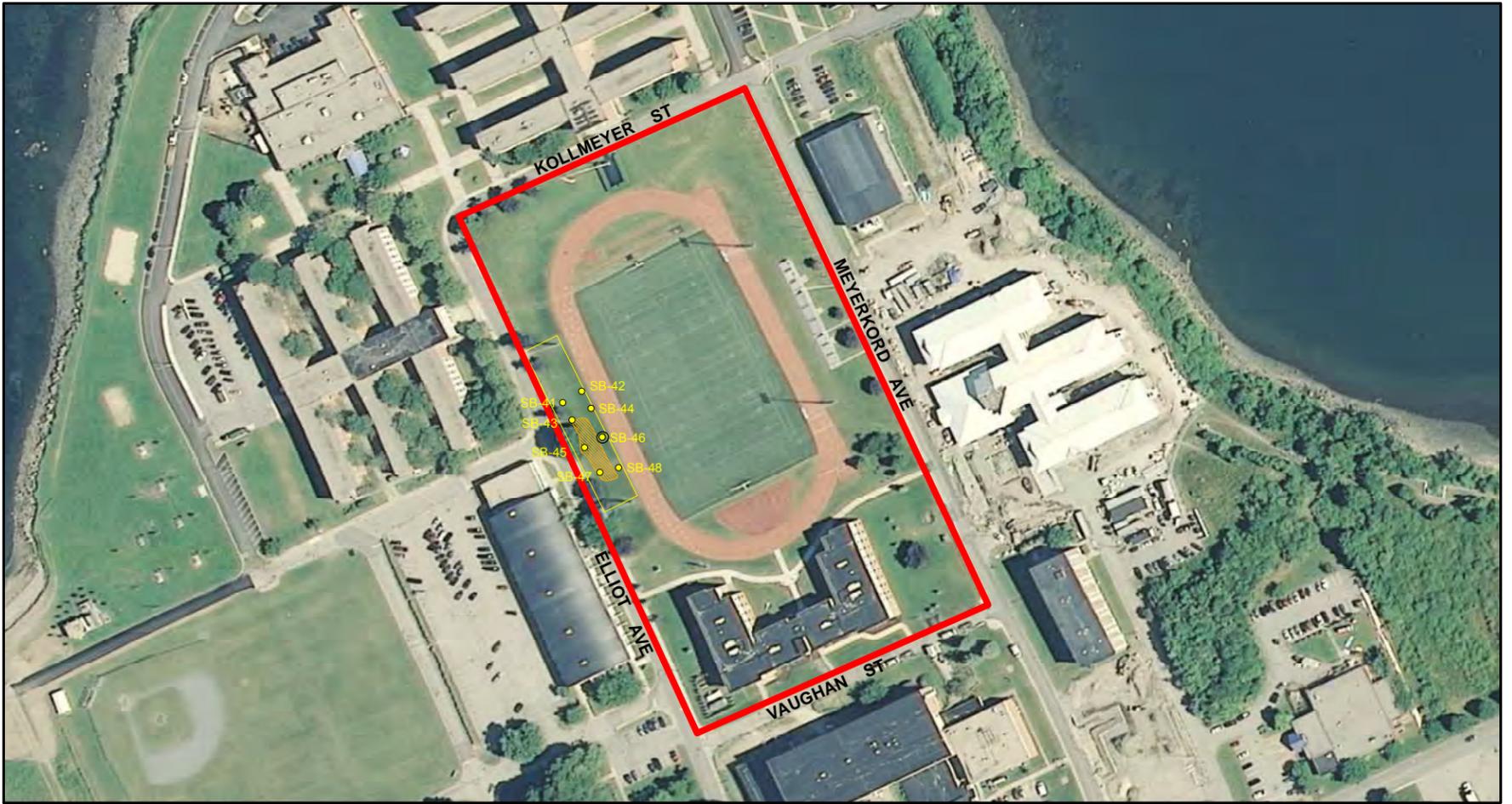


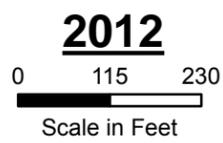
FIGURE 6
NEW OTC BARRACKS

CODDINGTON POINT
 NAVSTA NEWPORT, RHODE ISLAND

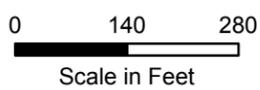


Legend

-  Study Area Boundary
-  Area where ACM was Identified and removed during trenching in July 2010 (NAVFAC, 2011)
-  2011 Geophysical Survey Area (Tetra Tech, 2012)
-  2011 Soil Boring (Tetra Tech, 2012)
-  Debris Observed in 2011 Soil Boring (Tetra Tech, 2012)



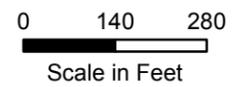
1939



1962



1981




Drawn: JB 08/07/2013
 Approved: MK 08/07/2013
 Project #: 60277548

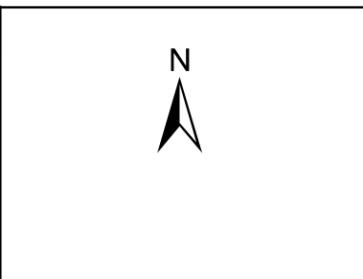


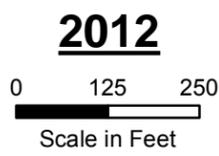
FIGURE 7
NIMITZ FIELD

CODDINGTON POINT
NAVSTA NEWPORT, RHODE ISLAND



Legend

- Study Area Boundary
- Area where ACM was Identified and removed during trenching in July 2010 (NAVFAC, 2011)
- 2011 Geophysical Survey Area (Tetra Tech, 2012)
- Potential Buried Debris Identified from Geophysical Survey (Tetra Tech 2012)
- 2011 Soil Boring (Tetra Tech, 2012)
- ⊙ Debris Observed in 2011 Soil Boring (Tetra Tech, 2012)



1939

Scale in Feet



1962

Scale in Feet



1981

Scale in Feet

Drawn: JB 08/28/2013
 Approved: MK 08/28/2013
 Project #: 60277548

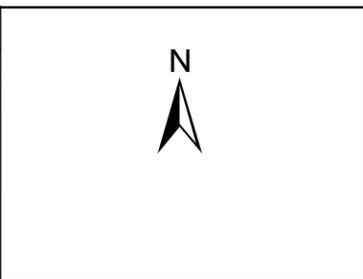


FIGURE 8
BISHOPS ROCK

CODDINGTON POINT
NAVSTA NEWPORT, RHODE ISLAND

- Legend**
- Soil Boring to Verify Cover Materials Thickness
 - Soil Boring to Verify Cover Thickness and Sample Subsurface Soil within Debris Zone (>2 Feet bgs)
 - ▲ Soil Boring to Verify Cover Thickness and Sample Surface Soil Materials and Subsurface Soil within Debris Zone
 - 2011 Soil Boring (Tetra Tech, 2012)
 - ⊙ Debris Observed in 2011 Soil Boring (Tetra Tech, 2012)
 - ▭ Study Area Boundary
 - ▨ Areas where ACM was Encountered during Construction Activities (NAVFAC, 2011)
 - ▭ 2011 Geophysical Survey Area (Tetra Tech, 2012)
 - ▭ 2009 Geophysical Survey Area (Tetra Tech, 2012)
 - ▭ Potential Buried Debris Identified from Geophysical Survey (Tetra Tech 2012)
 - ▭ Former Water Storage Reservoir as Identified from Geophysical Survey (Tetra Tech, 2012)



RESOLUTION CONSULTANTS

Drawn: JB 08/12/2013
 Approved: MK 08/12/2013
 Project #: 60277548

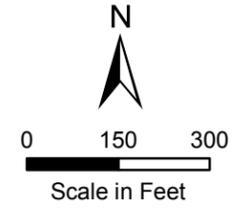


FIGURE 9
INVESTIGATION SUMMARY

CODDINGTON POINT
NAVSTA NEWPORT, RHODE ISLAND

Appendix A

Resolution Consultants SOPs

Utility Clearance

Procedure 3-01

1.0 Purpose and Scope

- 1.1 This standard operating procedure (SOP) describes the process for determining the presence of subsurface utilities and other cultural features at locations where planned site activities involve the physical disturbance of subsurface materials.
- 1.2 This procedure is the Program-approved professional guidance for work performed by Resolution Consultants under the Comprehensive Long-Term Environmental Action Navy (CLEAN) contract (Contract Number N62470-11-D-8013).
- 1.3 The procedure applies to the following activities: soil gas surveying, excavating, trenching, drilling of borings and installation of monitoring and extraction wells, use of soil recovery or slide-hammer hand augers, and all other intrusive sampling activities.
- 1.4 The primary purpose of the procedure is to minimize the potential for damage to underground utilities and other subsurface features, which could result in physical injury, disruption of utility service, or disturbance of other subsurface cultural features.
- 1.5 If there are procedures, whether it be from Resolution Consultants, state, and/or federal, that are not addressed in this SOP and are applicable to utility clearance, those procedures should be added as an appendix to the project specific SAP.
- 1.6 As guidance for specific activities, this procedure does not obviate the need for professional judgment. Deviations from this procedure while planning or executing planned activities must be approved in accordance with Program requirements for technical planning and review.

2.0 Safety

- 2.1 Field and subcontractor personnel shall adhere to a site-specific health and safety plan (HASP).

3.0 Terms and Definitions

3.1 Utility

For the purposes of this SOP, a utility is defined as a manmade underground line or conduit, cable, pipe, vault or tank that is, or was, used for the transmission of material or energy (e.g., gas, electrical, telephone, steam, water or sewage, product transfer lines, or underground storage tanks).

3.2 As-Built Plans

As-built plans are plans or blueprints depicting the locations of structures and associated utilities on a property.

3.3 One-Call

The Utility Notification Center is the one-call agency for nationwide call before you dig. The Utility Notification Center is open 24 hours a day, and accepts calls from anyone planning to dig. The phone number 811 is the designated call before you dig phone number that directly connects you to your local one-call center. Additional information can be found at www.call811.com.

Calling before you dig ensures that any publicly owned underground lines will be marked so that you can dig around them safely. Having the utility lines marked not only prevents accidental damage to the lines, but prevents property damage and personal injuries that could result in breaking a line.

The following information will need to be provided when a call is placed to One-Call:

- Your name, phone number, company name (if applicable), and mailing address.
- What type of work is being done.
- Who the work is being done for.
- The county and city the work is taking place in.
- The address or the street where the work is taking place.
- Marking instructions, (specific instructions as to where the work is taking place).

Under normal circumstances it takes between 2 to 5 days from the time you call (not counting weekends or holidays) to have the underground lines marked. Because these laws vary from state to state, exactly how long it will take depends on where your worksite is located. You will be given an exact start time and date when your locate request is completed, which will comply with the laws in your area.

In the event of an emergency (any situation causing damage to life or property, or a service outage), lines can be marked sooner than the original given time if requested.

3.4 **Toning**

Toning is the process of surveying an area utilizing one or more surface geophysical methods to determine the presence or absence of underground utilities. Typically, toning is conducted after identifying the general location of utilities and carefully examining all available site utility plans. Each location is marked according to the type of utility being identified. In addition, areas cleared by toning are flagged or staked to indicate that all identified utilities in a given area have been toned.

4.0 **Training and Qualifications**

- 4.1 The **Contract Task Order (CTO) Manager** is responsible for verifying that these utility locating procedures are performed prior to the initiation of active subsurface exploration.
- 4.2 The **Program Quality Manager** is responsible for ensuring overall compliance with this procedure.
- 4.3 The **Field Manager** is responsible for ensuring that all utility locating activities are performed in accordance with this procedure.
- 4.4 All **Field Personnel** are responsible for the implementation of this procedure.

5.0 **Equipment and Supplies**

- 5.1 Equipment and supplies necessary for locating subsurface utilities will be provided by the subcontractor; however, the project **Field Manager/Field Personnel** will provide any additional equipment and supplies as needed as well as maintain information regarding the utility clearance activities in the field logbook.

6.0 **Procedure**

Proceed with the following steps where subsurface exploration will include excavations, drilling, or any other subsurface investigative method that could damage utilities at a site. In addition to the steps outlined below, always exercise caution while conducting subsurface exploratory work.

6.1 **Prepare Preliminary Site Plan**

- Prepare a preliminary, scaled site plan depicting the proposed exploratory locations as part of the project specific Sampling and Analysis Plan (SAP) or Work Plan. Include as many of the cultural and natural features as practical in this plan.

6.2 **Review Background Information**

- Search existing plan files to review the as-built plans to identify the known location of utilities at the site. Plot the locations of utilities identified onto a preliminary, scaled site plan. Inform the CTO Manager if utilities lie within close proximity to a proposed exploration or excavation location. The CTO Manager will determine if it is necessary to relocate proposed sampling or excavation locations.
- Include the utility location information gathered during previous investigations (e.g., remedial investigation or remedial site evaluation) in the project design documents for removal or remedial actions. In this manner, information regarding utility locations collected during implementation of a CTO can be shared with the subcontractor during implementation of a particular task order. In many instances, this will help to reduce the amount of additional geophysical surveying work the subcontractor may have to perform.
- Conduct interviews with onsite and facility personnel familiar with the site to obtain additional information regarding the known and suspected locations of underground utilities. In addition, if appropriate, contact shall be made with local utility companies to request their help in locating underground lines. Pencil in the dimensions, orientation, and depth of utilities, other than those identified on the as-built plans, at their approximate locations on the preliminary plans. Enter the type of utility, the personnel who provided the information, and the date the information was provided into the field log.
- During the pre-field work interviewing process, the interviewer will determine which site personnel should be notified in the event of an incident involving damage to existing utilities. Record this information in the field logbook with the corresponding telephone numbers and addresses.

6.3 **Site Visit/Locate Utilities/Toning**

- Prior to the initiation of field activities, the Field Task Manager or similarly qualified field personnel shall visit the site and note existing structures and evidence of associated utilities, such as fire hydrants, irrigation systems, manhole and vault box covers, standpipes, telephone switch boxes, free-standing light poles, gas or electric meters, pavement cuts, and linear depression. Compare notes of the actual site configuration to the preliminary site plan. Note deviations in the field logbook and on the preliminary site plan. Accurately locate or survey and clearly mark with stakes, pins, flags, paint, or other suitable devices all areas where subsurface exploration is proposed. These areas shall correspond with the locations drawn on the preliminary site plan.
- Following the initial site visit by the Field Task Manager, a trained utility locating subcontractor will locate, identify, and tone all utilities depicted on the preliminary site plan. The Field Task Manager or similarly qualified field personnel shall visit the site and identify the areas of subsurface disturbance with white spray paint, chalk, white pin flags or some other easily identifiable marking. The utility locator should utilize appropriate sensing equipment to attempt to locate utilities that might not have appeared on the as-built plans. At a minimum, the utility subcontractor should utilize a metal detector and/or magnetometer; however, it is important to consider the possibility that non-metallic utilities or tanks might be present at the site. Use other appropriate surface geophysical methods such as Ground Penetrating Radar, Radiodetection, etc. as appropriate. Clear proposed exploration areas of all utilities in the immediate area where subsurface exploration is proposed. Clearly tone all anomalous areas. Clearly identify all toned areas on the preliminary site plan. All utilities near the area of subsurface disturbance should also be marked out by the utility subcontractor using the universal colors for subsurface utilities (i.e., red – electric; blue – water; green – sewer; yellow – gas; etc.). After toning the site and plotting all known or suspected buried utilities on the preliminary site plan, the utility locator shall provide the Field Task Manager with a copy of the completed preliminary

site plan. Alternatively, the Field Task Manager or designee shall document the results of the survey on the preliminary site plan.

- Report to the Field Task Manager anomalous areas detected and toned that are in close proximity to the exploration or excavation areas. The Field Task Manager shall determine the safe distance to maintain from the known or suspected utility. It may be necessary to relocate the proposed exploration or excavation areas. If this is required, the Field Task Manager or designee shall relocate them and clearly mark them using the methods described above. Completely remove the markings at the prior location. Plot the new locations on the site plan and delete the prior locations from the plan. In some instances, such as in areas extremely congested with subsurface utilities, it may be necessary to dig by hand or use techniques such as air knife to determine the location of the utilities.

6.4 **Prepare Site Plan**

- Prior to the initiation of field activities, draft a final site plan that indicates the location of subsurface exploration areas and all known or suspected utilities present at the site. Provide copies of this site plan to the Navy Technical Representative (NTR), the CTO Manager, and the subcontractor who is to conduct the subsurface exploration/excavation work. Review the site plan with the NTR to verify its accuracy prior to initiating subsurface sampling activities.

7.0 **Quality Control and Assurance**

7.1 Utility locating must incorporate quality control measures to ensure conformance to these and the project requirements.

8.0 **Records, Data Analysis, Calculations**

8.1 A bound field logbook will be kept detailing all activities conducted during the utility locating procedure.

8.2 The logbook will describe any changes and modifications made to the original exploration plan. The trained utility locator shall prepare a report and keep it in the project file. Also, a copy of the final site plan will be kept in the project file.

9.0 **Attachments or References**

Department of Defense, United States (DoD). 2005. [Uniform Federal Policy for Quality Assurance Project Plans, Part 1: UFP-QAPP Manual](http://www.epa.gov/fedfac/pdf/ufp_qapp_v1_0305.pdf). Final Version 1. DoD: DTIC ADA 427785, EPA-505-B-04-900A. In conjunction with the U. S. Environmental Protection Agency and the Department of Energy. Washington: Intergovernmental Data Quality Task Force. March. On-line updates available at: http://www.epa.gov/fedfac/pdf/ufp_qapp_v1_0305.pdf.

Author	Reviewer	Revisions (Technical or Editorial)
Caryn DeJesus Senior Scientist	Bob Shoemaker Senior Scientist	Rev 0 – Initial Issue (June 2012)

Logbooks

Procedure 3-02

1.0 Purpose and Scope

- 1.1 This standard operating procedure (SOP) describes the activities and responsibilities pertaining to the identification, use, and control of logbooks and associated field data records.
- 1.2 As guidance for specific activities, this procedure does not obviate the need for professional judgment. Deviations from this procedure while planning or executing planned activities must be approved in accordance with Program requirements for technical planning and review.

2.0 Safety

- 2.1 In order to keep the logbook clean, store it in a clean location and use it only when outer gloves used for PPE have been removed.

3.0 Terms and Definitions

3.1 Logbook

A logbook is a bound field notebook with consecutively numbered, water-repellent pages that is clearly identified with the name of the relevant activity, the person assigned responsibility for maintenance of the logbook, and the beginning and ending dates of the entries.

3.2 Data Form

A data form is a predetermined format utilized for recording field data that may become, by reference, a part of the logbook (e.g., soil boring logs, trenching logs, surface soil sampling logs, groundwater sample logs, and well construction logs are data forms).

4.0 Training and Qualifications

- 4.1 The **Contract Task Order (CTO) Manager** or **designee** is responsible for determining which team members shall record information in field logbooks and for obtaining and maintaining control of the required logbooks. The **CTO Manager** shall review the field logbook on at least a monthly basis. The **CTO Manager** or **designee** is responsible for reviewing logbook entries to determine compliance with this procedure and to ensure that the entries meet the project requirements.
- 4.2 A knowledgeable individual such as the **Field Manager**, **CTO Manager**, or **Program Quality Manager** shall perform a technical review of each logbook at a frequency commensurate with the level of activity (weekly is suggested, or, at a minimum, monthly). Document these reviews by the dated signature of the reviewer on the last page or page immediately following the material reviewed.
- 4.3 The **Program Quality Manager** is responsible for ensuring overall compliance with this procedure.
- 4.4 The **Field Manager** is responsible for ensuring that all **field personnel** follow these procedures and that the logbook is completed properly and daily. The **Field Manager** is also responsible for submitting copies to the **CTO Manager**, who is responsible for filing them and submitting a copy (if required by the CTO Statement of Work).
- 4.5 The **logbook user** is responsible for recording pertinent data into the logbook to satisfy project requirements and for attesting to the accuracy of the entries by dated signature. The **logbook user** is also responsible for safeguarding the logbook while having custody of it.

4.6 All **field personnel** are responsible for the implementation of this procedure.

5.0 Equipment and Supplies

5.1 Field logbooks shall be bound field notebooks with water-repellent pages.

5.2 Pens shall have indelible black ink.

6.0 Procedure

6.1 The field logbook serves as the primary record of field activities. Make entries chronologically and in sufficient detail to allow the writer or a knowledgeable reviewer to reconstruct the applicable events. Store the logbook in a clean location and use it only when outer gloves used for personal protective equipment (PPE) have been removed.

6.2 Individual data forms may be generated to provide systematic data collection documentation. Entries on these forms shall meet the same requirements as entries in the logbook and shall be referenced in the applicable logbook entry. Individual data forms shall reference the applicable logbook and page number. At a minimum, include names of all samples collected in the logbook even if they are recorded elsewhere.

6.3 Enter field descriptions and observations into the logbook, as described in Attachment 1, using indelible black ink.

6.4 Typical information to be entered includes the following:

- Dates (month/day/year) and times (military) of all on-site activities and entries made in logbooks/forms;
- Site name and description;
- Site location by longitude and latitude, if known;
- Weather conditions, including temperature and relative humidity;
- Fieldwork documentation, including site entry and exit times;
- Descriptions of, and rationale for, approved deviations from the work plan (WP) or field sampling plan;
- Field instrumentation readings;
- Names, job functions, and organizational affiliations of on-site personnel;
- Photograph references;
- Site sketches and diagrams made on site;
- Identification and description of sample morphology, collection locations, and sample numbers;
- Sample collection information, including dates (month/day/year) and times (military) of sample collections, sample collection methods and devices, station location numbers, sample collection depths/heights, sample preservation information, sample pH (if applicable), analysis requested (analytical groups), etc., as well as chain-of-custody (COC) information such as sample identification numbers cross-referenced to COC sample numbers;
- Sample naming convention;
- Field quality control (QC) sample information;
- Site observations, field descriptions, equipment used, and field activities accomplished to reconstruct field operations;

- Meeting information;
- Important times and dates of telephone conversations, correspondence, or deliverables;
- Field calculations;
- PPE level;
- Calibration records;
- Contractor and subcontractor information (address, names of personnel, job functions, organizational affiliations, contract number, contract name, and work assignment number);
- Equipment decontamination procedures and effectiveness;
- Laboratories receiving samples and shipping information, such as carrier, shipment time, number of sample containers shipped, and analyses requested; and
- User signatures.

6.5 The logbook shall reference data maintained in other logs, forms, etc. Correct entry errors by drawing a single line through the incorrect entry, then initialing and dating this change. Enter an explanation for the correction if the correction is more than for a mistake.

6.6 At least at the end of each day, the person making the entry shall sign or initial each entry or group of entries.

6.7 Enter logbook page numbers on each page to facilitate identification of photocopies.

6.8 If a person's initials are used for identification, or if uncommon acronyms are used, identify these on a page at the beginning of the logbook.

6.9 At least weekly and preferably daily, the **preparer** shall photocopy and retain the pages completed during that session for backup. This will prevent loss of a large amount of information if the logbook is lost.

7.0 Quality Control and Assurance

7.1 Review per Section 4.2 shall be recorded.

8.0 Records, Data Analysis, Calculations

8.1 Retain the field logbook as a permanent project record. If a particular CTO requires submittal of photocopies of logbooks, perform this as required.

8.2 Deviations from this procedure shall be documented in field records. Significant changes shall be approved by the **Program Quality Manager**.

9.0 Attachments or References

9.1 Attachment 1 – Description of Logbook Entries

9.2 Department of Defense, United States (DoD). 2005. *Uniform Federal Policy for Quality Assurance Project Plans, Part 1: UFP-QAPP Manual*. Final Version 1. DoD: DTIC ADA 427785, EPA-505-B-04-900A. In conjunction with the U. S. Environmental Protection Agency and the Department of Energy. Washington: Intergovernmental Data Quality Task Force. March. On-line updates available at: http://www.epa.gov/fedfac/pdf/ufp_qapp_v1_0305.pdf.

Author	Reviewer	Revisions (Technical or Editorial)
Mark Kromis Program Chemist	Chris Barr Program Quality Manager	Rev 0 – Initial Issue

Attachment 1 Description of Logbook Entries

Logbook entries shall be consistent with Section A.1.4 *Field Documentation SOPs* of the UFP-QAPP Manual (DoD 2005) and contain the following information, as applicable, for each activity recorded. Some of these details may be entered on data forms, as described previously.

Name of Activity	For example, Asbestos Bulk Sampling, Charcoal Canister Sampling, Aquifer Testing.
Task Team Members and Equipment	Name all members on the field team involved in the specified activity. List equipment used by serial number or other unique identification, including calibration information.
Activity Location	Indicate location of sampling area as indicated in the field sampling plan.
Weather	Indicate general weather and precipitation conditions.
Level of PPE	Record the level of PPE (e.g., Level D).
Methods	Indicate method or procedure number employed for the activity.
Sample Numbers	Indicate the unique numbers associated with the physical samples. Identify QC samples.
Sample Type and Volume	Indicate the medium, container type, preservative, and the volume for each sample.
Time and Date	Record the time and date when the activity was performed (e.g., 0830/08/OCT/89). Use the 24-hour clock for recording the time and two digits for recording the day of the month and the year.
Analyses	Indicate the appropriate code for analyses to be performed on each sample, as specified in the WP.
Field Measurements	Indicate measurements and field instrument readings taken during the activity.
Chain of Custody and Distribution	Indicate chain-of-custody for each sample collected and indicate to whom the samples are transferred and the destination.
References	If appropriate, indicate references to other logs or forms, drawings, or photographs employed in the activity.
Narrative (including time and location)	<p>Create a factual, chronological record of the team's activities throughout the day including the time and location of each activity. Include descriptions of general problems encountered and their resolution. Provide the names and affiliations of non-field team personnel who visit the site, request changes in activity, impact the work schedule, request information, or observe team activities. Record any visual or other observations relevant to the activity, the contamination source, or the sample itself.</p> <p>It should be emphasized that logbook entries are for recording data and chronologies of events. The logbook author must include observations and descriptive notations, taking care to be objective and recording no opinions or subjective comments unless appropriate.</p>
Recorded by	Include the signature of the individual responsible for the entries contained in the logbook and referenced forms.
Checked by	Include the signature of the individual who performs the review of the completed entries.

Recordkeeping, Sample Labeling, and Chain-of-Custody

Procedure 3-03

1.0 Purpose and Scope

- 1.1 The purpose of this standard operating procedure is to establish standard protocols for all field personnel for use in maintaining field and sampling activity records, writing sample logs, labeling samples, ensuring that proper sample custody procedures are utilized, and completing chain-of-custody/analytical request forms.
- 1.2 As guidance for specific activities, this procedure does not obviate the need for professional judgment. Deviations from this procedure while planning or executing planned activities must be approved in accordance with Program requirements for technical planning and review.

2.0 Safety

Not applicable.

3.0 Terms and Definitions

3.1 Logbook

A logbook is a bound field notebook with consecutively numbered, water-repellent pages that is clearly identified with the name of the relevant activity, the person responsible for maintenance of the logbook, and the beginning and ending dates of the entries.

3.2 Chain-of-Custody

Chain-of-custody (COC) is documentation of the process of custody control. Custody control includes possession of a sample from the time of its collection in the field to its receipt by the analytical laboratory, and through analysis and storage prior to disposal.

4.0 Training and Qualifications

- 4.1 The **CTO Manager** is responsible for determining which team members shall record information in the field logbook and for checking sample logbooks and COC forms to ensure compliance with these procedures. The **CTO Manager** shall review COC forms on a monthly basis at a minimum.
- 4.2 The **CTO Manager** and **Program Quality Manager** are responsible for evaluating project compliance with the Project Procedures Manual.
- 4.3 The **Program Quality Manager** is responsible for ensuring overall compliance with this procedure.
- 4.4 The **Laboratory Project Manager** or **Sample Control Department Manager** is responsible for reporting any sample documentation or COC problems to the **CTO Manager** or **CTO Laboratory Coordinator** within 24 hours of sample receipt.
- 4.5 The **Field Manager** is responsible for ensuring that all **field personnel** follow these procedures. The **CTO Laboratory Coordinator** is responsible for verifying that the COC/analytical request forms have been completed properly and match the sampling and analysis plan. The **CTO Manager** or **CTO Laboratory Coordinator** is responsible for notifying the **laboratory, data managers, and data validators** in writing if analytical request changes are required as a corrective action. These small changes are different from change orders, which involve changes to the scope of the subcontract with

the laboratory and must be made in accordance with a respective contract (e.g., CLEAN remedial action contract).

- 4.6 All **field personnel** are responsible for following these procedures while conducting sampling activities. **Field personnel** are responsible for recording pertinent data into the logbook to satisfy project requirements and for attesting to the accuracy of the entries by dated signature.

5.0 Procedure

This procedure provides standards for documenting field activities, labeling the samples, documenting sample custody, and completing COC/analytical request forms. The standards presented in this section shall be followed to ensure that samples collected are maintained for their intended purpose and that the conditions encountered during field activities are documented.

5.1 Recordkeeping

The field logbook serves as the primary record of field activities. Make entries chronologically and in sufficient detail to allow the writer or a knowledgeable reviewer to reconstruct each day's events. Field logs such as soil boring logs and ground-water sampling logs will also be used. These procedures are described in Procedure 3-02, *Logbooks*.

5.2 Sample Labeling

Affix a sample label with adhesive backing to each individual sample container. Place clear tape over each label (preferably prior to sampling) to prevent the labels from tearing off, falling off, being smeared, and to prevent loss of information on the label. Record the following information with a waterproof marker on each label:

- Project name or number (optional);
- COC sample number;
- Date and time of collection;
- Sampler's initials;
- Matrix (optional);
- Sample preservatives (if applicable); and
- Analysis to be performed on sample (this shall be identified by the method number or name identified in the subcontract with the laboratory).

These labels may be obtained from the analytical laboratory or printed from a computer file onto adhesive labels.

5.3 Custody Procedures

For samples intended for chemical analysis, sample custody procedures shall be followed through collection, transfer, analysis, and disposal to ensure that the integrity of the samples is maintained. Maintain custody of samples in accordance with the U.S. Environmental Protection Agency (EPA) COC guidelines prescribed in EPA *NEIC Policies and Procedures*, National Enforcement Investigations Center, Denver, Colorado, revised May 1986; EPA *RCRA Ground Water Monitoring Technical Enforcement Guidance Document (TEGD)*; *Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA* (EPA OSWER Directive 9355 3-01); Appendix 2 of the *Technical Guidance Manual for Solid Waste Water Quality Assessment Test (SWAT) Proposals and Reports*; and *Test Methods for Evaluating Solid Waste* (EPA SW-846)

A description of sample custody procedures is provided below.

5.3.1 Sample Collection Custody Procedures

According to the U.S. EPA guidelines, a sample is considered to be in custody if one of the following conditions is met:

- It is in one's actual physical possession or view;
- It is in one's physical possession and has not been tampered with (i.e., it is under lock or official seal);
- It is retained in a secured area with restricted access; and
- It is placed in a container and secured with an official seal such that the sample cannot be reached without breaking the seal.

Place custody seals on sample containers immediately after sample collection and on shipping coolers if the cooler is to be removed from the sampler's custody. Place custody seals in such a manner that they must be broken to open the containers or coolers. Label the custody seals with the following information:

- Sampler's name or initials; and
- Date and time that the sample/cooler was sealed.

These seals are designed to enable detection of sample tampering. An example of a custody seal is shown in Attachment 1.

Field personnel shall also log individual samples onto COC forms (carbon copy or computer generated) when a sample is collected. These forms may also serve as the request for analyses. Procedures for completing these forms are discussed in Section 7.4, indicating sample identification number, matrix, date and time of collection, number of containers, analytical methods to be performed on the sample, and preservatives added (if any). The **samplers** will also sign the COC form signifying that they were the personnel who collected the samples. The COC form shall accompany the samples from the field to the laboratory. When a cooler is ready for shipment to the analytical laboratory, the **person delivering the samples for transport** will sign and indicate the date and time on the accompanying COC form. One copy of the COC form will be retained by the **sampler** and the remaining copies of the COC form shall be placed inside a self-sealing bag and taped to the inside of the cooler. Each cooler must be associated with a unique COC form. Whenever a transfer of custody takes place, **both parties** shall sign and date the accompanying carbon copy COC forms, and the **individual relinquishing the samples** shall retain a copy of each form. One exception is when the samples are shipped; the **delivery service personnel** will not sign or receive a copy because they do not open the coolers. The **laboratory** shall attach copies of the completed COC forms to the reports containing the results of the analytical tests. An example COC form is provided in Attachment 2.

5.3.2 Laboratory Custody Procedures

The following custody procedures are to be followed by an **independent laboratory** receiving samples for chemical analysis; the procedures in their Naval Facilities Engineering Service Center-evaluated Laboratory Quality Assurance Plan must follow these same procedures. A **designated sample custodian** shall take custody of all samples upon their arrival at the analytical laboratory. The **custodian** shall inspect all sample labels and COC forms to ensure that the information is consistent, and that each is properly completed. The **custodian** will also measure the temperature of the temperature blank in the coolers upon arrival using either a National Institute for Standards and Technology calibrated thermometer or an infra-red temperature gun. The **custodian** shall note the condition of the samples including:

- If the samples show signs of damage or tampering;
- If the containers are broken or leaking;
- If headspace is present in sample vials;
- If proper preservation of samples has occurred (made by pH measurement, except volatile organic compounds [VOCs] and purgeable total petroleum hydrocarbons [TPH] and temperature). The pH of VOC and purgeable TPH samples will be checked by the **laboratory analyst** after the sample aliquot has been removed from the vial for analysis; and
- If any sample holding times have been exceeded.

All of the above information shall be documented on a sample receipt sheet by the **custodian**.

Discrepancies or improper preservation shall be noted by the **laboratory** as an out-of-control event and shall be documented on an out-of-control form with corrective action taken. The out-of-control form shall be signed and dated by the **sample control custodian** and **any other persons** responsible for corrective action. An example of an out-of-control form is included as Attachment 4.

The **custodian** shall then assign a unique laboratory number to each sample and distribute the samples to secured storage areas maintained at 4 degrees Celsius (soil samples for VOC analysis are to be stored in a frozen state until analysis). The unique laboratory number for each sample, COC sample number, client name, date and time received, analysis due date, and storage shall also be manually logged onto a sample receipt record and later entered into the laboratory's computerized data management system. The **custodian** shall sign the shipping bill and maintain a copy.

Laboratory personnel shall be responsible for the care and custody of samples from the time of their receipt at the laboratory through their exhaustion or disposal. Samples should be logged in and out on internal laboratory COC forms each time they are removed from storage for extraction or analysis.

5.4 **Completing COC/Analytical Request Forms**

COC form/analytical request form completion procedures are crucial in properly transferring the custody and responsibility of samples from field personnel to the laboratory. This form is important for accurately and concisely requesting analyses for each sample; it is essentially a release order from the analysis subcontract.

Attachment 2 is an example of a generic COC/analytical request form that may be used by **field personnel**. Multiple copies may be tailored to each project so that much of the information described below need not be handwritten each time. Attachment 3 is an example of a completed site-specific COC/analytical request form, with box numbers identified and discussed in text below.

COC forms tailored to each CTO can be drafted and printed onto multi-ply forms. This eliminates the need to rewrite the analytical methods column headers each time. It also eliminates the need to write the project manager, name, and number; QC Level; TAT; and the same general comments each time.

Complete one COC form per cooler. Whenever possible, place all VOC analyte vials into one cooler in order to reduce the number of trip blanks. Complete all sections and be sure to sign and date the COC form. One copy of the COC form must remain with the field personnel.

Box 2 **Bill To:** List the name and address of the person/company to bill only if it is not in the subcontract with the laboratory.

Box 3 **Sample Disposal Instructions:** These instructions will be stated in the Master Service Agreement or each CTO statement of work with each laboratory.

Shipment Method: State the method of shipment (e.g., hand carry or air courier via FedEx or DHL).

Comments: This area shall be used by the field team to communicate observations, potential hazards, or limitations that may have occurred in the field or additional information regarding analysis (e.g., a specific metals list, samples expected to contain high analyte concentrations).

Box 4 **Cooler No.:** This will be written on the inside or outside of the cooler and shall be included on the COC. Some laboratories attach this number to the trip blank identification, which helps track samples for VOC analysis. If a number is not on the cooler, field personnel shall assign a number, write it on the cooler, and write it on the COC.

QC Level: Enter the reporting quality control (QC) requirements (e.g., Full Data Package, Summary Data Package).

Turnaround time (TAT): TAT will be determined by a sample delivery group (SDG), which may be formed over a 14-day period, not to exceed 20 samples. Once the SDG has been completed, standard TAT is 21 calendar days from receipt of the last sample in the SDG. Entering NORMAL or STANDARD in this field will be acceptable. If quicker TAT is required, it shall be in the subcontract with the laboratory and reiterated on each COC to remind the laboratory.

Box 5 **Type of Containers:** Write the type of container used (e.g., 1-liter glass amber, for a given parameter in that column).

Preservatives: Field personnel must indicate on the COC the correct preservative used for the analysis requested. Indicate the pH of the sample (if tested) in case there are buffering conditions found in the sample matrix.

Box 6 **Sample Identification (ID) Number:** This is typically a five-character alphanumeric identifier used by the contractor to identify samples. The use of this identifier is important since the laboratories are restricted to the number of characters they are able to use. Sample numbering shall be in accordance with the project-specific sampling and analysis plan.

Description (Sample ID): This name will be determined by the location and description of the sample, as described in the project-specific sampling and analysis plan. This sample identification should not be submitted to the laboratory, but should be left blank. If a computer COC version is used, the sample identification can be input, but printed with this block black. A cross-referenced list of the COC Sample Number and sample identification must be maintained separately.

Date Collected: Record the collection date in order to track the holding time of the sample. Note: For trip blanks, record the date it was placed in company with samples.

Time Collected: When collecting samples, record the time the sample is first collected. Use of the 24-hour military clock will avoid a.m. or p.m. designations (e.g., 1815 instead of 6:15 p.m.). Record local time; the laboratory is responsible for calculating holding times to local time.

Lab ID: This is for laboratory use only.

-
- Box 7 **Matrix/QC:** Identify the matrix (e.g., water, soil, air, tissue, fresh water sediment, marine sediment, or product). If a sample is expected to contain high analyte concentrations (e.g., a tank bottom sludge or distinct product layer), notify the laboratory in the comment section. Mark an "X" for the sample(s) that have extra volume for laboratory QC matrix spike/matrix spike duplicate (MS/MSD) purposes. The sample provided for MS/MSD purposes is usually a field duplicate.
- Box 8 **Analytical Parameters:** Enter the parameter by descriptor and the method number desired (e.g., BTEX 8260B, PAHs 8270C, etc.). Whenever practicable, list the parameters as they appear in the laboratory subcontract to maintain consistency and avoid confusion.
- If the COC does not have a specific box for number of sample containers, use the boxes below the analytical parameter, to indicate the number of containers collected for each parameter.
- Box 9 **Sampler's Signature:** The person who collected samples must sign here.
- Relinquished By:** The person who turned over the custody of the samples to a second party other than an express mail carrier, such as FedEx or DHL, must sign and date here.
- Received By:** Typically, a representative of the receiving laboratory signs and dates here. Or, a field crew member who delivered the samples in person from the field to the laboratory might sign here. A courier, such as FedEx or DHL, does not sign here because they do not open the coolers. It must also be used by the prime contracting laboratory when samples are to be sent to a subcontractor.
- Relinquished By:** In the case of subcontracting, the primary laboratory will sign and date the Relinquished By space and fill out an additional COC to accompany the samples being subcontracted.
- Received By (Laboratory):** This space is for the final destination (e.g., at a subcontracted laboratory). A representative of the final destination (e.g., subcontracted laboratory) must sign and date here.
- Box 10 **Lab No. and Questions:** This box is to be filled in by the laboratory only.
- Box 11 **Control Number:** This number is the "COC" followed by the first contractor identification number in that cooler, or contained on that COC. This control number must be unique (i.e., never used twice). Record the date the COC is completed. It should be the same date the samples are collected.
- Box 12 **Total # of Containers:** Sum the number of containers in that row.
- Box 13 **Totals:** Sum the number of containers in each column. Because COC forms contain different formats depending on who produced the form, not all of the information listed in items 1 to 13 may be recorded; however, as much of this information as possible shall be included.
-

6.0 Quality Control and Assurance

- 6.1 Recordkeeping, sample labeling, and chain-of-custody activities must incorporate quality control measures to ensure accuracy and completeness.
- 6.2 Deviations from this procedure or the project-specific CTO work plan shall be documented in field records. Significant changes shall be approved by the **Program Quality Manager**.

7.0 Records, Data Analysis, Calculations

- 7.1 The COC/analytical request form shall be faxed approximately daily to the **CTO Laboratory Coordinator** for verification of accuracy. Following the completion of sampling activities, the sample

logbook and COC forms will be transmitted to the **CTO Manager** for storage in project files. The **data validators** shall receive a copy also. The original COC/analytical request form shall be submitted by the **laboratory** along with the data delivered. Any changes to the analytical requests that are required shall be made in writing to the laboratory. A copy of this written change shall be sent to the data validators and placed in the project files. The reason for the change shall be included in the project files so that recurring problems can be easily identified.

- 7.2 Deviations from this procedure or the project-specific sampling and analysis plan shall be documented in the records. Significant changes shall be approved by the **Program Quality Manager**.

8.0 Attachments or References

- 8.1 Attachment 1 – Chain-of-Custody Seal
- 8.2 Attachment 2 – Generic Chain-of-Custody/Analytical Request Form
- 8.3 Attachment 3 – Sample Completed Chain-of-Custody
- 8.4 Attachment 4 – Sample Out-of-Control Form
- 8.5 Environmental Protection Agency, United States (EPA). 1988. *Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA*. Interim Final. EPA/540/G-89/004. Office of Emergency and Remedial Response. October.
- 8.6 EPA. 1992. *RCRA Groundwater Monitoring Draft Technical Guidance*. EPA/530/R-93/001. Office of Solid Waste. November.
- 8.7 EPA. 1997. Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW-846. 3rd ed., Final Update IIIA. Office of Solid Waste.
- 8.8 Water Resources Control Board, State of California. 1988. *Technical Guidance Manual for Solid Waste Water Quality Assessment Test (SWAT) Proposals and Reports*. August.
- 8.9 Procedure 3-02, *Logbooks*.

Author	Reviewer	Revisions (Technical or Editorial)
Mark Kromis Program Chemist	Chris Barr Program Quality Manager	Rev 0 – Initial Issue

Attachment 1

Chain-of-Custody Seal

CHAIN-OF-CUSTODY SEAL

<i>[LABORATORY]</i>	SAMPLE NO.	DATE	SEAL BROKEN BY
	SIGNATURE		DATE
	PRINT NAME AND TITLE (<i>Inspector, Analyst or Technician</i>)		

Attachment 2 Generic Chain-of-Custody/Analytical Request Form

MD01575

CHAIN OF CUSTODY RECORD												Page ____ of ____	
Client/Project Name:				Project Location:				Analysis Requested					
Project Number:				Field Logbook No.:									
Sample#: (Print Name)/Affiliation:				Chain of Custody Tape No.:									
Signature:				Send Results/Report to:									
Field Sample No./ Identification	Date	Time	Grab	Comp	Sample Container (Size/Mat)	Sample Type (Liquid, Sludge, Etc.)	Preservative	Filter				Lab. I.D.	Remarks
Relinquished by: (Print Name)				Date:	Received by: (Print Name)				Date:	Analytical Laboratory (Destination):			
Signature:				Time:	Signature:				Time:				
Relinquished by: (Print Name)				Date:	Received by: (Print Name)				Date:				
Signature:				Time:	Signature:				Time:				
Relinquished by: (Print Name)				Date:	Received by: (Print Name)				Date:	Serial No.			
Signature:				Time:	Signature:				Time:				

Attachment 4 Sample Out-of-Control Form

OUT OF CONTROL FORM	Status	Date	Initial
	Noted OOC		
	Submit for CA*		
	Resubmit for CA*		
	Completed		

Date Recognized:	By:	Samples Affected (List by Accession AND Sample No.)
Dated Occurred:	Matrix	
Parameter (Test Code):	Method:	
Analyst:	Supervisor:	
1. Type of Event (Check all that apply)	2. Corrective Action (CA)* (Check all that apply)	
<input type="checkbox"/> Calibration Corr. Coefficient <0.995	<input type="checkbox"/> Repeat calibration	
<input type="checkbox"/> %RSD>20%	<input type="checkbox"/> Made new standards	
<input type="checkbox"/> Blank >MDL	<input type="checkbox"/> Reran analysis	
<input type="checkbox"/> Does not meet criteria:	<input type="checkbox"/> Sample(s) redigested and rerun	
<input type="checkbox"/> Spike	<input type="checkbox"/> Sample(s) reextracted and rerun	
<input type="checkbox"/> Duplicate	<input type="checkbox"/> Recalculated	
<input type="checkbox"/> LCS	<input type="checkbox"/> Cleaned system	
<input type="checkbox"/> Calibration Verification	<input type="checkbox"/> Ran standard additions	
<input type="checkbox"/> Standard Additions	<input type="checkbox"/> Notified	
<input type="checkbox"/> MS/MSD	<input type="checkbox"/> Other (please explain)	
<input type="checkbox"/> BS/BSD		
<input type="checkbox"/> Surrogate Recovery		
<input type="checkbox"/> Calculations Error		
<input type="checkbox"/> Holding Times Missed		
<input type="checkbox"/> Other (Please explain)	Comments:	

3. Results of Corrective Action	
<input type="checkbox"/>	Return to Control (indicated with)
<input type="checkbox"/>	Corrective Actions Not Successful - DATA IS TO BE FLAGGED with _____.

Analyst:	Date:
Supervisor:	Date:
QA Department:	Date:

Sample Handling, Storage, and Shipping

Procedure 3-04

1.0 Purpose and Scope

- 1.1 This standard operating procedure describes the actions to be used by personnel engaged in handling, storing, and transporting samples. The objective is to obtain samples of actual conditions with as little alteration as possible.
- 1.2 As guidance for specific activities, this procedure does not obviate the need for professional judgment. Deviations from this procedure while planning or executing planned activities must be approved in accordance with Program requirements for technical planning and review.

2.0 Safety

- 2.1 Avoid lifting heavy coolers with back muscles; instead, use leg muscles or dollies.
- 2.2 Wear proper gloves, such as blue nitrile and latex, as defined in the project-specific health and safety plan, when handling sample containers to avoid contacting any materials that may have spilled out of the sample containers.

3.0 Terms and Definitions

None.

4.0 Training and Qualifications

- 4.1 The **Contract Task Order (CTO) Manager** and the **Laboratory Project Manager** are responsible for identifying instances of non-compliance with this procedure and ensuring that future sample transport activities comply with this procedure.
- 4.2 The **Field Manager** is responsible for ensuring that all samples are shipped according to this procedure.
- 4.3 **Field personnel** are responsible for the implementation of this procedure.
- 4.4 The **Program Quality Manager** is responsible for ensuring that sample handling, storage, and transport activities conducted during all CTOs comply with this procedure.
- 4.5 All **field personnel** are responsible for the implementation of this procedure.

5.0 Procedure

5.1 Handling and Storage

Immediately following collection, label all samples according to Procedure 3-03, *Recordkeeping, Sample Labeling, and Chain-of-Custody*. The lids of the containers shall not be sealed with duct tape, but may be covered with custody seals or placed directly into self-sealing bags. Place the sample containers in an insulated cooler with frozen gel packs (e.g., "blue ice") or ice in double, sealed self-sealing bags. Samples should occupy the lower portion of the cooler, while the ice should occupy the upper portion. Place an absorbent material (e.g., proper absorbent cloth material) on the bottom of the cooler to contain liquids in case of spillage. Fill all empty space between sample containers with Styrofoam® "peanuts" or other appropriate material. Prior to shipping, wrap glass sample containers on the sides, tops, and bottoms with bubble wrap or other appropriate padding and/or surround them in Styrofoam to

prevent breakage during transport. Pack all glass containers for water samples in an upright position, never stacked or on their sides. Prior to shipment, replace the ice or cold packs in the coolers so that samples will be maintained as close to 4 degrees Celsius (°C) as possible from the time of collection through transport to the analytical laboratory. Ship samples within 24 hours or on a schedule allowing the laboratory to meet holding times for analyses. The procedures for maintaining sample temperatures at 4°C pertain to all field samples.

5.2 **Shipping**

Follow all appropriate U.S. Department of Transportation regulations (e.g., 49 Code of Federal Regulations [CFR], Parts 171-179) for shipment of air, soil, water, and other samples. Elements of these procedures are summarized below.

5.2.1 **Hazardous Materials Shipment**

Field personnel must state whether any sample is suspected to be a hazardous material. A sample should be assumed hazardous unless enough evidence exists to indicate it is non-hazardous. If not suspected to be hazardous, shipments may be made as described in the Section 5.2.2 for non-hazardous materials. If hazardous, follow the procedures summarized below.

Any substance or material that is capable of posing an unreasonable risk to life, health, or property when transported is classified as hazardous. Perform hazardous materials identification by checking the list of dangerous goods for that particular mode of transportation. If not on that list, materials can be classified by checking the Hazardous Materials Table (49 CFR 172.102 including Appendix A) or by determining if the material meets the definition of any hazard class or division (49 CFR Part 173), as listed in Attachment 2.

All **persons shipping hazardous materials** must be properly trained in the appropriate regulations, as required by HM-126F, Training for Safe Transportation of Hazardous Materials (49 CFR HM-126F Subpart H). The training covers loading, unloading, handling, storing, and transporting of hazardous materials, as well as emergency preparedness in the case of accidents. **Carriers**, such as commercial couriers, must also be trained. Modes of shipment include air, highway, rail, and water.

When shipping hazardous materials, including bulk chemicals or samples suspected of being hazardous, the proper shipping papers (49 CFR 172 Subpart C), package marking (49 CFR 172 Subpart D), labeling (49 CFR 172 Subpart E), placarding (49 CFR 172 Subpart F, generally for carriers), and packaging must be used. Attachment 1 shows an example of proper package markings. Refer to a copy of 49 CFR each time hazardous materials/potentially hazardous samples are shipped.

According to Section 2.7 of the International Air Transport Association Dangerous Goods Regulations publication, very small quantities of certain dangerous goods may be transported without certain marking and documentation requirements as described in 49 CFR Part 172; however, other labeling and packing requirements must still be followed. Attachment 2 shows the volume or weight for different classes of substances. A "Dangerous Goods in Excepted Quantities" label must be completed and attached to the associated shipping cooler (Attachment 3). Certain dangerous goods are not allowed on certain airlines in any quantity.

As stated in item 4 of Attachment 4, the Hazardous Materials Regulations do not apply to hydrochloric acid (HCl), nitric acid (HNO₃), sulfuric acid (H₂SO₄), and sodium hydroxide (NaOH) added to water samples if their pH or percentage by weight criteria is met. These samples may be shipped as non-hazardous materials as discussed below.

5.2.2 **Non-Hazardous Materials Shipment**

If the samples are suspected to be non-hazardous based on previous site sample results, field screening results, or visual observations, if applicable, then samples may be shipped as non-hazardous.

When a cooler is ready for shipment to the laboratory, place two copies of the chain-of-custody form inside a self-sealing bag and tape it to the inside of the insulated cooler. Then, seal the cooler with waterproof tape and label it with "Fragile," "This-End-Up" (or directional arrows pointing up), or other appropriate notices. Place chain-of-custody seals on the coolers as discussed in Procedure 3-03, *Recordkeeping, Sample Labeling, and Chain-of-Custody*.

5.2.3 Shipments from Outside the Continental United States

Shipment of sample coolers to the United States from locations outside the continental United States is controlled by the U.S. Department of Agriculture (USDA) and is subject to their inspection and regulation. A "USDA Soil Import Permit" is required to prove that the receiving analytical laboratory is certified by the USDA to receive and properly dispose of soil. In addition, all sample coolers must be inspected by a **USDA representative**, affixed with a label indicating that the coolers contain environmental samples, and accompanied by shipping forms stamped by the **USDA inspector** prior to shipment.

In addition, the U.S. Customs Service must clear samples shipped from U.S. territorial possessions or foreign countries upon entry into the United States. As long as the commercial invoice is properly completed (see below), shipments typically pass through U.S. Customs Service without the need to open coolers for inspection.

Completion and use of proper paperwork will, in most cases, minimize or eliminate the need for the USDA and U.S. Customs Service to inspect the contents. Attachment 5 shows an example of how paperwork may be placed on the outside of coolers for non-hazardous materials. For hazardous materials, refer to Section 5.2.1.

In summary, tape the paperwork listed below to the outside of the coolers to accompany sample shipments. If a shipment is made up of multiple pieces (e.g., more than one cooler), the paperwork need only be attached to one cooler, provided that the **courier** agrees. All other coolers in the shipment need only to be taped and have the address and chain-of-custody seals affixed.

1. **Courier Shipping Form & Commercial Invoice:** See Attachment 6 and Attachment 7 for examples of the information to be included on the commercial invoices for soil and water, respectively. Place the courier shipping form and commercial invoice inside a clear, plastic, adhesive-backed pouch that adheres to the package (typically supplied by the courier) and place it on the cooler lid as shown in Attachment 5.
2. **Soil Import Permit (soil only):** See Attachment 8 and Attachment 9 for examples of the soil import permit and soil samples restricted entry labels, respectively. The **laboratory** shall supply these documents prior to mobilization. The USDA often stops shipments of soil without these documents. Staple together the 2-inch × 2-inch USDA label (described below) and soil import permit, and place them inside a clear plastic pouch. The **courier** typically supplies the clear, plastic, adhesive-backed pouches that adhere to the package.

Placing one restricted entry label as shown in Attachment 5 (covered with clear packing tape) and one stapled to the actual permit is suggested.

The USDA does not control water samples, so the requirements for soil listed above do not apply.

3. **Chain-of-Custody Seals:** The **laboratory** should supply the seals. **CTO personnel** must sign and date these. At least two seals should be placed in such a manner that they stick to both the cooler lid and body. Placing the seals over the tape (as shown in Attachment 5), then covering it with clear packing tape is suggested. This prevents the seal from coming loose and enables detection of tampering.
4. **Address Label:** Affix a label stating the destination (laboratory address) to each cooler.
5. **Special Requirements for Hazardous Materials:** See Section 5.2.1.

Upon receipt of sample coolers at the laboratory, the **sample custodian** shall inspect the sample containers as discussed in Procedure 3-03, *Recordkeeping, Sample Labeling, and Chain-of-Custody*. The samples shall then be immediately extracted and/or analyzed, or stored in a refrigerated storage area until they are removed for extraction and/or analysis. Whenever the samples are not being extracted or analyzed, they shall be returned to refrigerated storage.

6.0 Quality Control and Assurance

- 6.1 Sample handling, storage, and shipping must incorporate quality control measures to ensure conformance to these and the project requirements.

7.0 Records, Data Analysis, Calculations

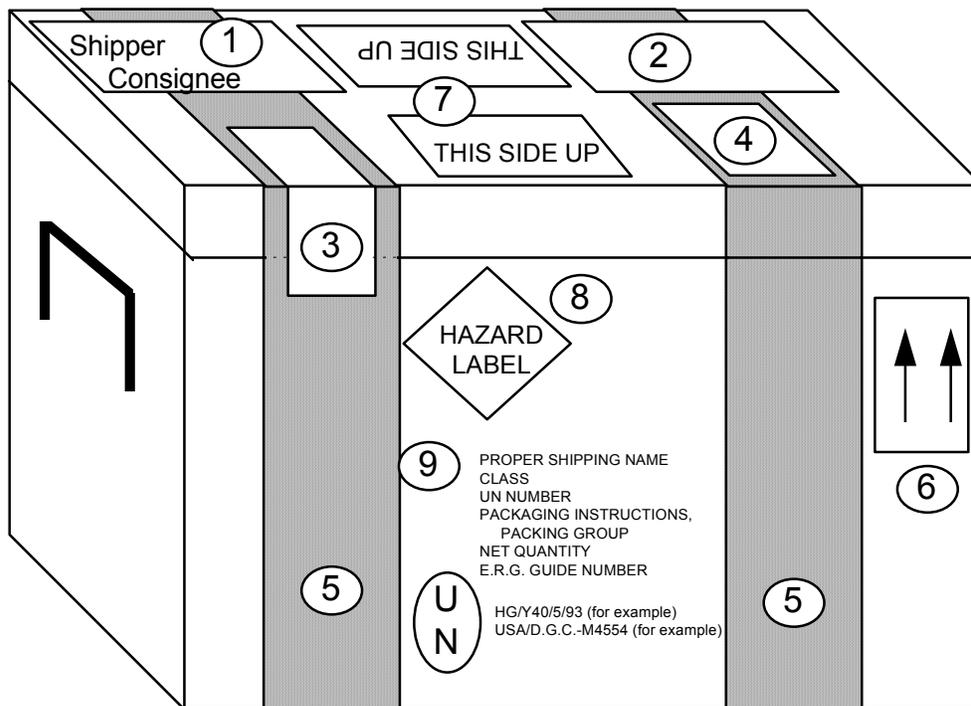
- 7.1 Maintain records as required by implementing these procedures.
- 7.2 Deviations from this procedure or the project-specific sampling and analysis plan shall be documented in field records. Significant changes shall be approved by the **Program Quality Manager**.

8.0 Attachments or Reference

- 8.1 Attachment 1 – Example Hazardous Material Package Marking
- 8.2 Attachment 2 – Packing Groups
- 8.3 Attachment 3 – Label for Dangerous Goods in Excepted Quantities
- 8.4 Attachment 4 – SW-846 Preservative Exception
- 8.5 Attachment 5 – Non-Hazardous Material Cooler Marking Figure for Shipment from Outside the Continental United States
- 8.6 Attachment 6 – Commercial Invoice – Soil
- 8.7 Attachment 7 – Commercial Invoice – Water
- 8.8 Attachment 8 – Soil Import Permit
- 8.9 Attachment 9 – Soil Samples Restricted Entry Labels
- 8.10 NAVSEA T0300-AZ-PRO-010. *Navy Environmental Compliance Sampling and Field Testing Procedures Manual*. August 2009.
- 8.11 Procedure 3-03, *Recordkeeping, Sample Labeling, and Chain-of-Custody*.

Author	Reviewer	Revisions (Technical or Editorial)
Mark Kromis Program Chemist	Chris Barr Program Quality Manager	Rev 0 – Initial Issue

Attachment 1 Example Hazardous Material Package Marking



- | | |
|--|---|
| ① AIR BILL/COMMERCIAL INVOICE | ⑥ DIRECTION ARROWS STICKER - TWO REQUIRED |
| ② USDA PERMIT (Letter to Laboratory from USDA) | ⑦ THIS SIDE UP STICKERS |
| ③ CUSTODY SEAL | ⑧ HAZARD LABEL |
| ④ USDA 2" X 2" SOIL IMPORT PERMIT | ⑨ HAZARDOUS MATERIAL INFORMATION |
| ⑤ WATERPROOF STRAPPING TAPE | ⑩ PACKAGE SPECIFICATIONS |

Attachment 2 Packing Groups

PACKING GROUP OF THE SUBSTANCE	PACKING GROUP I		PACKING GROUP II		PACKING GROUP III	
CLASS or DIVISION of PRIMARY or SUBSIDIARY RISK	Packagings		Packagings		Packagings	
	Inner	Outer	Inner	Outer	Inner	Outer
1: Explosives	----- Forbidden ^(Note A) -----					
2.1: Flammable Gas	----- Forbidden ^(Note B) -----					
2.2: Non-Flammable, non-toxic gas	----- See Notes A and B -----					
2.3: Toxic gas	----- Forbidden ^(Note A) -----					
3: Flammable liquid	30 mL	300 mL	30 mL	500 mL	30 mL	1 L
4.1 Self-reactive substances	Forbidden		Forbidden		Forbidden	
4.1: Other flammable solids	Forbidden		30 g	500 g	30 g	1 kg
4.2: Pyrophoric substances	Forbidden		Not Applicable		Not Applicable	
4.2 Spontaneously combustible substances	Not Applicable		30 g	500 g	30 g	1 kg
4.3: Water reactive substances	Forbidden		30 g or 30 mL	500 g or 500 mL	30 g or 30 mL	1 kg or 1 L
5.1: Oxidizers	Forbidden		30 g or 30 mL	500 g or 500 mL	30 g or 30 mL	1 kg or 1 L
5.2: Organic peroxides ^(Note C)	See Note A		30 g or 30 mL	500 g or 250 mL	Not Applicable	
6.1: Poisons - Inhalation toxicity	Forbidden		1 g or 1 mL	500 g or 500 mL	30 g or 30 mL	1 kg or 1 L
6.1: Poisons - oral toxicity	1 g or 1 mL	300 g or 300 mL	1 g or 1 mL	500 g or 500 mL	30 g or 30 mL	1 kg or 1 L
6.1: Poisons - dermal toxicity	1 g or 1 mL	300 g or 300 mL	1 g or 1 mL	500 g or 500 mL	30 g or 30 mL	1 kg or 1 L
6.2: Infectious substances	----- Forbidden ^(Note A) -----					
7: Radioactive material ^(Note D)	----- Forbidden ^(Note A) -----					
8: Corrosive materials	Forbidden		30 g or 30 mL	500 g or 500 mL	30 g or 30 mL	1 kg or 1 L
9: Magnetized materials	----- Forbidden ^(Note A) -----					
9: Other miscellaneous materials ^(Note E)	Forbidden		30 g or 30 mL	500 g or 500 mL	30 g or 30 mL	1 kg or 1 L

Note A: Packing groups are not used for this class or division.

Note B: For inner packagings, the quantity contained in receptacle with a water capacity of 30 mL. For outer packagings, the sum of the water capacities of all the inner packagings contained must not exceed 1 L.

Note C: Applies only to Organic Peroxides when contained in a chemical kit, first aid kit or polyester resin kit.

Note D: See 6.1.4.1, 6.1.4.2, and 6.2.1.1 through 6.2.1.7, radioactive material in excepted packages.

Note E: For substances in Class 9 for which no packing group is indicated in the List of Dangerous Goods, Packing Group II quantities must be used.

Attachment 3 Dangerous Goods in Excepted Quantities

DANGEROUS GOODS IN EXCEPTED QUANTITIES							
This package contains dangerous goods in excepted small quantities and is in all respects in compliance with the applicable international and national government regulations and the IATA Dangerous Goods Regulations.							

Signature of Shipper							
_____				_____			
Title				Date			

Name and address of Shipper							
This package contains substance(s) in Class(es) (check applicable box(es))							
Class:	2	3	4	5	6	8	9
	<input type="checkbox"/>						
and the applicable UN Numbers are:							

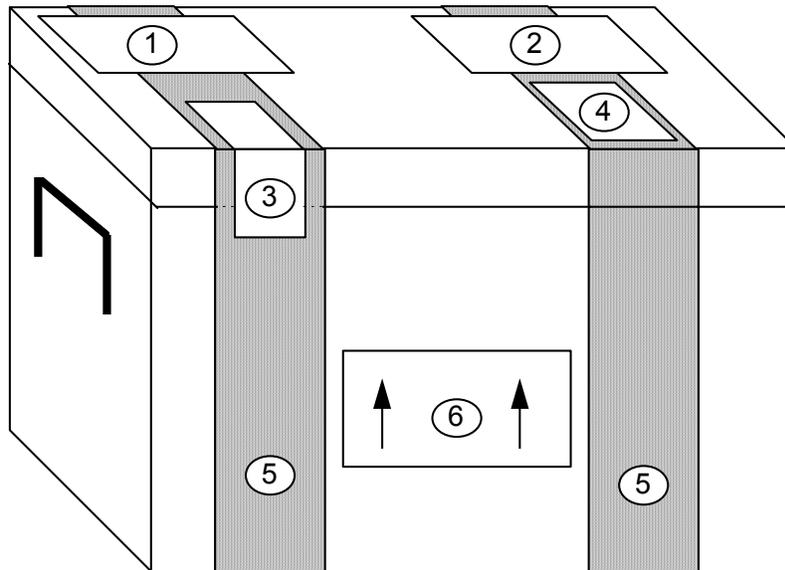
Attachment 4

SW-846 Preservative Exception

Measurement	Vol. Req. (mL)	Container ²	Preservative ^{3,4}	Holding Time ⁵
MBAS	250	P, G	Cool, 4°C	48 Hours
NTA	50	P, G	Cool, 4°C	24 Hours

1. More specific instructions for preservation and sampling are found with each procedure as detailed in this manual. A general discussion on sampling water and industrial wastewater may be found in ASTM, Part 31, p. 72-82 (1976) Method D-3370.
 2. Plastic (P) or Glass (G). For metals, polyethylene with a polypropylene cap (no liner) is preferred.
 3. Sample preservation should be performed immediately upon sample collection. For composite samples each aliquot should be preserved at the time of collection. When use of an automated sampler makes it impossible to preserve each aliquot, then samples may be preserved by maintaining at 4°C until compositing and sample splitting is completed.
4. When any sample is to be shipped by common carrier or sent through the United States Mail, it must comply with the Department of Transportation Hazardous Materials Regulations (49 CFR Part 172). The person offering such material for transportation is responsible for ensuring such compliance. For the preservation requirements of Table 1, the Office of Hazardous Materials, Materials Transportation Bureau, Department of Transportation has determined that the Hazardous Materials regulations do not apply to the following materials: Hydrochloric acid (HCl) in water solutions at concentration of 0.04% by weight or less (pH about 1.96 or greater); Nitric acid (HNO₃) in water solutions at concentrations of 0.15% by weight or less (pH about 1.62 or greater); Sulfuric acid (H₂SO₄) in water solutions at concentrations of 0.35% by weight or less (pH about 1.15 or greater); Sodium hydroxide (NaOH) in water solutions at concentrations of 0.080% by weight or less (pH about 12.30 or less).
5. Samples should be analyzed as soon as possible after collection. The times listed are the maximum times that samples may be held before analysis and still considered valid. Samples may be held for longer periods only if the permittee, or monitoring laboratory, has data on file to show that the specific types of sample under study are stable for the longer time, and has received a variance from the Regional Administrator. Some samples may not be stable for the maximum time period given in the table. A permittee, or monitoring laboratory, is obligated to hold the sample for a shorter time if knowledge exists to show this is necessary to maintain sample stability.
 6. Should only be used in the presence of residual chlorine.

Attachment 5 Non-Hazardous Material Cooler Marking Figure for Shipment from Outside the Continental United States



- ① AIR BILL/COMMERCIAL INVOICE
- ② USDA PERMIT (Letter to Laboratory from USDA)
- ③ CUSTODY SEAL
- ④ USDA 2" X 2" SOIL IMPORT PERMIT
- ⑤ WATERPROOF STRAPPING TAPE
- ⑥ DIRECTION ARROWS STICKER - TWO REQUIRED

Attachment 6 Commercial Invoice – Soil

DATE OF EXPORTATION <i>1/1/94</i>				EXPORT REFERENCES (i.e., order no., invoice no., etc.) <CJO #>				
SHIPPER/EXPORTER (complete name and address) <i>Joe Smith Ogden c/o <hotel name> <hotel address></i>				CONSIGNEE <i>Sample Receipt <Lab Name> <Lab Address></i>				
COUNTRY OF EXPORT <i>Guam, USA</i>				IMPORTER - IF OTHER THAN CONSIGNEE				
COUNTRY OF ORIGIN OF GOODS <i>Guam, USA</i>								
COUNTRY OF ULTIMATE DESTINATION <i>USA</i>								
INTERNATIONAL AIR WAYBILL NO.					(NOTE: All shipments must be accompanied by a Federal Express International Air Waybill)			
MARKS/NOS	NO. OF PKGS	TYPE OF PACKAGING	FULL DESCRIPTION OF GOODS	QTY	UNIT OF MEASURE	WEIGHT	UNIT VALUE	TOTAL VALUE
	<i>3</i>	<i>coolers</i>	<i>Soil samples for laboratory analysis only</i>				<i>\$1.00</i>	<i>\$3.00</i>
	TOTAL NO. OF PKGS.					TOTAL WEIGHT		TOTAL INVOICE VALUE
	<i>3</i>							<i>\$3.00</i>
Check one <input type="checkbox"/> F.O.B. <input type="checkbox"/> C&F <input type="checkbox"/> C.I.F.								

THESE COMMODITIES ARE LICENSED FOR THE ULTIMATE DESTINATION SHOWN.

DIVERSION CONTRARY TO UNITED STATES LAW IS PROHIBITED.

I DECLARE ALL THE INFORMATION CONTAINED IN THIS INVOICE TO BE TRUE AND CORRECT

SIGNATURE OF SHIPPER/EXPORTER (Type name and title and sign)

Joe Smith, Ogden

Joe Smith

1/1/94

Name/Title

Signature

Date

Attachment 7 Commercial Invoice – Water

DATE OF EXPORTATION <i>1/1/94</i>				EXPORT REFERENCES (i.e., order no., invoice no., etc.) <CJO #>				
SHIPPER/EXPORTER (complete name and address) <i>Joe Smith Ogden c/o <hotel name> <hotel address></i>				CONSIGNEE <i>Sample Receipt <Lab Name> <Lab Address></i>				
COUNTRY OF EXPORT <i>Guam, USA</i>				IMPORTER - IF OTHER THAN CONSIGNEE				
COUNTRY OF ORIGIN OF GOODS <i>Guam, USA</i>								
COUNTRY OF ULTIMATE DESTINATION <i>USA</i>								
INTERNATIONAL AIR WAYBILL NO.					(NOTE: All shipments must be accompanied by a Federal Express International Air Waybill)			
MARKS/NOS	NO. OF PKGS	TYPE OF PACKAGING	FULL DESCRIPTION OF GOODS	QTY	UNIT OF MEASURE	WEIGHT	UNIT VALUE	TOTAL VALUE
	<i>3</i>	<i>coolers</i>	<i>Water samples for laboratory analysis only</i>				<i>\$1.00</i>	<i>\$3.00</i>
	TOTAL NO. OF PKGS.					TOTAL WEIGHT		
	<i>3</i>						<i>\$3.00</i>	
Check one <input type="checkbox"/> F.O.B. <input type="checkbox"/> C&F <input type="checkbox"/> C.I.F.								

THESE COMMODITIES ARE LICENSED FOR THE ULTIMATE DESTINATION SHOWN.

DIVERSION CONTRARY TO UNITED STATES LAW IS PROHIBITED.

I DECLARE ALL THE INFORMATION CONTAINED IN THIS INVOICE TO BE TRUE AND CORRECT

SIGNATURE OF SHIPPER/EXPORTER (Type name and title and sign)

Joe Smith, Ogden

Joe Smith

1/1/94

Attachment 8 Soil Import Permit



**UNITED STATES
DEPARTMENT OF
AGRICULTURE**

Animal and Plant
Health Inspection
Service

Plant Protection and
Quarantine

Soil Permit

Columbia Analytical Services
(Lee Wolf)
1317 S. 13th Avenue
Kelso, Washington 98626
TELEPHONE: (360) 577-7222

Issued To:

Under the authority of the Federal Plant Pest Act of May 23, 1957, permission is hereby granted to the facility/individual named above subject to the following conditions:

1. Valid for shipments of soil not heat treated at the port of entry, only if a compliance agreement (PPQ Form 519) has been completed and signed. Compliance Agreements and Soil permits are non-transferable. If you hold a Soil Permit and you leave your present employer or company, you must notify your local USDA office promptly.
2. To be shipped in sturdy, leakproof, containers.
3. To be released without treatment at the port of entry.
4. To be used only for analysis and only in the facility of the permittee at Columbia Analytical Services, located in Kelso, Washington.
5. No use of soil for growing purposes is authorized, including the isolation or culture of organisms imported in soil.
6. All unconsumed soil, containers, and effluent is to be autoclaved, incinerated, or heat treated by the permittee at the conclusion of the project as approved and prescribed by Plant Protection and Quarantine.
7. This permit authorizes shipments from all foreign sources, including Guam, Hawaii, Puerto Rico, and the U.S. Virgin Islands through any U.S. port of entry.

Permit Number: S-52239

Expiration Date: JUNE 30, 2006

Deborah M. Knott
Approving Official DEBORAH M. KNOTT

WARNING: Any alteration, forgery, or unauthorized use of this Federal form is subject to civil penalties of up to \$250,000 (7 U.S.C. s 7754(b)) or punishable by a fine of not more than \$10,000, or imprisonment of not more than 5 years, or both (18 U.S.C. s 1001).

PPQ FORM 525B (8/94)

Pt. 1 - PERMITTEE

Attachment 9

Soil Samples Restricted Entry Labels

U.S. DEPARTMENT OF AGRICULTURE
ANIMAL AND PLANT HEALTH INSPECTION
SERVICE
PLANT PROTECTION AND QUARANTINE
HYATTSVILLE, MARYLAND 20782

SOIL SAMPLES
RESTRICTED ENTRY

The material contained in this
package is imported under authority
of the Federal Plant Pest Act of May
23, 1957.

For release without treatment
if addressee is currently listed
as approved by Plant
Protection and Quarantine.

PPQ FORM 550 *Edition of 12/77 may be used*

(JAN 83)

Investigation Derived Waste Management

Procedure 3-05

1.0 Purpose and Scope

This standard operating procedure (SOP) describes activities and responsibilities of the United States (U.S.) Navy Environmental Restoration (ER) Program, Naval Facilities Engineering Command, Atlantic (NAVFAC Atlantic) with regard to management of investigation-derived waste (IDW). The purpose of this procedure is to provide guidance for the minimization, handling, labelling, temporary storage, inventory, classification, and disposal of IDW generated under the ER Program. This procedure will also apply to personal protective equipment (PPE), sampling equipment, decontamination fluids, non-IDW trash, non-indigenous IDW, and hazardous waste generated during implementation of removal or remedial actions. The information presented will be used to prepare and implement work plans (WPs) for IDW-related field activities. The results from implementation of WPs will then be used to develop and implement final IDW disposal plans.

If there are procedures whether it be from Resolution Consultants, state and/or federal that are not addressed in this SOP and are applicable to IDW then those procedures may be added as an appendix to the project specific SAP.

This procedure applies to all Navy ER projects performed in the NAVFAC Atlantic Area of Responsibility.

This procedure shall serve as management-approved professional guidance for the ER Program and is consistent with protocol in the Uniform Federal Policy-Quality Assurance Project Plan (DoD 2005). As professional guidance for specific activities, this procedure is not intended to obviate the need for professional judgment during unforeseen circumstances. Deviations from this procedure while planning or executing planned activities must be approved by both the Contract Task Order (CTO) Manager and the Quality Assurance (QA) Manager or Technical Director, and documented.

This procedure was developed to serve as management-approved professional guidance for the management of IDW generated under the ER Program. It focuses on the requirements for minimizing, segregating, handling, labeling, storing, and inventorying IDW in the field. Certain drum inventory requirements related to the screening, sampling, classification, and disposal of IDW are also noted in this procedure.

2.0 Safety

The health and safety considerations for the work associated with this SOP, including both potential physical and chemical hazards, will be addressed in the project Health and Safety Plan (HASP). In the absence of a HASP, work will be conducted according to the CTO WP and/or direction from the **Site Safety Officer (SSO)**.

All **Field Personnel** responsible for IDW management must adhere to the HASP and must wear the PPE specified in the site-specific HASP. Generally, this includes, at a minimum, steel-toed boots or steel-toed rubber boots, safety glasses, American National Standards Institute-standard hard hats, and hearing protection (if heavy equipment is in operation). If safe alternatives are not achievable, discontinue site activities immediately.

3.0 Terms and Definitions

None.

4.0 Training and Qualifications

- 4.1 The **CTO Manager** is responsible for ensuring that IDW management activities comply with this procedure. The **CTO Manager** is responsible for ensuring that all personnel involved in IDW management shall have the appropriate education, experience, and training to perform their assigned tasks.
- 4.2 The **Program Quality Manager** is responsible for ensuring overall compliance with this procedure.
- 4.3 The **Field Manager** is responsible for ensuring that all IDW is managed according to this procedure.
- 4.4 All **Field Personnel** are responsible for the implementation of this procedure.

5.0 Equipment and Supplies

The equipment and supplies required for implementation of this SOP include the following:

- Containers for waste (e.g., [U.S. Department of Transportation] DOT approved 55-gallon open and closed top drums) and material to cover waste to protect from weather (e.g., plastic covering);
- Hazardous /non-hazardous waste drum labels (weatherproof);
- Permanent marking pens;
- Inventory forms for project file;
- Plastic garbage bags, zip lock storage bags, roll of plastic sheeting; and
- Steel-toed boots, chemical resistant gloves, coveralls, safety glasses, and any other PPE required in the HASP.

6.0 Procedure

The following procedures are used to handle the IDW.

6.1 Drum Handling

- 6.1.1 IDW shall be containerized using DOT approved drums. The drums shall be made of steel or plastic, have a 55-gallon capacity, be completely painted or opaque, and have removable lids (i.e., United Nations Code 1A2 or 1H2). Typically 55-gallon drums are used, however small drums may be used depending on the amount of waste generated. New steel drums are preferred over recycled drums.
- 6.1.2 Recycled drums should not be used for hazardous waste, PCBs or other regulated shipments. For short-term storage of liquid IDW prior to discharge, double-walled bulk steel or plastic storage tanks may be used. For this scenario, consider the scheduling and cost-effectiveness of this type of bulk storage, treatment, and discharge system versus longer-term drum storage.
- 6.1.3 For long-term IDW storage at other project locations, the DOT approved drums with removable lids are recommended. Verify the integrity of the foam or rubber sealing ring located on the underside of some drum lids prior to sealing drums containing IDW liquids.
- 6.1.4 If the ring is only partially attached to the drum lid, or if a portion of the ring is missing, select another drum lid with a sealing ring that is in sound condition.
- 6.1.5 To prepare IDW drums for labeling, wipe clean the outer wall surfaces and drum lids of all material that might prevent legible and permanent labeling. If potentially contaminated material adheres to the outer surface of a drum, wipe that material from the drum, and segregate the paper towel or rag used to remove the material with visibly soiled PPE and

disposable sampling equipment. Label all IDW drums and place them on pallets prior to storage.

6.2 Labelling

- 6.2.1 Containers used to store IDW must be properly labelled. Two general conditions exist: 1) from previous studies or on-site data, waste characteristics are known to be either hazardous or nonhazardous; or 2) waste characteristics are unknown until additional data are obtained.
- 6.2.2 For situations where the waste characteristics are known, the waste containers should be packaged and labelled in accordance with state regulations and any federal regulations that may govern the labelling of waste.
- 6.2.3 The following information shall be placed on all non-hazardous waste labels:
- Description of waste (i.e., purge water, soil cuttings);
 - Contact information (i.e., contact name and telephone number);
 - Date when the waste was first accumulated.
- 6.2.4 The following information shall be placed on all hazardous waste labels:
- Description of waste (i.e., purge water, soil cuttings);
 - Generator information (i.e., name, address, contact telephone number);
 - EPA identification number (supplied by on-site client representative);
 - Date when the waste was first accumulated.
- 6.2.5 When the final characterization of a waste is unknown, a notification label should be placed on the drum with the words "waste characterization pending analysis" and the following information included on the label:
- Description of waste (i.e., purge water, soil cuttings);
 - Contact information (i.e., contact name and telephone number);
 - Date when the waste was first accumulated.
- 6.2.6 Once the waste has been characterized, the label should be changed as appropriate for a nonhazardous or hazardous waste.
- 6.2.7 Waste labels should be constructed of a weatherproof material and filled out with a permanent marker to prevent being washed off or becoming faded by sunlight. It is recommended that waste labels be placed on the side of the container, since the top is more subject to weathering. However, when multiple containers are accumulated together, it also may be helpful to include labels on the top of the containers to facilitate organization and disposal.
- 6.2.8 Each container of waste generated shall be recorded in the field notebook used by the person responsible for labelling the waste. After the waste is disposed of, either by transportation off-site or disposal on-site in an approved disposal area, an appropriate record shall be made in the same field notebook to document proper disposition of IDW.

6.3 **Types of Site Investigation Waste**

Several types of waste are generated during site investigations that may require special handling. These include solid, liquid, and used PPE, as discussed further below.

Solid Waste

Soil cuttings from boreholes will typically be placed in containers unless site specific requirements allow for soil cuttings to be placed back into the borehole after drilling is complete. Drilling mud generated during investigation activities shall be collected in containers. Covers should be included on the containers and must be secured at all times and only open during filling activities. The containers shall be labelled in accordance with this SOP. An inventory containing the source, volume, and description of material put in the containers shall be logged on prescribed forms and kept in the project file.

Non-hazardous solid waste can be disposed on-site in the designated site landfill or in a designated evaporation pond if it is liquefied. Hazardous wastes must be disposed off-site at an approved hazardous waste landfill.

Liquid Waste

Groundwater generated during monitoring well development, purging, and sampling can be collected in truck-mounted containers and/or other transportable containers (i.e., 55-gallon drums). Lids or bungs on drums must be secured at all times and only open during filling or pumping activities. The containers shall be labelled in accordance with this SOP. Non-hazardous liquid waste can be disposed of in one of the designated lined evaporation ponds on-site. Hazardous wastes must be handled separately and disposed off-site at an approved hazardous waste facility.

Personal Protective Equipment

PPE that is generated throughout investigation activities shall be placed in plastic garbage bags. If the solid or liquid waste that was being handled is characterized as hazardous waste, then the corresponding PPE should also be disposed as hazardous waste. If not, all PPE should be disposed as non-hazardous waste in the designated on-site landfill. Trash that is generated as part of field activities may be disposed of in the landfill as long as the trash was not exposed to hazardous media.

6.4 **Waste Accumulation On-Site**

6.4.1 Solid, liquid, or PPE waste generated during investigation activities that are classified as nonhazardous or "characterization pending analysis" should be disposed of as soon as possible. Until disposal, such containers should be inventoried, stored as securely as possible, and inspected regularly, as a general good practice.

6.4.2 Solid, liquid, or PPE waste generated during investigation activities that are classified as hazardous shall not be accumulated on-site longer than 90 days. All hazardous waste containers shall be stored in a secured storage area. The following requirements for the hazardous waste storage area must be implemented:

- Proper hazardous waste signs shall be posted as required by any state or federal statutes that may govern the labelling of waste;
- Secondary containment to contain spills;
- Spill containment equipment must be available;
- Fire extinguisher;
- Adequate aisle space for unobstructed movement of personnel.

- 6.4.3 Weekly storage area inspections shall be performed and documented to ensure compliance with these requirements. Throughout the project, an inventory shall be maintained to itemize the type and quantity of the waste generated.

6.5 Waste Disposal

- 6.5.1 Solid, liquid, and PPE waste will be characterized for disposal through the use of client knowledge, laboratory analytical data created from soil or groundwater samples gathered during the field activities, and/or composite samples from individual containers.
- 6.5.2 All waste generated during field activities will be stored, transported, and disposed of according to applicable state, federal, and local regulations. All wastes classified as hazardous will be disposed of at a licensed treatment storage and disposal facility or managed in other approved manners.
- 6.5.3 In general, waste disposal should be carefully coordinated with the facility receiving the waste. Facilities receiving waste have specific requirements that vary even for non-hazardous waste, so characterization should be conducted to support both applicable regulations and facility requirements.

6.6 Regulatory Requirements

The following federal and state regulations shall be used as resources for determining waste characteristics and requirements for waste storage, transportation, and disposal:

- Code of Federal Regulations (CFR), Title 40, Part 261;
- CFR, Title 49, Parts 172, 173, 178, and 179.

6.7 Waste Transport

A state-certified hazardous waste hauler shall transport all wastes classified as hazardous. Typically, the facility receiving any waste can coordinate a hauler to transport the waste. Shipped hazardous waste shall be disposed of in accordance with all RCRA/USEPA requirements. All waste manifests or bills of lading will be signed either by the client or the client's designee.

7.0 Quality Control and Assurance

- 7.1 Management of IDW must incorporate quality control measures to ensure conformance to these and the project requirements.

8.0 Records, Data Analysis, Calculations

- 8.1 Maintain records as required by implanting the procedures in this SOP.
- 8.2 Deviations from this procedure or the sampling and analysis plan shall be documented in field records. Significant changes shall be approved by the **Program Quality Manager**.

9.0 Attachments or References

Department of Defense, United States (DoD). 2005. [Uniform Federal Policy for Quality Assurance Project Plans, Part 1: UFP-QAPP Manual](#). Final Version 1. DoD: DTIC ADA 427785, EPA-505-B-04-900A. In conjunction with the U. S. Environmental Protection Agency and the Department of Energy. Washington: Intergovernmental Data Quality Task Force. March. On-line updates available at: http://www.epa.gov/-fedfac/pdf/ufp_qapp_v1_0305.pdf.

Department of Energy, United States (DOE). 1994. [The Off-Site Rule](#). EH-231-020/0194. Office of Environmental Guidance. March.



1999. *Management of Remediation Waste under the Resource Conservation and Recovery Act (RCRA)*. Office of Environmental Policy and Assistance. 20 December.

Department of the Navy (DON). 2001. [Department of the Navy Installation Restoration Manual. 2001 Update](#). Draft. Alexandria, VA: Naval Facilities Engineering Command. August.

2007. [Navy Environmental and Natural Resources Program Manual](#). OPNAV Instruction 5090.1c . October.

Environmental Protection Agency, United States (EPA). 1991. *Management of Investigative-Derived Wastes During Site Inspections*. Office of Emergency and Remedial Response. EPA/540/G-91/009. May.

1992a. *Guidance for Performing Site Inspections under CERCLA*. [EPA/540/R-92/021](#). Office of Emergency and Remedial Response. September.

1992b. *Guide to Management of Investigative-Derived Wastes*. Quick reference fact sheet. OSWER Dir. 9345.3-03FS. Office of Solid Waste and Emergency Response. January.

1997a. *Sending Wastes Off Site? OSC and RPM Responsibilities under the Off-Site Rule*. EPA/540-F-97-006, Office of Solid Waste and Emergency Response. September.

1997b. *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW-846*. 3rd ed., Final Update IIIA. Office of Solid Waste. Updates available: www.epa.gov/epaoswer/hazwaste/test/new-meth.htm.

1998. *Management of Remediation Waste under RCRA*. EPA/530-F-98-026. Office of Solid Waste and Emergency Response. October.

(No Date). *Compliance with the Off-Site Rule During Removal Actions*. Office of Regional Counsel (Region 3). Hendershot, Michael.

NAVFAC NW Standard Operating Procedure Number I-D-1, *Drum Sampling*.

NAVFAC NW Standard Operating Procedure Number I-F, *Equipment Decontamination*.

NAVFAC NW Standard Operating Procedure Number III-D, *Logbooks*.

Author	Reviewer	Revisions (Technical or Editorial)
Mark Kromis Program Chemist	Chris Barr Program Quality Manager	Rev 0 – Initial Issue (May 2012)

Equipment Decontamination

Procedure 3-06

1.0 Purpose and Scope

- 1.1 This standard operating procedure (SOP) describes methods of equipment decontamination, to be used for activities where samples for chemical analysis are collected or where equipment will need to be cleaned before leaving the site or before use in subsequent activities.
- 1.2 As guidance for specific activities, this procedure does not obviate the need for professional judgment. Deviations from this procedure while planning or executing planned activities must be approved in accordance with Program requirements for technical planning and review.

2.0 Safety

It is the responsibility of the **Site Safety Officer (SSO)** to set up the site zones (i.e., exclusion, transition, and clean) and decontamination areas. Generally the decontamination area is located within the transition zone, upwind of intrusive activities, and serves as the washing area for both personnel and equipment to minimize the spread of contamination into the clean zone. Typically, for equipment, a series of buckets are set up on a visqueen-lined bermed area. Separate spray bottles containing cleaning solvents as described in this procedure or the Contract Task Order (CTO) Work Plan (WP) and distilled water are used for final rinsing of equipment. Depending on the nature of the hazards and the site location, decontamination of heavy equipment, such as augers, pump drop pipe, and vehicles, may be accomplished using a variety of techniques.

All **Field Personnel** responsible for equipment decontamination must adhere to the site-specific health and safety plan (HSP) and must wear the personal protective equipment (PPE) specified in the site-specific HSP. Generally this includes, at a minimum, Tyvek® coveralls, steel-toed boots with boot covers or steel-toed rubber boots, safety glasses, American National Standards Institute-standard hard hats, and hearing protection (if heavy equipment is in operation). Air monitoring by the **SSO** may result in an upgrade to the use of respirators and cartridges in the decontamination area; therefore, this equipment must be available on site. If safe alternatives are not achievable, discontinue site activities immediately.

In addition to the aforementioned precautions, the following sections describe safe work practices that will be employed.

2.1 Chemical Hazards associated with Equipment Decontamination

- Avoid skin contact with and/or incidental ingestion of decontamination solutions and water.
- Utilize PPE as specified in the site-specific HSP to maximize splash protection.
- Refer to material safety data sheets, safety personnel, and/or consult sampling personnel regarding appropriate safety measures (i.e., handling, PPE including skin and respiratory).
- Take the necessary precautions when handling detergents and reagents.

2.2 Physical Hazards associated with Equipment Decontamination

- To avoid possible back strain, it is recommended to raise the decontamination area 1 to 2 feet above ground level.
- To avoid heat stress, over exertion, and exhaustion, it is recommended to rotate equipment decontamination among all site personnel.

- Take necessary precautions when handling field sampling equipment.

3.0 Terms and Definitions

None.

4.0 Training and Qualifications

- 4.1 The **CTO Manager** is responsible for ensuring that decontamination activities comply with this procedure. The **CTO Manager** is responsible for ensuring that all personnel involved in equipment decontamination shall have the appropriate education, experience, and training to perform their assigned tasks.
- 4.2 The **Program Quality Manager** is responsible for ensuring overall compliance with this procedure.
- 4.3 The **Field Manager** is responsible for ensuring that all field equipment is decontaminated according to this procedure.
- 4.4 All **Field Personnel** are responsible for the implementation of this procedure.

5.0 Procedure

Decontamination of equipment used in soil/sediment sampling, groundwater monitoring, well drilling and well development, as well as equipment used to sample groundwater, surface water, sediment, waste, wipe, asbestos, and unsaturated zone, is necessary to prevent cross-contamination and to maintain the highest integrity possible in collected samples. Planning a decontamination program requires consideration of the following factors:

- Location where the decontamination procedures will be conducted
- Types of equipment requiring decontamination
- Frequency of equipment decontamination
- Cleaning technique and types of cleaning solutions appropriate to the contaminants of concern
- Method for containing the residual contaminants and wash water from the decontamination process
- Use of a quality control measure to determine the effectiveness of the decontamination procedure

The following subsections describe standards for decontamination, including the frequency of decontamination, cleaning solutions and techniques, containment of residual contaminants and cleaning solutions, and effectiveness.

5.1 Decontamination Area

Select an appropriate location for the decontamination area at a site based on the ability to control access to the area, the ability to control residual material removed from equipment, the need to store clean equipment, and the ability to restrict access to the area being investigated. Locate the decontamination area an adequate distance away and upwind from potential contaminant sources to avoid contamination of clean equipment.

5.2 Types of Equipment

Drilling equipment that must be decontaminated includes drill bits, auger sections, drill-string tools, drill rods, split barrel samplers, tremie pipes, clamps, hand tools, and steel cable. Decontamination of monitoring well development and groundwater sampling equipment includes submersible pumps, bailers, interface probes, water level meters, bladder pumps, airlift pumps, peristaltic pumps, and lysimeters. Other sampling equipment that requires decontamination includes, but is not limited to, hand trowels,

hand augers, slide hammer samplers, shovels, stainless-steel spoons and bowls, soil sample liners and caps, wipe sampling templates, composite liquid waste samplers, and dippers. Equipment with a porous surface, such as rope, cloth hoses, and wooden blocks, cannot be thoroughly decontaminated and shall be properly disposed of after one use.

5.3 **Frequency of Equipment Decontamination**

Decontaminate down-hole drilling equipment and equipment used in monitoring well development and purging prior to initial use and between each borehole or well. Down-hole drilling equipment, however, may require more frequent cleaning to prevent cross-contamination between vertical zones within a single borehole. When drilling through a shallow contaminated zone and installing a surface casing to seal off the contaminated zone, decontaminate the drilling tools prior to drilling deeper. Initiate groundwater sampling by sampling groundwater from the monitoring well where the least contamination is suspected. Decontaminate groundwater, surface water, and soil sampling devices prior to initial use and between collection of each sample to prevent the possible introduction of contaminants into successive samples.

5.4 **Cleaning Solutions and Techniques**

Decontamination can be accomplished using a variety of techniques and fluids. The preferred method of decontaminating major equipment, such as drill bits, augers, drill string, and pump drop-pipe, is steam cleaning. To steam clean, use a portable, high-pressure steam cleaner equipped with a pressure hose and fittings. For this method, thoroughly steam wash equipment and rinse it with potable tap water to remove particulates and contaminants.

A rinse decontamination procedure is acceptable for equipment such as bailers, water level meters, new and re-used soil sample liners, and hand tools. The decontamination procedure shall consist of the following: (1) wash with a non-phosphate detergent (Alconox®, Liquinox®, or other suitable detergent) and potable water solution; (2) rinse with potable water; (3) spray with laboratory-grade isopropyl alcohol; (4) rinse with deionized or distilled water; and (5) spray with deionized or distilled water. If possible, disassemble equipment prior to cleaning. Add a second wash at the beginning of the process if equipment is very soiled.

Decontaminating submersible pumps requires additional effort because internal surfaces become contaminated during usage. Decontaminate these pumps by washing and rinsing the outside surfaces using the procedure described for small equipment or by steam cleaning. Decontaminate the internal surfaces by recirculating fluids through the pump while it is operating. This recirculation may be done using a relatively long (typically 4 feet) large-diameter pipe (4-inch or greater) equipped with a bottom cap. Fill the pipe with the decontamination fluids, place the pump within the capped pipe, and operate the pump while recirculating the fluids back into the pipe. The decontamination sequence shall include: (1) detergent and potable water; (2) potable water rinse; (3) potable water rinse; and (4) deionized water rinse. Change the decontamination fluids after each decontamination cycle.

Solvents other than isopropyl alcohol may be used, depending upon the contaminants involved. For example, if polychlorinated biphenyls or chlorinated pesticides are contaminants of concern, hexane may be used as the decontamination solvent; however, if samples are also to be analyzed for volatile organics, hexane shall not be used. In addition, some decontamination solvents have health effects that must be considered. Decontamination water shall consist of distilled or deionized water. Steam-distilled water shall not be used in the decontamination process as this type of water usually contains elevated concentrations of metals. Decontamination solvents to be used during field activities will be specified in the CTO WP.

Rinse equipment used for measuring field parameters, such as pH (indicates the hydrogen ion concentration – acidity or basicity), temperature, specific conductivity, and turbidity with deionized or distilled water after each measurement. Also wash new, unused soil sample liners and caps with a fresh

detergent solution and rinse them with potable water followed by distilled or deionized water to remove any dirt or cutting oils that might be on them prior to use.

5.5 **Containment of Residual Contaminants and Cleaning Solutions**

A decontamination program for equipment exposed to potentially hazardous materials requires a provision for catchment and disposal of the contaminated material, cleaning solution, and wash water.

When contaminated material and cleaning fluids must be contained from heavy equipment, such as drill rigs and support vehicles, the area must be properly floored, preferably with a concrete pad that slopes toward a sump pit. If a concrete pad is impractical, planking can be used to construct solid flooring that is then covered by a nonporous surface and sloped toward a collection sump. If the decontamination area lacks a collection sump, use plastic sheeting and blocks or other objects to create a bermed area for collection of equipment decontamination water. Situate items, such as auger flights, which can be placed on metal stands or other similar equipment, on this equipment during decontamination to prevent contact with fluids generated by previous equipment decontamination. Store clean equipment in a separate location to prevent recontamination. Collect decontamination fluids contained within the bermed area and store them in secured containers as described below.

Use wash buckets or tubs to catch fluids from the decontamination of lighter-weight drilling equipment and hand-held sampling devices. Collect the decontamination fluids and store them on site in secured containers, such as U.S. Department of Transportation-approved drums, until their disposition is determined by laboratory analytical results. Label containers in accordance with Procedure 3-05, *IDW Management*.

6.0 **Quality Control and Assurance**

A decontamination program must incorporate quality control measures to determine the effectiveness of cleaning methods. Quality control measures typically include collection of equipment blank samples or wipe testing. Equipment blanks consist of analyte-free water that has been poured over or through the sample collection equipment after its final decontamination rinse. Wipe testing is performed by wiping a cloth over the surface of the equipment after cleaning. These quality control measures provide "after-the-fact" information that may be useful in determining whether or not cleaning methods were effective in removing the contaminants of concern.

7.0 **Records, Data Analysis, Calculations**

Any project where sampling and analysis is performed shall be executed in accordance with an approved sampling and analysis plan. This procedure may be incorporated by reference or may be incorporated with modifications described in the plan.

Deviations from this procedure or the sampling and analysis plan shall be documented in field records. Significant changes shall be approved by the **Program Quality Manager**.

8.0 **Attachments or References**

- 8.1 ASTM Standard D5088. 2008. *Standard Practice for Decontamination of Field Equipment Used at Waste Sites*. ASTM International, West Conshohocken, PA. 2008. DOI: 10.1520/D5088-02R08. www.astm.org.
- 8.2 NAVSEA T0300-AZ-PRO-010. *Navy Environmental Compliance Sampling and Field Testing Procedures Manual*. August 2009.
- 8.3 Procedure 3-05, *IDW Management*.

Author	Reviewer	Revisions (Technical or Editorial)
Mark Kromis Program Chemist	Chris Barr Program Quality Manager	Rev 0 – Initial Issue

Land Surveying

Procedure 3-07

1.0 Purpose and Scope

- 1.1 The purpose of this document is to define the standard operating procedure (SOP) for acquiring land surveying data to facilitate the location and mapping of geologic, hydrologic, geotechnical data, and analytical sampling points and to establish topographic control over project sites.
- 1.2 This procedure is the Program-approved professional guidance for work performed by Resolution Consultants under the Comprehensive Long-Term Environmental Action Navy (CLEAN) contract (Contract Number N62470-11-D-8013).
- 1.3 As guidance for specific activities, this procedure does not obviate the need for professional judgment. Deviations from this procedure while planning or executing planned activities must be approved in accordance with Program requirements for technical planning and review. If there are procedures whether it be from Resolution Consultants, state and/or federal that are not addressed in this SOP and are applicable to surface water sampling then those procedures may be added as an appendix to the project specific SAP.
- 1.4 It is fully expected that the procedures outlined in this SOP will be followed. Procedural modifications may be warranted depending upon field conditions, equipment limitations, or limitations imposed by the procedure. Substantive modification to this SOP will be approved in advance by the Program Quality Manager. Deviations to this SOP will be documented in the field records.
- 1.5 If there are procedures, whether it be from Resolution Consultants, state and/or federal, that are not addressed in this SOP and are applicable to land surveying then those procedures may be added as an appendix to the project specific Sampling and Analysis Plan (SAP).

2.0 Safety

- 2.1 Depending upon the site-specific contaminants, various protective programs must be implemented prior to conducting fieldwork. All **field sampling personnel** must review the project-specific health and safety plan (HASP) paying particular attention to the control measures planned for the specific field tasks. Conduct preliminary area monitoring to determine the potential hazard to field sampling personnel. If significant contamination is observed, minimize contact with potential contaminants in both the vapor and liquid phase through the use of respirators and disposable clothing.
- 2.2 In addition, observe standard health and safety practices according to the project-specific HASP. Suggested minimum protection includes inner disposable vinyl gloves, outer chemical-protective nitrile gloves, rubberized steel-toed boots, and an American National Standards Institute-standard hard hat. Half-face respirators and cartridges and Tyvek® suits may be necessary depending on the contaminant concentrations, and shall always be available on site.
- 2.3 Daily safety briefs will be conducted at the start of each working day before any work commences. These daily briefs will be facilitated by the **Site Safety Officer (SSO)** or designee to discuss the day's events and any potential health risk areas covering every aspect of the work to be completed. Weather conditions are often part of these discussions. As detailed in the HASP, everyone on the field team has the authority to stop work if an unsafe condition is perceived until the conditions are fully remedied to the satisfaction of the SSO.
- 2.4 The health and safety considerations for the work associated with land surveying include:
 - Slip, trips and falls associated with work in the field;

- Biological hazards associated with work in the field; and,
- Potential hazards associated with contaminants of concern (COC) that may be located in the survey area,

3.0 Terms and Definitions

3.1 Boundary Survey

Boundary surveys are conducted by Certified Land Surveyors in order to delineate a legal property line for a site or section of a site.

3.2 Global Positioning System (GPS)

A system of satellites, computers, and receivers that is able to determine the latitude and longitude of a receiver on Earth by calculating the time difference for signals from different satellites to reach the receiver.

4.0 Interferences

- 4.1 Commercially available GPS units typically have a level of precision of (\pm) 3 to 5 meters. Field corrections can be made as described in Section 8.3 below.

5.0 Training and Qualifications

5.1 Qualifications and Training

- 5.1.1 The individual executing these procedures must have read, and be familiar with, the requirements of this SOP.

5.2 Responsibilities

- 5.2.1 The **Contract Task Order (CTO) Manager** is responsible for ensuring that land surveying activities comply with this procedure. The CTO Manager is responsible for ensuring that all field sampling personnel involved in land surveying shall have the appropriate education, experience, and training to perform their assigned tasks.
- 5.2.2 The **Program Quality Manager** is responsible for ensuring overall compliance with this procedure.
- 5.2.3 The **Field Manager (FM)** is responsible for ensuring that all field personnel follow these procedures. In virtually all cases, subcontractors will conduct these procedures. The FM or designee is responsible for overseeing the activities of the subcontractor and ensuring that sampling points and topographic features are properly surveyed.

6.0 Equipment and Supplies

- 6.1 The following equipment list contains materials that may be needed in carrying out the procedures outlined in this SOP. Not all equipment listed below may be necessary for a specific activity. Additional equipment may be required, pending field conditions.

- Personal protective equipment (PPE) and other safety equipment, as required by the HASP;
- Commercially available GPS unit; and,
- Field Logbook.

7.0 Calibration or Standardization

- 7.1 An authorized manufacturer's representative shall inspect and calibrate survey instruments in accordance with the manufacturer's specifications regarding procedures and frequencies. At a minimum, instruments shall be calibrated no more than six months prior to the start of the survey work.
- 7.2 Standards for all survey work shall be in accordance with National Oceanic and Atmospheric Administration standards and, at a minimum, with accuracy standards set forth below. The horizontal accuracy for the location of all grid intersection and planimetric features shall be (\pm) 0.1 feet. The horizontal accuracy for boundary surveys shall be 1 in 10,000 feet (1:10,000). The vertical accuracy for ground surface elevations shall be (\pm) 0.1 feet. Benchmark elevation accuracy and elevation of other permanent features, including monitoring wellheads, shall be (\pm) 0.01 feet.

8.0 Procedure

8.1 Theodolite/Electronic Distance Measurement (EDM)

Follow the procedures listed below during theodolite/EDM land surveying conducted under the NAVFAC CLEAN Program:

- A land surveyor registered in the state or territory in which the work is being performed shall directly supervise all surveying work.
- Reference surveys to the local established coordinate systems and base all elevations and benchmarks established on U.S. Geological Survey datum, 1929 general adjustment.
- Reference surveyed points to Mean Sea Level (Lower Low Water Level).
- Jointly determine appropriate horizontal and vertical control points prior to the start of survey activities. If discrepancies in the survey (e.g., anomalous water level elevations) are observed, the surveyor may be required to verify the survey by comparison to a known survey mark. If necessary, a verification survey may be conducted by a qualified third party.
- All field notes, sketches, and drawings shall clearly identify the horizontal and vertical control points by number designation, description, coordinates, and elevations. Map all surveyed locations using a base map or other site mapping, as specified by the project Work Plan or SAP.
- Begin and end all surveys at the designated horizontal and vertical control points to determine the degree of accuracy of the surveys.
- Iron pins used to mark control points shall be made of reinforcement steel or an equivalent material and shall be 18 inches long with a minimum diameter of 5/8 inch. Drive pins to a depth of 18 inches into the soil.
- Stakes used to mark survey lines and points shall be made from 3-foot lengths of 2-inch by 2-inch lumber and pointed at one end. Clearly mark them with brightly colored weatherproof flagging and paint.
- Clearly mark the point on a monitoring well casing or well riser that is surveyed by filing grooves into the casing/riser on either side of the surveyed point, or by marking the riser with a permanent ink marker.

8.2 Global Positioning System (GPS) to Conduct Land Survey

Follow the procedures listed below during land surveying using GPS:

- A land surveyor registered in the state or territory in which the work is being performed shall directly supervise all surveying work.
- Reference surveys to the local established coordinate systems and base all elevations and benchmarks established on U.S. Geological Survey datum, 1929 general adjustment.

- All field notes, sketches, and drawings shall clearly identify the horizontal and vertical control points by number designation, description, coordinates, and elevations. Map all surveyed locations using a base map or other site mapping, as specified in the project Work Plan or SAP.
- Begin and end all surveys at the designated horizontal and vertical control points (as applicable) to determine the degree of accuracy of the surveys.
- Iron pins used to mark control points shall be made of reinforcement steel or an equivalent material and shall be 18 inches long with a minimum diameter of 5/8 inch. Drive pins to a depth of 18 inches into the soil.
- Stakes used to mark survey lines and points shall be made from 3-foot lengths of 2-inch by 2-inch lumber and pointed at one end. Clearly mark them with brightly colored weatherproof flagging and paint.
- Clearly mark the point on a monitoring well casing that is surveyed by filing grooves into the casing on either side of the surveyed point.

8.3 **Global Positioning System (GPS) to Position Sample Locations or Locate Site Features**

Experienced field personnel may use a GPS system unit to position sample locations (e.g. grid positioned samples, soil boring locations) at a site. The decision to use field personnel or a licensed land surveyor will depend on the objectives of the survey (e.g. vertical elevation is not required) and the levels of precision required. Typically when a level of precision greater than (\pm) 3 to 5 meters is required, a licensed surveyor will be required. When a level of precision of (\pm) 3 to 5 meters is sufficient to meet project requirements (i.e. when laying sampling grids, identifying significant site features, or locating features identified in GIS figures) experienced field personnel may use commercially available, consumer-grade GPS units. Follow the procedures listed below to locate samples or site features using GPS:

- A commercially available GPS unit with Wide Angle Averaging System (WAAS), topographic map display, and waypoint storage capabilities should be used.
- If waypoints are to be imported into a GIS database, the same grid projection system should be used.
- If a permanent reference point near the site is available, it is recommended that a waypoint at this location be taken every day waypoints are stored.
- When laying out a sampling grid from a GIS map, upload the coordinates from GIS to the GPS unit, including coordinates for an easily identified, permanent, nearby feature (i.e. building corner, roadway intersection, or USGS benchmark).
- If during the initial site walk, the permanent feature identified does not overlay within (\pm) 5 meters as identified in the GPS unit, field corrections of the waypoints should be made.
- Field corrections can be made by adding/subtracting the difference in x,y coordinates between the field measurement of the permanent site feature and the anticipated x,y coordinates. This correction should then be applied to the x,y coordinates for each sampling location to be marked. Corrected x,y coordinates can then be uploaded into the GPS unit.
- Sampling points and site features can then be located in the field using the GPS units "Go To" function. When the distance to the sampling point or feature remains close to zero, the location can be marked.
- If no field corrections to the sampling location need to be made, or if sampling locations are to be surveyed by a licensed surveyor at a later date, no additional waypoints need to be taken. If significant changes to the sampling location are made, GPS coordinates at the corrected location shall be stored and labeled.

- It is recommended that GPS coordinates be uploaded to a storage device such as PC at the end of each day.
- Field logs shall indicate manufacturer and model number for GPS unit used, map datum and projection used, and any field corrections made. If the GPS unit cannot lock onto a WAAS system at the site, this should also be noted.

9.0 Quality Control and Assurance

None.

10.0 Data and Records Management

The surveyor shall record field notes daily using generally accepted practices. The data shall be neat, legible, in indelible ink, and easily reproducible. Copies of the surveyor's field notes and calculation forms generated during the work shall be obtained and placed in the project files.

Surveyor's field notes shall, at a minimum, clearly indicate:

- The date of the survey;
- General weather conditions;
- The name of the surveying firm;
- The names and job titles of personnel performing the survey work;
- Equipment used, including serial numbers; and,
- Field book designations, including page numbers.

A land surveyor registered in the state or territory in which the work was done shall sign, seal, and certify the drawings and calculations submitted by the surveyor.

Dated records of land surveying equipment calibration shall be provided by the surveyor and placed in the project files. Equipment serial numbers shall be provided in the calibration records.

11.0 Attachments or References

Department of Defense, United States (DoD). 2005. *Uniform Federal Policy for Quality Assurance Project Plans, Part 1: UFP-QAPP Manual*. Final Version 1. DoD: DTIC ADA 427785, EPA-505-B-04-900A. In conjunction with the U. S. Environmental Protection Agency and the Department of Energy. Washington: Intergovernmental Data Quality Task Force. March. On-line updates available at: http://www.epa.gov/fedfac/pdf/ufp_qapp_v1_0305.pdf.

<i>Author</i>	<i>Reviewer</i>	<i>Revisions (Technical or Editorial)</i>
Robert Shoemaker Senior Scientist	Naomi Ouellette, Project Manager	Rev 0 – Initial Issue

Soil and Rock Classification

Procedure 3-16

1.0 Purpose and Scope

- 1.1 The purpose of this document is to define the standard operating procedure (SOP) to thoroughly describe the physical characteristics of the sample and classify it according to the Unified Soil Classification System (USCS).
- 1.2 This procedure is the Program-approved professional guidance for work performed by Resolution Consultants under the Comprehensive Long-Term Environmental Action Navy (CLEAN) contract (Contract Number N62470-11-D-8013).
- 1.3 As guidance for specific activities, this procedure does not obviate the need for professional judgment. Deviations from this procedure while planning or executing planned activities must be approved in accordance with Program requirements for technical planning and review. If there are procedures whether it be from Resolution Consultants, state and/or federal that are not addressed in this SOP and are applicable to surface water sampling then those procedures may be added as an appendix to the project specific SAP.
- 1.4 It is fully expected that the procedures outlined in this SOP will be followed. Procedural modifications may be warranted depending upon field conditions, equipment limitations, or limitations imposed by the procedure. Substantive modification to this SOP will be approved in advance by the Program Quality Manager. Deviations to this SOP will be documented in the field records.

2.0 Safety

- 2.1 Depending upon the site-specific contaminants, various protective programs must be implemented prior to sampling. All **field sampling personnel** responsible for sampling activities must review the project-specific health and safety plan (HASP) paying particular attention to the control measures planned for the sampling tasks. Conduct preliminary area monitoring to determine the potential hazard to field sampling personnel. If significant contamination is observed, minimize contact with potential contaminants in both the vapor and liquid phase through the use of respirators and disposable clothing.
- 2.2 In addition, observe standard health and safety practices according to the project-specific HASP. Suggested minimum protection during well sampling activities includes inner disposable vinyl gloves, outer chemical-protective nitrile gloves, rubberized steel-toed boots, and an American National Standards Institute-standard hard hat. Half-face respirators and cartridges and Tyvek® suits may be necessary depending on the contaminant concentrations, and shall always be available on site.
- 2.3 Daily safety briefs will be conducted at the start of each working day before any work commences. These daily briefs will be facilitated by the **Site Safety Officer (SSO)** or designee to discuss the day's events and any potential health risk areas covering every aspect of the work to be completed. Weather conditions are often part of these discussions. As detailed in the HASP, everyone on the field team has the authority to stop work if an unsafe condition is perceived until the conditions are fully remedied to the satisfaction of the SSO.
- 2.4 The health and safety considerations for the work associated with soil classification include:

- At no time during classification activities are personnel to reach for debris near machinery that is in operation, place any samples in their mouth, or come in contact with the soils/rocks without the use of gloves.
- Stay clear of all moving equipment and be aware of pinch points on machinery. Avoid wearing loose fitting clothing.
- When using cutting tools, cut away from yourself. The use of appropriate, task specific cutting tools is recommended.
- To avoid heat/cold stress as a results of exposure to extreme temperatures and PPE, drink electrolyte replacement fluids (1 to 2 cups per hour is recommended) and in case of extreme cold, wear insulating clothing.

3.0 Terms and Definitions

None.

4.0 Interference

None.

5.0 Training and Qualifications

- 5.1 The **Contract Task Order (CTO) Manager** is responsible for ensuring that the soil and rock classification procedures comply with this procedure. The **CTO Manager** is responsible for ensuring that all personnel involved in soil and rock classification shall have the appropriate education, experience, and training to perform their assigned tasks.
- 5.2 The **Program Quality Manager** is responsible for ensuring overall compliance with this procedure.
- 5.3 The **Field Manager** is responsible for ensuring that all project **field personnel** follow these procedures.
- 5.4 Field personnel are responsible for the implementation of this procedure. Minimum qualifications for **field sampling personnel** require that one individual on the field team shall have a minimum of 6 months of experience with soil and rock classification.
- 5.5 The **project geologist** and/or **task manager** is responsible for directly supervising the soil and rock classification procedures to ensure that they are conducted according to this procedure, and for recording all pertinent data collected. If deviations from the procedure are required because of anomalous field conditions, they must first be approved by the **Program Quality Manager** and then documented in the field logbook and associated report or equivalent document.

6.0 Equipment and Supplies

- 6.1 The following equipment list contains materials which may be needed in carrying out the procedures outlined in this SOP. Not all equipment listed below may be necessary for a specific activity. Additional equipment may be required, pending field conditions.
- Personal protective equipment (PPE) and other safety equipment, as required by the HASP
 - Field log book and pen with indelible ink
 - Boring log

- Munsell Soil Color Chart
- Scoopula, spatula, and/or other small hand tools
- California Sampler
- Hand-held penetrometer

7.0 Calibration or Standardization

None.

8.0 Procedure

8.1 Soil Classification

The basic purpose of the classification of soil is to thoroughly describe the physical characteristics of the sample and to classify it according to an appropriate soil classification system. The USCS was developed so that soils could be described on a common basis by different investigators and serve as a "shorthand" description of soil. A classification of a soil in accordance with the USCS includes not only a group symbol and name, but also a complete word description.

Describing soil on a common basis is essential so that soil described by different site qualified personnel is comparable. Site individuals describing soil as part of site activities *must* use the classification system described herein to provide the most useful geologic database for all present and future subsurface investigations and remedial activities.

The site geologist or other qualified individual shall describe the soil and record the description in a boring log, logbook, and/or electronic field data collection device. The essential items in any written soil description are as follows:

- Classification group name (e.g., silty sand)
- Color, moisture, and odor
- Range of particle sizes and maximum particle size
- Approximate percentage of boulders, cobbles, gravel, sand, and fines
- Plasticity characteristics of the fines
- In-place conditions, such as consistency, density, and structure
- USCS classification symbol

The USCS serves as "shorthand" for classifying soil into 15 basic groups:

GW ¹	Well graded (poorly sorted) gravel (>50 percent gravel, <5percent fines)
GP ¹	Poorly graded (well sorted) gravel (>50percent gravel, <5percent fines)
GM ¹	Silty gravel (>50 percent gravel, >15 percent silt)
GC ¹	Clayey gravel (>50 percent gravel, >15 percent clay)
SW ¹	Well graded (poorly sorted) sand (>50 percent sand, <5 percent fines)
SP ¹	Poorly graded (well sorted) sand (>50 percent sand, <5 percent fines)

¹ If percentage of fine is 5 percent to 15 percent, a dual identification shall be given (e.g., a soil with more than 50 percent poorly sorted gravel and 10 percent clay is designated GW-GC).

SM ¹	Silty sand (>50 percent sand, >15 percent silt)
SC ¹	Clayey sand (>50 percent sand, >15 percent clay)
ML ²	Inorganic, low plasticity silt (slow to rapid dilatancy, low toughness, and plasticity)
CL ²	Inorganic, low plasticity (lean) clay (no or slow dilatancy, medium toughness and plasticity)
MH ²	Inorganic elastic silt (no to slow dilatancy, low to medium toughness and plasticity)
CH ²	Inorganic, high plasticity (fat) clay (no dilatancy, high toughness, and plasticity)
OL	Organic low plasticity silt or organic silty clay
OH	Organic high plasticity clay or silt
PT	Peat and other highly organic soil

Figure 8-1 defines the terminology of the USCS. Flow charts presented in Figure 8-2 and indicate the process for describing soil. The particle size distribution and the plasticity of the fines are the two properties of soil used for classification. In some cases, it may be appropriate to use a borderline classification (e.g., SC/CL) if the soil has been identified as having properties that do not distinctly place the soil into one group.

8.1.1 Estimation of Particle Size Distribution

One of the most important factors in classifying a soil is the estimated percentage of soil constituents in each particle size range. Being proficient in estimating this factor requires extensive practice and frequent checking. The steps involved in determining particle size distribution are listed below:

1. Select a representative sample (approximately 1/2 of a 6-inch long by 2.5-inch diameter sample liner).
2. Remove all particles larger than 3 inches from the sample. Estimate and record the percent by volume of these particles. Only the fraction of the sample smaller than 3 inches is classified.
3. Estimate and record the percentage of dry mass of gravel (less than 3 inches and greater than 1/4 inch).
4. Considering the rest of the sample, estimate, and record the percentage of dry mass of sand particles (about the smallest particle visible to the unaided eye).
5. Estimate and record the percentage of dry mass of fines in the sample (do not attempt to separate silts from clays).
6. Estimate percentages to the nearest 5 percent. If one of the components is present in a quantity considered less than 5 percent, indicate its presence by the term "trace".
7. The percentages of gravel, sand, and fines must add up to 100 percent. "Trace" is not included in the 100 percent total.

8.1.2 Soil Dilatancy, Toughness, and Plasticity

8.1.2.1 Dilatancy

To evaluate dilatancy, follow these procedures:

² If the soil is estimated to have 15 percent to 25 percent sand or gravel, or both, the words "with sand" or "with gravel" (whichever predominates) shall be added to the group name (e.g., clay with sand, CL; or silt with gravel, ML). If the soil is estimated to have 30 percent or more sand or gravel, or both, the words "sandy" or "gravely" (whichever predominates) shall be added to the group name (e.g., sandy clay, CL). If the percentage of sand is equal to the percent gravel, use "sandy."

1. From the specimen, select enough material to mold into a ball about 1/2 inch (12 millimeters [mm]) in diameter. Mold the material, adding water if necessary, until it has a soft, but not sticky, consistency.
2. Smooth the soil ball in the palm of one hand with the blade of a knife or small spatula. Shake horizontally, striking the side of the hand vigorously against the other hand several times. Note the reaction of water appearing on the surface of the soil. Squeeze the sample by closing the hand or pinching the soil between the fingers, and note the reaction as none, slow, or rapid in accordance with the criteria in Table 8-1. The reaction is the speed with which water appears while shaking, and disappears while squeezing.

Table 8-1: Criteria for Describing Dilatancy

Description	Criteria
None	No visible change in specimen.
Slow	Water appears slowly on the surface of the specimen during shaking and does not disappear or disappears slowly upon squeezing.
Rapid	Water appears quickly on the surface of the specimen during shaking and disappears quickly upon squeezing.

8.1.2.2 *Toughness*

Following the completion of the dilatancy test, shape the test specimen into an elongated pat and roll it by hand on a smooth surface or between the palms into a thread about 1/8 inch (3 mm) in diameter. (If the sample is too wet to roll easily, spread it into a thin layer and allow it to lose some water by evaporation.) Fold the sample threads and re-roll repeatedly until the thread crumbles at a diameter of about 1/8 inch. The thread will crumble at a diameter of 1/8 inch when the soil is near the plastic limit. Note the pressure required to roll the thread near the plastic limit. Also, note the strength of the thread. After the thread crumbles, lump the pieces together and knead it until the lump crumbles. Note the toughness of the material during kneading. Describe the toughness of the thread and lump as low, medium, or high in accordance with the criteria in Table 8-2.

Table 8-2: Criteria for Describing Toughness

Description	Criteria
Low	Only slight pressure is required to roll the thread near the plastic limit. The thread and the lump are weak and soft.
Medium	Medium pressure is required to roll the thread near the plastic limit. The thread and the lump have medium stiffness.
High	Considerable pressure is required to roll the thread near the plastic limit. The thread and the lump have very high stiffness.

DEFINITION OF TERMS							
MAJOR DIVISIONS		SYMBOLS		TYPICAL DESCRIPTIONS			
COARSE GRAINED SOILS More Than Half of Material is Larger Than No. 200 Sieve Size	GRAVELS More Than Half of Coarse Fraction is Smaller Than No. 4 Sieve	CLEAN GRAVELS (Less than 6% Fines)		GW	Well graded gravels, gravel-sand mixtures, little or no fines		
		GRAVELS With Fines		GP	Poorly graded gravels, gravel-sand mixtures, little or no fines		
				GM	Silty gravels, gravel-sand-silt mixtures, non-plastic fines		
				GC	Clayey gravels, gravel-sand-clay mixtures, plastic fines		
	SANDS More Than Half of Coarse Fraction is Smaller Than No. 4 Sieve	CLEAN SANDS (Less than 6% Fines)		SW	Well graded sands, gravelly sands, little or no fines		
		SANDS With Fines		SP	Poorly graded sands, gravelly sands, little or no fines		
				SM	Silty sands, sand-silt mixtures, non-plastic fines		
				SC	Clayey sands, sand-clay mixtures, plastic fines		
FINE GRAINED SOILS More Than Half of Material is Smaller Than No. 200 Sieve Size	SILTS AND CLAYS Liquid Limit is Less Than 50%		ML	Inorganic silts, rock flour, fine sandy silts or clays, and clayey silts with non- or slightly-plastic fines			
			CL	Inorganic clays of low to medium plasticity, gravelly clays, silty clays, sandy clays, lean clays			
			OL	Organic silts and organic silty clays of low plasticity			
	SILTS AND CLAYS Liquid Limit is Greater Than 50%		MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts, clayey silt			
			CH	inorganic clays of high plasticity, fat clays			
			OH	Organic clays of medium to high plasticity, organic silts			
HIGHLY ORGANIC SOILS			PT	Peat and other highly organic soils			

GRAIN SIZES								
SILTS AND CLAYS	SAND				GRAVEL		COBBLES	BOULDERS
	FINE	MEDIUM	COARSE	FINE	COARSE			
	200	40	10	4	3/4"	3"	12"	
	U.S. STANDARD SERIES SIEVE				CLEAR SQUARE SIEVE OPENINGS			

Figure8-1: Unclassified Soil Classification System (USCS)

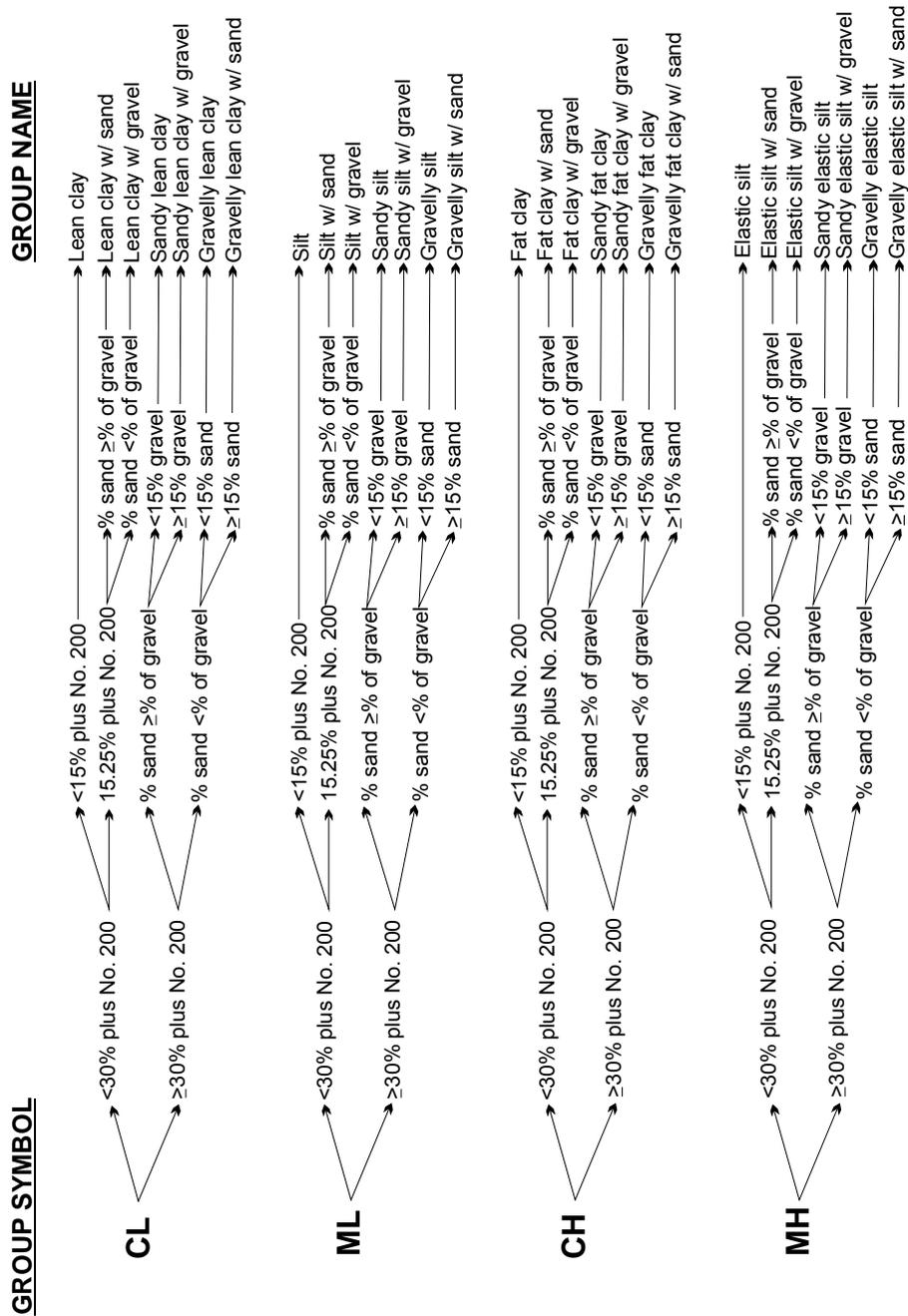


Figure 8-2: Flow Chart for Fine Grain Soil Classification

8.1.2.3 *Plasticity*

The plasticity of a soil is defined by the ability of the soil to deform without cracking, the range of moisture content over which the soil remains in a plastic state, and the degree of cohesiveness at the plastic limit. The plasticity characteristic of clays and other cohesive materials is defined by the liquid limit and plastic limit. The liquid limit is defined as the soil moisture content at which soil passes from the liquid to the plastic state as moisture is removed. The test for the liquid limit is a laboratory, not a field, analysis.

The plastic limit is the soil moisture content at which a soil passes from the plastic to the semi-solid state as moisture is removed. The plastic limit test can be performed in the field and is indicated by the ability to roll a 1/8-inch (0.125-inch) diameter thread of fines, the time required to roll the thread, and the number of times the thread can be re-rolled when approaching the plastic limit.

The plasticity tests are not based on natural soil moisture content, but on soil that has been thoroughly mixed with water. If a soil sample is too dry in the field, add water prior to performing classification. If a soil sample is too sticky, spread the sample thin and allow it to lose some soil moisture.

Table 8-3 presents the criteria for describing plasticity in the field using the rolled thread method.

Table 8-3: Criteria for Describing Plasticity

Description	Criteria
Non-Plastic	A 1/8-inch thread cannot be rolled.
Low Plasticity	The thread can barely be rolled.
Medium Plasticity	The thread is easy to roll and not much time is required to reach the plastic limit.
High Plasticity	It takes considerable time rolling the thread to reach the plastic limit.

8.1.3 **Angularity**

The following criteria describe the angularity of the coarse sand and gravel particles:

- **Rounded** particles have smoothly-curved sides and no edges.
- **Subrounded** particles have nearly plane sides, but have well-rounded corners and edges.
- **Subangular** particles are similar to angular, but have somewhat rounded or smooth edges.
- **Angular** particles have sharp edges and relatively plane sides with unpolished surfaces. Freshly broken or crushed rock would be described as angular.

8.1.4 **Color, Moisture, and Odor**

The natural moisture content of soil is very important. Table 8-4 shows the terms for describing the moisture condition and the criteria for each.

Table 8-4: Soil Moisture Content Qualifiers

Qualifier	Criteria
Dry	Absence of moisture, dry to the touch
Moist	Damp but no visible water
Wet	Visible water, usually soil is below water table

Color is described by hue and chroma using the Munsell Soil Color Chart (Munsell 2000). For uniformity, all site geologists shall utilize this chart for soil classification. Doing so will facilitate correlation of geologic units between boreholes logged by different geologists. The Munsell Color Chart is a small booklet of numbered color chips with names like "5YR 5/6, yellowish-red." Note mottling or banding of colors. It is particularly important to note and describe staining because it may indicate contamination.

In general, wear a respirator if strong organic odors are present. If odors are noted, describe them if they are unusual or suspected to result from contamination. An organic odor may have the distinctive smell of decaying vegetation. Unusual odors may be related to hydrocarbons, solvents, or other chemicals in the subsurface. An organic vapor analyzer may be used to detect the presence of volatile organic contaminants.

8.1.5 **In-Place Conditions**

Describe the conditions of undisturbed soil samples in terms of their density/consistency (i.e., compactness), cementation, and structure utilizing the following guidelines:

8.1.5.1 *Density/Consistency*

Density and consistency describe a physical property that reflects the relative resistance of a soil to penetration. The term “density” is commonly applied to coarse to medium-grained sediments (i.e., gravels, sands), whereas the term “consistency” is normally applied to fine-grained sediments (i.e., silts, clays). There are separate standards of measure for both density and consistency that are used to describe the properties of a soil.

The density or consistency of a soil is determined by observing the number of blows required to drive a 1 3/8-inch (35 mm) diameter split barrel sampler 18 inches using a drive hammer weighing 140 lbs (63.5 kilograms [kg]) dropped over a distance of 30 inches (0.76 meters). Record the number of blows required to penetrate each 6 inches of soil in the field boring log during sampling. The first 6 inches of penetration is considered to be a seating drive; therefore, the blow count associated with this seating drive is recorded, but not used in determining the soil density/consistency. The sum of the number of blows required for the second and third 6 inches of penetration is termed the “standard penetration resistance,” or the “N-value.” The observed number of blow counts must be corrected by an appropriate factor if a different type of sampling device (e.g., Modified California Sampler with liners) is used. For a 2 3/8-inch inner diameter (I.D.) Modified California Sampler equipped with brass or stainless steel liners and penetrating a cohesionless soil (sand/gravel), the N-value from the Modified California Sampler must be divided by 1.43 to provide data that can be compared to the 1 3/8-inch diameter sampler data.

For a cohesive soil (silt/clay), the N-value for the Modified California Sampler should be divided by a factor of 1.13 for comparison with 1 3/8-inch diameter sampler data.

Drive the sampler and record blow counts for each 6-inch increment of penetration until one of the following occurs:

- A total of 50 blows have been applied during any one of the three 6-inch increments; a 50-blow count occurrence shall be termed “refusal” and noted as such on the boring log.
- A total of 150 blows have been applied.
- The sampler is advanced the complete 18 inches without the limiting blow counts occurring, as described above.

If the sampler is driven less than 18 inches, record the number of blows per partial increment on the boring log. If refusal occurs during the first 6 inches of penetration, the number of blows will represent the N-value for this sampling interval. Table 8-5 and Table 8-6 present representative descriptions of soil density/consistency vs. N-values.

Table 8-5: Measuring Soil Density with a California Sampler – Relative Density (Sands, Gravels)

Description	Field Criteria (N-Value)	
	1 3/8 in. ID Sampler	2 in. ID Sampler using 1.43 factor
Very Loose	0–4	0–6
Loose	4–10	6–14
Medium Dense	10–30	14–43
Dense	30–50	43–71
Very Dense	> 50	> 71

Table 8-6: Measuring Soil Density with a California Sampler – Fine Grained Cohesive Soil

Description	Field Criteria (N-Value)	
	1 3/8 in. ID Sampler	2 in. ID Sampler using 1.13 factor
Very Soft	0–2	0–2
Soft	2–4	2–4
Medium Stiff	4–8	4–9
Stiff	8–16	9–18
Very Stiff	16–32	18–36
Hard	> 32	> 36

For undisturbed fine-grained soil samples, it is also possible to measure consistency with a hand-held penetrometer. The measurement is made by placing the tip of the penetrometer against the surface of the soil contained within the sampling liner or Shelby tube, pushing the penetrometer into the soil a distance specified by the penetrometer manufacturer, and recording the pressure resistance reading in pounds per square foot (psf). The values are as follows (Table 8-7):

Table 8-7: Measuring Soil Consistency with a Hand-Held Penetrometer

Description	Pocket Penetrometer Reading (psf)
Very Soft	0–250
Soft	250–500
Medium Stiff	500–1000
Stiff	1000–2000
Very Stiff	2000–4000
Hard	>4000

Consistency can also be estimated using thumb pressure using Table 8-8.

Table 8-8: Measuring Soil Consistency Using Thumb Pressure

Description	Criteria
Very Soft	Thumb will penetrate soil more than 1 inch (25 mm)
Soft	Thumb will penetrate soil about 1 inch (25 mm)
Firm	Thumb will penetrate soil about 1/4 inch (6 mm)
Hard	Thumb will not indent soil but readily indented with thumbnail
Very Hard	Thumbnail will not indent soil

8.1.5.2 *Cementation*

Cementation is used to describe the friability of a soil. Cements are chemical precipitates that provide important information as to conditions that prevailed at the time of deposition, or conversely, diagenetic effects that occurred following deposition. Seven types of chemical cements are recognized by Folk (1980). They are as follows:

- Quartz – siliceous
- Chert – chert-cemented or chalcedonic
- Opal – opaline
- Carbonate – calcitic, dolomitic, sideritic (if in doubt, calcareous should be used)
- Iron oxides – hematitic, limonitic (if in doubt, ferruginous should be used)
- Clay minerals – if the clay minerals are detrital or have formed by recrystallization of a previous clay matrix, they are not considered to be a cement. Only if they are chemical precipitates, filling previous pore space (usually in the form of accordion-like stacks or fringing radial crusts) should they be included as “kaolin-cemented,” “chlorite-cemented,” etc.
- Miscellaneous minerals – pyritic, collophane-cemented, glauconite-cemented, gypsiferous, anhydrite-cemented, baritic, feldspar-cemented, etc.

The degree of cementation of a soil is determined qualitatively by utilizing finger pressure on the soil in one of the sample liners to disrupt the gross soil fabric. The three cementation descriptors are as follows:

- Weak – friable; crumbles or breaks with handling or slight finger pressure
- Moderate – friable; crumbles or breaks with considerable finger pressure
- Strong – not friable; will not crumble or break with finger pressure

8.1.5.3 *Structure*

This variable is used to qualitatively describe physical characteristics of soil that are important to incorporate into hydrogeological and/or geotechnical descriptions of soil at a site. Appropriate soil structure descriptors are as follows:

- Granular – spherically shaped aggregates with faces that do not accommodate adjoining faces
- Stratified – alternating layers of varying material or color with layers at least 6 mm (1/4 inch) thick; note thickness
- Laminated – alternating layers of varying material or color with layers less than 6 mm (1/4 inch) thick; note thickness
- Blocky – cohesive soil that can be broken down into small angular or subangular lumps that resist further breakdown
- Lensed – inclusion of a small pocket of different soil, such as small lenses of sand, should be described as homogeneous if it is not stratified, laminated, fissured, or blocky. If lenses of different soil are present, the soil being described can be termed homogeneous if the description of the lenses is included
- Prismatic or Columnar – particles arranged about a vertical line, ped is bounded by planar, vertical faces that accommodate adjoining faces; prismatic has a flat top; columnar has a rounded top
- Platy – particles are arranged about a horizontal plane

8.1.5.4 *Other Features*

- Mottled – soil that appears to consist of material of two or more colors in blotchy distribution
- Fissured – breaks along definite planes of fracture with little resistance to fracturing (determined by applying moderate pressure to sample using thumb and index finger)
- Slickensided – fracture planes appear polished or glossy, sometimes striated (parallel grooves or scratches)

8.1.6 **Development of Soil Description**

Develop standard soil descriptions according to the following examples. There are three principal categories under which all soil can be classified. They are described below.

8.1.6.1 *Coarse-grained Soil*

Coarse-grained soil is divided into sands and gravels. A soil is classified as a sand if over 50 percent of the coarse fraction is “sand-sized.” It is classified as a gravel if over 50 percent of the coarse fraction is composed of “gravel-sized” particles.

The written description of a coarse-grained soil shall contain, in order of appearance: Typical name including the second highest percentage constituent as an adjective, if applicable (underlined); grain size of coarse fraction; Munsell color and color number; moisture content; relative density; sorting; angularity; other features, such as stratification (sedimentary structures) and cementation, possible formational name, primary USCS classification, secondary USCS classification (when necessary), and approximate percentages of minor constituents (i.e., sand, gravel, shell fragments, rip-up clasts) in parentheses.

Example: POORLY-SORTED SAND WITH SILT, medium- to coarse-grained, light olive gray, 5Y 6/2, saturated, loose, poorly sorted, subrounded clasts, SW/SM (minor silt with approximately 20 percent coarse-grained sand-sized shell fragments, and 80 percent medium-grained quartz sand, and 5 percent to 15 percent ML).

8.1.6.2 *Fine-grained Soil*

Fine-grained soil is further subdivided into clays and silts according to its plasticity. Clays are rather plastic, while silts have little or no plasticity.

The written description of a fine-grained soil should contain, in order of appearance: Typical name including the second highest percentage constituent as an adjective, if applicable (underlined); Munsell color; moisture content; consistency; plasticity; other features, such as stratification, possible formation name, primary USCS classification, secondary USCS classification (when necessary), and the percentage of minor constituents in parentheses.

Example: SANDY LEAN CLAY, dusky red, 2.5 YR 3/2, moist, firm, moderately plastic, thinly laminated, CL (70 percent fines, 30 percent sand, with minor amounts of disarticulated bivalves [about 5 percent]).

8.1.6.3 *Organic Soil*

For highly organic soil, describe the types of organic materials present as well as the type of soil constituents present using the methods described above. Identify the soil as an organic soil, OL/OH, if the soil contains enough organic particles to influence the soil properties. Organic soil usually has a dark brown to black color and may have an organic odor. Often, organic soils will change color, (e.g., from black to brown) when exposed to air. Some organic soils will lighten in color significantly when air-dried. Organic soils normally will not have a high toughness or plasticity. The thread for the toughness test will be spongy.

8.2 Example: ORGANIC CLAY, black, 2.5Y, 2.5/1, wet, soft, low plasticity, organic odor, OL (100 percent fines), weak reaction to HCl.

8.3 **Rock Classification**

The purpose of rock classification is to thoroughly describe the physical and mineralogical characteristics of a specimen and to classify it according to an established system. The generalized rock classification system described below was developed because, unlike the USCS for soils, there is no universally accepted rock classification system. In some instances, a more detailed and thorough rock classification system may be appropriate. Any modifications to this classification system, or the use of an alternate classification system should be considered during preparation of the site work plan. Both the CTO Manager and the QA Manager or Technical Director must approve any modifications to this classification system, or the use of another classification system.

Describing rock specimens on a common basis is essential so that rocks described by different site geologists are comparable. Site geologists describing rock specimens as a part of investigative activities must use the classification system described herein, or if necessary, another more detailed classification system. Use of a common classification system provides the most useful geologic database for all present and future subsurface investigations and remedial activities.

In order to provide a more consistent rock classification between geologists, a rock classification template has been designated as shown in **Error! Reference source not found.**. The template includes classification of rocks by origin and mineralogical composition. When classifying rocks, all site geologists shall use this template.

The site geologist shall describe the rock specimen and record the description in a boring log or logbook. The items essential for classification include (i.e., metamorphic foliated):

- Classification Name (i.e., schist)
- Color
- Mineralogical composition and percent
- Texture/Grain size (i.e., fine-grained, pegmatitic, aphyllitic, glassy)
- Structure (i.e., foliated, fractured, lenticular)
- Rock Quality Designation (sum of all core pieces greater than two times the diameter of the core divided by the total length of the core run, expressed as a percentage)
- Classification symbol (i.e., MF)

Example: Metamorphic foliated schist: Olive gray, 5Y, 3/2, Garnet 25 percent, Quartz 45 percent, Chlorite 15 percent, Tourmaline 15 percent, Fine-grained with Pegmatite garnet, highly foliated, slightly wavy, MF.

9.0 Quality Control and Assurance

None

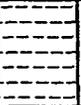
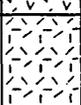
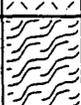
DEFINITION OF TERMS					
PRIMARY DIVISIONS		SYMBOLS		SECONDARY DIVISIONS	
SEDIMENTARY ROCKS	Clastic Sediments	CONGLOMERATE		CG	Coarse-grained Clastic Sedimentary Rock types including: Conglomerates and Breccias
		SANDSTONE		SS	Clastic Sedimentary Rock types including: Sandstone, Arkose and Greywacke
		SHALE		SH	Fine-grained Clastic Sedimentary Rock types including: Shale, Siltstone, Mudstone and Claystone
	Chemical Precipitates	CARBONATES		LS	Chemical Precipitates including: Limestone, Crystalline Limestone, Fossiliferous Limestone Micrite and Dolomite
		EVAPORITES		EV	Evaporites including: Anhydrite, Gypsum, Halite, Travertine and Caliche
IGNEOUS ROCKS	EXTRUSIVE (Volcanic)		IE	Volcanic Rock types including: Basalt, Andesite, Rhyolite, Volcanic Tuff, and Volcanic Breccia	
	INTRUSIVE (Plutonic)		II	Plutonic Rock types including: Granite, Diorite and Gabbro	
METAMORPHIC ROCKS	FOLIATED		MF	Foliated Rock types including: Slate, Phyllite, Schist and Gneiss	
	NON-FOLIATED		MN	Non-foliated Rock types including: Metaconglomerate, Quartzite and Marble	

Figure 8-4: Rock Classification System

10.0 Data and Records Management

- 10.1 Document soil classification information collected during soil sampling onto the field boring logs, field trench logs, and into the field notebook. Copies of this information shall be sent to the **CTO Manager** for the project files.
- 10.2 Field notes will be kept during coring activities in accordance with SOP 3-03 – Recordkeeping, Sample Labeling, and Chain of Custody. The information pertinent to soil classification activities includes chronology of events, sample locations (x,y,z), time/date, sampler name, methods (including type of core liner/barrel, if applicable), sampler penetration and acceptability, sample observations, and the times and type of equipment decontamination. Deviations to the procedures detailed in the SOP should be recorded in the field logbook.

11.0 Attachments or References

American Society for Testing and Materials (ASTM). 2000. *Standard Practice for Description and Identification of Soils (Visual, Manual Procedure)*. D 2488-00. West Conshohocken, PA.

Birkeland, Peter W. 1984. *Soils and Geomorphology*. 3rd ed. New York: Oxford University Press.

Compton, Robert R. 1985. *Geology in the Field*. Hoboken, NJ: John Wiley & Sons, Inc.

Department of Defense, United States (DoD). 2005. *Uniform Federal Policy for Quality Assurance Project Plans, Part 1: UFP-QAPP Manual*. Final Version 1. DoD: DTIC ADA 427785, EPA-505-B-04-900A. In conjunction with the U. S. Environmental Protection Agency and the Department of Energy. Washington: Intergovernmental Data Quality Task Force. March. On-line updates available at: http://www.epa.gov/fedfac/pdf/ufp_qapp_v1_0305.pdf.

Department of the Navy (DON). 2007. *Navy Environmental and Natural Resources Program Manual*. OPNAV Instruction 5090.1c. October.

Folk, Robert L. 1980. *Petrology of Sedimentary Rocks*. Austin, TX: Hemphill Publishing Company.

Huang, Walter T. 1962. *Petrology*. New York: McGraw-Hill Book Company.

McCarthy, David F. 2005. *Essentials of Soil Mechanics and Foundations: Basic Geotechnics*. 7th Ed. Indianapolis, IN: Prentice Hall. July.

Munsell Color Company (Munsell). 2000. *Munsell Soil Color Chart, (Revised)*. Baltimore.

Pettijohn, F.J. 1957. *Sedimentary Rocks*. 2nd Edition. New York: Harper and Brothers.

Rahn, Perry H. 1996. *Engineering Geology*. 2nd Edition. Indianapolis, IN: Prentice Hall. August

<i>Author</i>	<i>Reviewer</i>	<i>Revisions (Technical or Editorial)</i>
Robert Shoemaker Senior Scientist	Naomi Ouellette, Project Manager	Rev 0 – Initial Issue

Headspace Screening for Total VOCs

Procedure 3-19

1.0 Purpose and Scope

- 1.1 This standard operating procedure (SOP) describes the basic techniques for using headspace analysis to screen for volatile organics in contaminated soils using a portable Photo Ionization Detector (PID) or Flame Ionization Detector (FID).
- 1.2 As guidance for specific activities, this procedure does not obviate the need for professional judgment. Deviations from this procedure while planning or executing planned activities must be approved in accordance with Program requirements for technical planning and review.

2.0 Safety

- 2.1 The health and safety considerations for the work associated with this SOP will be addressed in the project Health and Safety Plan (HASP). In the absence of a HASP, work will be conducted according to the Contract Task Order (CTO) Work Plan (WP) and/or direction from the **Site Safety Officer (SSO)**. Note that headspace screening usually requires Level D personal protection unless there is a potential for airborne exposure to site contaminants. Under circumstances where potential airborne exposure is possible respiratory protective equipment may be required based on personal air monitoring results. Upgrades to Level C will be coordinated with the Site Safety Officer (SSO) or **CTO Manager**.
- 2.2 Health and safety hazards and corresponding precautions include, but are not limited to, the following:
 - 2.2.1 Dermal contact with contaminated soil. Personnel should treat all soil as potentially contaminated and wear chemically impervious gloves. Minimize skin contact with soil by using sampling instruments such as stainless steel spades or spoons. Do not touch any exposed skin with contaminated gloves.
 - 2.2.2 Inhalation hazards. Appropriate air monitoring should be conducted to ensure that organic vapor concentrations in the breathing zone do not exceed action levels as specified in the Site-Specific HASP. When ambient temperatures are low enough to require warming samples using the vehicle heater, the vehicle's windows should be opened enough to prevent the build-up of any organic vapors. Use the PID or FID to verify the airborne concentrations in the vehicle remain below applicable action levels. Note that many volatile organic compounds (VOCs) are flammable and all precautions must be observed to eliminate any potential ignition sources.
 - 2.2.3 Shipping limitations. Follow applicable regulations when shipping FID/PID equipment. When shipping an FID by air, the hydrogen tank must be bled dry. Calibration gas canisters are considered dangerous goods and must be shipped according to IATA and DOT regulations. Consult your EHS Coordinator and check with your shipping company to determine the correct shipping procedures

3.0 Terms and Definitions

None.

4.0 Interferences

- 4.1 Regardless of which gas is used for calibration, the instrument will respond to all analytes present in the sample that can be detected by the type of lamp used in the PID.
- 4.2 Moisture will generate a positive interference in the concentration measured for a PID and is characterized by a slow increase in the reading as the measurement is made. Care must be taken to

minimize uptake of moisture to the extent possible. Refer to the manufacturers' instructions for care, cleaning, and maintenance.

- 4.3 Uptake of soil into the PID must be avoided as it will compromise instrument performance by blocking the probe, causing a positive interference, or dirtying the PID lamp. Refer to the manufacturers' instructions for care, cleaning, and maintenance.
- 4.4 The user should listen to the pitch of the sampling pump. Any changes in pitch may indicate a blockage and corrective action should be initiated.

5.0 Training and Qualifications

5.1 Qualifications and Training

The individual executing these procedures must have read, and be familiar with, the requirements of this SOP.

5.2 Responsibilities

- 5.2.1 The CTO Manager is responsible for ensuring that the collection of headspace readings comply with this procedure. The CTO Manager is responsible for ensuring that all personnel involved in the collection of headspace readings shall have the appropriate education, experience, and training to perform their assigned tasks.
- 5.2.2 The Program Quality Manager is responsible for ensuring overall compliance with this procedure.
- 5.2.3 The Field Manager is responsible for ensuring that all headspace readings are conducted according to this procedure as well as verifying that the PID/FID is in proper operating condition prior to use and for implementing the calibration.
- 5.2.4 All Field Personnel are responsible for the implementation of this procedure.

6.0 Equipment and Supplies

6.1 The following materials must be on hand in good operating condition and/or in sufficient quantity to ensure that proper field analysis procedures may be followed:

- Calibrated PID/FID instrument;
- Top-sealing "Zip-Loc" type plastic bags – or – 16 ounces of soil or "mason-" type glass jars and aluminum foil;
- Project field book and/or boring logs;
- Personal Protective Equipment (PPE) as specified in the project HASP; and
- Material Safety Data Sheets (MSDSs) for any chemicals or site-specific contaminants.

7.0 Procedure

7.1 Preparation

Review available project information to determine the types of organic vapors that will likely be encountered to select the right instrument. The two basic types of instruments are FIDs and PIDs.

FIDs work well with organic compounds that have relatively lightweight molecules, but may have problems detecting halogenated compounds or heavier organic compounds; FIDs can detect methane for example. Since the FID uses a flame to measure organic compounds, ensure that work is conducted in an atmosphere, which is free of combustible vapors. If ambient temperatures are below 40°F, the flame of the FID may be difficult to light.

When using a PID, select an instrument that can measure the ionization potential of the anticipated contaminants of concern. PIDs work well with a range of organic compounds and can detect some halogenated hydrocarbons; PIDs cannot detect methane. The correct ultraviolet (UV) light bulb must be selected according to the types of organic vapors that will likely be encountered. The energy of the UV light must equal or exceed the ionization potential of the organic molecules that the PID will measure. The NIOSH Pocket Guide to Chemical Hazards is one source for determining ionization potentials for different chemicals. Bulbs available for PIDs include 9.4 eV, 10.6 (or 10.2) eV, and 11.7 eV bulbs. The 10.6 eV bulb is most commonly used as it detects a fairly large range of organic molecules and does not burn out as easily as the 11.7 eV bulb. The 9.4 eV bulb is the most rugged, but detects only a limited range of compounds. Under very humid or very cold ambient conditions, the window covering the UV light may fog up, causing inaccurate readings. Ask the **SSO** about correction factors when high humidity conditions exist.

After selecting the correct instrument, calibrate the PID/FID according to the manufacturer's instructions. Record background/ambient levels of organic vapors measured on the PID/FID after calibration and make sure to subtract the background concentration (if any) from your readings. Check the PID/FID readings against the calibration standard every 20 readings or at any time when readings are suspected to be inaccurate, and recalibrate, if necessary. Be aware that, after measuring highly contaminated soil samples, the PID/FID may give artificially high readings for a time.

7.2 **Top-Sealing Plastic Bag**

Place a quantity of soil in a top-sealing plastic bag and seal the bag immediately. The volume of soil to be used should be determined by the **CTO Manager** or **Field Manager**. The volume of soil may vary between projects but should be consistent for all samples collected for one project. Ideally, the bag should be at least 1/10th-filled with soil and no more than half-filled with soil. Once the bag is sealed, shake the bag to distribute the soil evenly. If the soil is hard or clumpy, use your fingers to gently work the soil (through the bag) to break up the clumps. Do not use a sampling instrument or a rock hammer since this may create small holes in the plastic bag and allow organic vapors to escape. Alternatively, the sample may be broken up before it is placed in the bag. Use a permanent marker to record the following information on the outside of the bag:

- Site identification information (i.e., borehole number);
- Depth interval; and
- Time the sample was collected. For example: "SS-12, 2-4 ft, @1425".

Headspace should be allowed to develop before organic vapors are measured with a PID/FID. The amount of time required for sufficient headspace development will be determined by the project-specific sampling plan and the ambient temperature. Equilibration time should be the same for all samples to allow an accurate comparison of organic vapor levels between samples. However, adjustments to equilibration times may be necessary when there are large variations in ambient temperature from day to day. When ambient temperatures are below 32°F, headspace development should be within a heated building or vehicle. When heating samples, be sure there is adequate ventilation to prevent the build-up or organic vapors above action levels.

Following headspace development, open a small opening in the seal of the plastic bag. Insert the probe of a PID/FID and seal the bag back up around the probe as tightly as possible. Alternatively, the probe can be inserted through the bag to avoid loss of volatiles. Since PIDs and FIDs are sensitive to moisture, avoid touching the probe to the soil or any condensation that has accumulated inside of the bag. Since the PID/FID consumes organic vapors, gently agitate the soil sample during the reading to release fresh organic vapors from the sample. Erratic meter response may occur at high organic vapor concentrations or conditions of elevated headspace moisture, in which case, headspace data should be discounted. Record the highest reading on the field form or in the field notebook as described in Section 9.

7.3 **Jar and Aluminum Foil (Alternate Method)**

Half-fill a clean glass jar with the soil sample to be screened. Quickly cover the jar's opening with one to two sheets of clean aluminum foil and apply the screw cap to tightly seal the jar. Allow headspace development for at least ten minutes. Vigorously shake the jar for 15 seconds, both at the beginning and at the end of the headspace development period. Where ambient temperatures are below 32°F (0°C), headspace development should be within a heated area. When heating samples, be sure there is adequate ventilation to prevent the build-up of organic vapors above action levels.

Subsequent to headspace development, remove the jar lid and expose the foil seal. Quickly puncture the foil seal with the instrument sampling probe, to a point about one-half of the headspace depth. Exercise care to avoid uptake of water droplets or soil particulates. As an alternative, use a syringe to withdraw a headspace sample, and then inject the sample into the instrument probe or septum-fitted inlet. This method is acceptable contingent upon verification of methodology accuracy using a test gas standard. Following probe insertion through the foil seal or sample injection to probe, record the highest meter response on the field form or in the field notebook. Using foil seal/probe insertion method, maximum response should occur between two and five seconds. Erratic meter response may occur at high organic vapor concentrations or conditions of elevated headspace moisture, in which case, headspace data should be discounted.

8.0 **Quality Control and Assurance**

Quality Assurance/Quality Control (QA/QC) will include the collection of duplicate samples. In general, one duplicate will be collected per 20 samples. Organic vapor concentrations measured in the primary and duplicate samples should be similar within plus or minus 20 percent. The frequency of headspace duplicate collection will be determined by the project manager/task manager. The PID/FID instrument must be calibrated according to the manufacturer's instructions before beginning screening, and checked or recalibrated every 20 analyses or when readings are suspected to be inaccurate. Record ambient organic vapor levels in the field notebook and on the field form. Periodically check ambient organic vapor levels. If ambient levels have changed more than 20 percent, recalibrate the PID/FID. Make sure readings are not collected near a vehicle exhaust or downwind of a drill rig exhaust. If grossly contaminated soil is encountered, decontaminate sampling instruments between samples and/or change contaminated gloves to avoid cross contaminating less contaminated samples.

9.0 **Records, Data Analysis, Calculations**

9.1 All data generated (results and duplicate comparisons) will be recorded in the field notebook and/or on the field form. Any deviation from the outlined procedure will also be noted. Field conditions (ambient temperature, wind, etc.) should also be recorded in the field notebook.

9.2 Readings may be recorded in a field notebook, on a boring log, or on an appropriate form specific to the project. The form should include the following information:

- When the PID/FID was calibrated (date/time) and calibration standard used;
- Background/ambient concentrations measured after PID/FID calibration;
- Location of sample (i.e., bore-hole number);
- Depth interval of sample measured;
- Lithology of material measured; and
- PID/FID reading and units of measure.

- 9.3 Note that if PID/FID measurements are recorded on a boring log, it is not necessary to duplicate information in the column where the PID/FID readings are recorded (e.g., borehole number, depth interval, lithology type).
- 9.4 All documentation will be stored in the project files and retained following completion of the project.

10.0 Attachments or References

SOP 3-20 Operation and Calibration of a Photoionization Detector

Author	Reviewer	Revisions (Technical or Editorial)
Robert Shoemaker Senior Scientist	Chris Barr Program Quality Manager	Rev 0 – Initial Issue (May 2012)

Operation and Calibration of a Photoionization Detector

Procedure 3-20

1.0 Purpose and Scope

1.1 Purpose and Applicability

- 1.1.1 This standard operating procedure (SOP) describes the procedures that will be followed by field staff for operation and calibration of a photoionization detector (PID). The PID is primarily used by AECOM personnel for safety and survey monitoring of ambient air, determining the presence of volatiles in soil and water, and detecting leakage of volatiles.
- 1.1.2 PIDs routinely used by field personnel include the Photovac Microtip, Thermoelectron 580EZ, and MiniRAE 2000. Personnel responsible for using the PID should first read and thoroughly familiarize themselves with the instrument instruction manual.

1.2 Principle of Operation

- 1.2.1 The PID is a non-specific vapor/gas detector. The unit generally consists of a hand-held probe that houses a PID, consisting of an ultraviolet (UV) lamp, two electrodes, and a small fan which pulls ambient air into the probe inlet tube. The probe is connected to a readout/control box that consists of electronic control circuits, a readout display, and the system battery. Units are available with UV lamps having an energy from 9.5 electron volts (eV) to 11.7 eV.
- 1.2.2 The PID analyzer measures the concentration of trace gas present in the atmosphere by photoionization. Photoionization occurs when an atom or molecule absorbs a photon of sufficient energy to release an electron and become a positive ion. This will occur when the ionization potential of the molecule (in electron volts (eV)) is less than the energy of the photon. The source of photons is an ultraviolet lamp in the probe unit. Lamps are available with energies ranging from 9.5 eV to 11.7 eV. All organic and inorganic vapor/gas compounds having ionization potentials lower than the energy output of the UV lamp are ionized and the resulting potentiometric change is seen as a positive reading on the unit. The reading is proportional to the concentration of organics and/or inorganics in the vapor.
- 1.2.3 Sample gases enter the probe through the inlet tube and enter the ion chamber where they are exposed to the photons emanating from the UV lamp. Ionization occurs for those molecules having ionization potentials near to or less than that of the lamp. A positive-biased polarizing electrode causes these positive ions to travel to a collector electrode in the chamber. Thus the ions create an electrical current which is amplified and displayed on the meter. This current is proportional to the concentration of trace gas present in the ion chamber and to the sensitivity of that gas to photoionization.
- 1.2.4 In service, the analyzer is first calibrated with a gas of known composition equal to, close to, or representative of that to be measured. Gases with ionization potentials near to or less than the energy of the lamp will be ionized. These gases will thus be detected and measured by the analyzer. Gases with ionization potentials greater than the energy of the lamp will not be detected. The ionization potentials of the major components of air, i.e., oxygen, nitrogen, and carbon dioxide, range from about 12.0 eV to 15.6 eV and are not ionized by any of the lamps available. Gases with ionization potentials near to or slightly higher than the lamp are partially ionized, with low sensitivity.

1.3 Specifications

- 1.3.1 Refer to the manufacturer's instructions for the technical specifications of the instrument being used. The operating concentration range is typically 0.1 to 2,000 ppm isobutylene equivalent.

2.0 Safety

- 2.1 The health and safety considerations for the work associated with this SOP, including both potential physical and chemical hazards, will be addressed in the project Health and Safety Plan (HASP). In the absence of a HASP, work will be conducted according to the Contract Task Order (CTO) Work Plan (WP) and/or direction from the **Site Safety Officer (SSO)**.
- 2.2 Only PIDs stamped Division I Class I may be used in explosive atmospheres. Refer to the project HASP for instructions pertaining to instrument use in explosive atmospheres.

3.0 Terms and Definitions

None.

4.0 Interferences

- 4.1 Regardless of which gas is used for calibration, the instrument will respond to all analytes present in the sample that can be detected by the type of lamp used in the PID.
- 4.2 Moisture will generate a positive interference in the concentration measured for a PID and is characterized by a slow increase in the reading as the measurement is made. Care must be taken to minimize uptake of moisture to the extent possible. Refer to the manufacturers' instructions for care, cleaning, and maintenance.
- 4.3 Uptake of soil into the PID must be avoided as it will compromise instrument performance by blocking the probe, causing a positive interference, or dirtying the PID lamp. Refer to the manufacturers' instructions for care, cleaning, and maintenance.
- 4.4 The user should listen to the pitch of the sampling pump. Any changes in pitch may indicate a blockage and corrective action should be initiated.

5.0 Training and Qualifications

5.1 Qualifications and Training

The individual executing these procedures must have read, and be familiar with, the requirements of this SOP.

5.2 Responsibilities

- 5.2.1 The CTO Manager is responsible for ensuring that the operation and calibration activities comply with this procedure. The CTO Manager is responsible for ensuring that all personnel involved in the operation and calibration shall have the appropriate education, experience, and training to perform their assigned tasks.
- 5.2.2 The Program Quality Manager is responsible for ensuring overall compliance with this procedure.
- 5.2.3 The Field Manager is responsible for ensuring that all operation and calibration activities are conducted according to this procedure.
- 5.2.4 All Field Personnel are responsible for the implementation of this procedure.

6.0 Equipment and Supplies

- Calibration Gas: Compressed gas cylinder of isobutylene in air or similar stable gas mixture of known concentration. The selected gas should have an ionization potential similar to that of the vapors to be monitored, if known. The concentration should be at 50-75% of the range in which the instrument is to be calibrated;

- Regulator for calibration gas cylinder;
- Approximately 6 inches of Teflon® tubing;
- Tedlar bag (optional);
- Commercially-supplied zero grade air (optional);
- "Magic Marker" or "Sharpie" or other waterproof marker;
- Battery charger;
- Moisture traps;
- Spare lamps;
- Manufacturer's instructions; and
- Field data sheets or logbook/pen.

7.0 Procedure

7.1 Preliminary Steps

- 7.1.1 Preliminary steps (battery charging, check-out, calibration, maintenance) should be conducted in a controlled or non-hazardous environment.

7.2 Calibration

- 7.2.1 The PID must be calibrated in order to display concentrations in units equivalent to ppm. First a supply of zero air (ambient air or from a supplied source), containing no ionizable gases or vapors is used to set the zero point. A span gas, containing a known concentration of a photoionizable gas or vapor, is then used to set the sensitivity.
- 7.2.2 Calibrate the instrument according to the manufacturer's instructions. Record the instrument model and identification number, the initial and adjusted meter readings, the calibration gas composition and concentration, and the date and the time in the field records.
- 7.2.3 If the calibration cannot be achieved or if the span setting resulting from calibration is 0.0, then the lamp must be cleaned (Section 7.4).

7.3 Operation

- 7.3.1 Turn on the unit and allow it to warm up (minimum of 5 minutes). Check to see if the intake fan is functioning; if so, the probe will vibrate slightly and a distinct sound will be audible when holding the probe casing next to the ear. Also, verify on the readout display that the UV lamp is lit.
- 7.3.2 Calibrate the instrument as described in Section 7.2, following the manufacturer's instructions. Record the calibration information in the field records.
- 7.3.3 The instrument is now operational. Readings should be recorded in the field records.
- 7.3.4 When the PID is not being used or between monitoring intervals, the unit may be switched off to conserve battery power and UV lamp life; however, a "bump" test should be performed each time the unit is turned on and prior to taking additional measurements. To perform a bump test, connect the outlet tubing from a Tedlar bag containing a small amount of span gas to the inlet tubing on the unit and record the reading. If the reading is not within the tolerance specified in the project plan, the unit must be recalibrated.
- 7.3.5 At the end of each day, recheck the calibration. The check will follow the same procedures as the initial calibration (Section 7.2) except that no adjustment will be made to the instrument. Record the information in the field records.

- 7.3.6 Recharge the battery after each use (Section 7.4).
- 7.3.7 When transporting, ensure that the instrument is packed in its stored condition in order to prevent damage.

7.4 **Routine Maintenance**

- 7.4.1 Routine maintenance associated with the use of the PID includes charging the battery, cleaning the lamp window, replacing the detector UV lamp, replacing the inlet filter, and replacing the sample pump. Refer to the manufacturer's instructions for procedures and frequency.
- 7.4.2 All routine maintenance should be performed in a non-hazardous environment.

7.5 **Troubleshooting Tips**

- 7.5.1 One convenient method for periodically confirming instrument response is to hold the sensor probe next to the tip of a magic marker. A significant reading should readily be observed.
- 7.5.2 Air currents or drafts in the vicinity of the probe tip may cause fluctuations in readings.
- 7.5.3 A fogged or dirty lamp, due to operation in a humid or dusty environment, may cause erratic or fluctuating readings. The PID should never be operated without the moisture trap in place.
- 7.5.4 Moving the instrument from a cool or air-conditioned area to a warmer area may cause moisture to condense on the UV lamp and produce unstable readings.
- 7.5.5 A zero reading on the meter should not necessarily be interpreted as an absence of air contaminants. The detection capabilities of the PID are limited to those compounds that will be ionized by the particular probe used.
- 7.5.6 Many volatile compounds have a low odor threshold. A lack of meter response in the presence of odors does not necessarily indicate instrument failure.
- 7.5.7 When high vapor concentrations enter the ionization chamber in the PID the unit can become saturated or "flooded". Remove the unit to a fresh air environment to allow the vapors to be completely ionized and purged from the unit.

8.0 **Quality Control and Assurance**

- 8.1 The end use of the data will determine the quality assurance requirements that are necessary to produce data of acceptable quality. These quality assurance requirements will be defined in the site-specific workplan or Sampling and Analysis Plan (SAP), hereafter referred to as the project plan.
- 8.2 Calibration of the PID will be conducted at the frequency specified in the project plan. In the absence of project-specific guidance, calibration will be performed at the beginning of each day of sampling and will be checked at the end of the sampling day or whenever instrument operation is suspect. The PID will sample a calibration gas of known concentration. The instrument must agree with the calibration gas within $\pm 10\%$. If the instrument responds outside this tolerance, it must be recalibrated.
- 8.3 Checks of the instrument response (Section 7.5) should be conducted periodically and documented in the field records.

9.0 **Records, Data Analysis, Calculations**

Safety and survey monitoring with the PID will be documented in a bound field logbook, or on standardized forms, and retained in the project files. The following information is to be recorded:

- Project name and number;
- Instrument manufacturer, model, and identification number;

- Operator's signature;
- Date and time of operation;
- Calibration gas used;
- Calibration check at beginning and end of day (meter readings before adjustment);
- Span setting after calibration adjustment;
- Meter readings (monitoring data obtained);
- Instances of erratic or questionable meter readings and corrective actions taken; and
- Instrument checks and response verifications – e.g., battery check, magic marker response (Section 7.5) or similar test.

10.0 Attachments or References

United States Environmental Protection Agency. Environmental Investigations Standard Operating Procedures and Quality Assurance Manual (EISOPQAM). USEPA, Region 4, SESD, Enforcement and Investigations Branch, Athens, GA. November 2001.

Author	Reviewer	Revisions (Technical or Editorial)
Robert Shoemaker Senior Scientist	Chris Barr Program Quality Manager	Rev 0 – Initial Issue (May 2012)

Appendix B

Laboratory Certifications



EMSL Analytical S.O.P.

CARB Method 435 Asbestos Analysis of Bulk Material by PLM

1.0 Method Description

1.1 Applicable Matrix

This procedure was designed for aggregate but can be used for soil and other bulk materials. It lends itself particularly well to soil, rock and vermiculite samples.

1.2 Scope and application

This procedure may be used on most bulk sample materials. It is particularly useful on samples or matrices that pose trouble in regards to homogenizing and freeing sample components using normal prep techniques. The milling is followed by PLM analysis carried out to a targeted analytical sensitivity.

1.3 Summary of Method

Samples are optionally dried and milled prior to analysis. The milling process employs a cryomill to pulverize the sample to an approximate particle size of $\leq 75\mu\text{m}$. Stereomicroscopy and PLM analysis are performed on the milled sample.

1.4 Detection Limit

The detection limit for this procedure is dependent on the total points counted and is 0.25% for Level A (400 Point Count) and 0.10% for Level B (1000 Point Count).

2.0 Interferences

Interferences for this method include but are not limited to:

- 2.1 Non-regulated asbestos minerals such as the two polymorphs of Chrysotile, Lizardite and Antigorite.
- 2.2 Non-regulated amphiboles such as winchite and richterite, and pyroxenes.
- 2.3 Cleavage fragments of the regulated asbestos types which may at times have aspect ratios similar to the true asbestiform varieties.
- 2.4 Clay minerals that can have similar morphology to asbestos such as sepiolite and pallygorskite.
- 2.5 All non-asbestos particulate, fibrous or not, which can partially or completely obscure asbestos fibers.

3.0 Definitions

- 3.1 Asbestos - Generic term for a group of hydrated silicate minerals.
- 3.2 Aspect Ratio - The ratio of the length to width of a particle.
- 3.3 Dispersion Staining - Method of rapidly determining refractive index using a particles ability to bend various wavelengths of light in differing amount.
- 3.4 Laboratory Blanks - A known negative material prepped and analyzed along with samples.
- 3.5 Non-Empty Point - A graticle point that is superimposed on a particle, either asbestos or non-asbestos.
- 3.6 PLM - Polarized Light Microscope



- 3.7 Point Count - Method of quantitation that utilizes tabulation of randomly superimposed points from a reticule (either cross hair or Chalkley) to determine percentages of sample components.
- 3.8 Refractive Index - Measure of the speed of light passing through an object as compared to the speed of light through air.

4.0 Safety

All personnel performing preparation and/or analysis of samples must be familiar with the EMSL Chemical Hygiene Plan (EMSLChemHygiene 200.0).

4.1 Asbestos

- 4.1.1 While there is no guarantee that asbestos is present in the samples, prudent measures must be taken to prevent any possible airborne asbestos fiber release from occurring during sample handling.
- 4.1.2 Sample handling should be performed under the safety hood.
- 4.1.3 All safety hoods should be capable of flow rates ≥ 75 lfm.

4.2 Liquid Nitrogen

- 4.2.1 Liquid nitrogen is extremely cold and care should be taken to avoid skin contact
- 4.2.2 Appropriate clothing (lab coat, heavy gloves) should be worn while handling liquid nitrogen.
- 4.2.3 Excess nitrogen gas may cause a lack of oxygen in the local vicinity. A build up of nitrogen gas (as produced when the liquid evaporates) should be avoided by using only in non-confined spaces.

5.0 Equipment and Supplies

- 5.1 Applicator sticks or tongue depressors
- 5.2 Centrifuge tubes (flat bottom), 50 ml
- 5.3 Disposable aluminum tins of varying size
- 5.4 Disposable 500 ml (16 oz.) plastic jars with lids
- 5.5 Fine forceps
- 5.6 Freezer mill (Spex 6850)
- 5.7 HEPA Laminar Flow Hood
- 5.8 Sieves – 3/8 inch and 250 microns
- 5.9 Vortex Mixer
- 5.10 Glass microscope slides
- 5.11 Glass Cover slips
- 5.12 Scalpel handle and clean disposable scalpel blades

6.0 Reagents and Standards

All reagents should be of recognized analytical grade or better:

- 6.1 Concentrated HCl
- 6.2 Fiber free de-ionized water
- 6.3 Liquid Nitrogen
- 6.4 Refractive Index Liquids
- 6.5 NIST 1866 and 1867 asbestos standards
- 6.6 Non-Asbestos standards



7.0 Sample Collection, Preservation, Shipment and Storage

- 7.1 Obtaining a representative sample from the field is the client's responsibility.
- 7.2 4 - 8 oz samples should be submitted, 50 ml centrifuge tubes and/or 8 oz. glass or plastic wide mouth containers should be available in the lab for client use.
- 7.3 No preservation is necessary; samples that are wet should be submitted as soon as possible to prevent biological growth prior to analysis.
- 7.4 Only one sample per container should be submitted.
- 7.5 Samples are retained in an easily retrievable manner for a minimum of 60 days.

8.0 Calibration and Standardization

Each major component of the method is calibrated and/or standardized including the analyst. Examples follow:

- 8.1 The cryo mill is calibrated to determine milling time vs. particle size.
- 8.2 The Polarized Light Microscope is calibrated to:
 - 8.2.1 Verify the orientation of the polarizers
 - 8.2.2 Center the objectives with the rotational axis of the stage
 - 8.2.3 Alignment of central dispersion stop and sub stage condenser with the stage's rotational axis.
- 8.3 Calibration of refractive index liquids to ± 0.004

9.0 Procedure

9.1 Sample Receipt

- 9.1.1 Upon receipt of samples, check that the sample information on the Chain of Custody (COC) matches the information on the samples and other paperwork. Any discrepancies must be resolved before proceeding.
- 9.1.2 If the samples do not have a COC then one is completed at the time of log in. Have the client fill out the necessary information completely.
- 9.1.3 Information required on the Chain of Custody includes:
 - 9.1.3.1 Client name, address, telephone number, contact person, fax number
 - 9.1.3.2 Project number/ name, state where samples were taken
 - 9.1.3.3 Number of samples sent and sample ID's
 - 9.1.3.4 Type of analysis requested
 - 9.1.3.5 Sample volumes or areas if applicable
 - 9.1.3.6 Turn around time. "RUSH" is not acceptable
 - 9.1.3.7 A date and signature of the person relinquishing the samples
 - 9.1.3.8 All samples MUST be accounted for with the proper sample ID's
 - 9.1.3.9 All samples MUST be sealed, properly bagged and undamaged.
- 9.1.4 All samples must be clocked in at the time of receipt and signed and dated by an EMSL employee. If the lab does not have clock for sample receipt the receiving employee should record the time of receipt also.
- 9.1.5 Check to see if the samples match the COC and if the samples are open, damaged, or contaminated. If the samples are damaged or if the COC does not match, notify the client.



9.2 Sample Log In

If all of the above criteria for sample receiving are met then the samples can be logged in to Sample Master (LIMS) as per the Sample Master SOP.

9.2.1 This process will assign a unique EMSL order number for the project as well as unique lab sample ID's.

9.2.2 Sample Master generates an Internal Chain of Custody and the appropriate bench sheets for the analysis.

9.3 Preparation

9.3.1 All samples received must be dried in a drying oven prior to further preparation. If the sample submitted is larger than **8 oz.** it can be homogenized with multiple passes through a riffle splitter. If the sample is submitted wet it will need to be dried prior to riffle splitting.

9.3.2 Place the sample in a disposable aluminum tin and place in the drying oven until its weight is stabilized. A typical drying time of 8-12 hours at 100 degrees C will be sufficient in most cases. Excessively wet samples may affect turnaround times.

9.3.3 If the sample contains rocks and other material larger than 3/8 inch they will be excluded from analysis by passing the sample through a 3/8 inch sieve.

9.3.4 If possible, large soil clumps should be (gently) forced through the sieve. At client request the sample can be sent out for crushing at an external facility.

9.3.5 As a modification to the method: If the sample is suspected to have a significant organic component, the sample can be gravimetrically reduced by ashing in a muffle furnace at 480 degrees C. (Follow the prep procedure in EMSL's TEM NOB Analysis SOP)

9.3.6 As a modification to the method: If the sample is known or suspected of having a significant carbonate component, then the sample can be gravimetrically reduced with hydrochloric acid. (Follow the prep procedure in EMSL's TEM NOB Analysis SOP)

9.3.7 Within a HEPA filtered hood, the sample is added to a clean milling vial (one steel end cap and the stainless steel rod (hammer) already inserted) for the Spex freezer mill.

9.3.7.1 The vial should be filled no more than 3/4 full, otherwise milling efficiency is reduced.

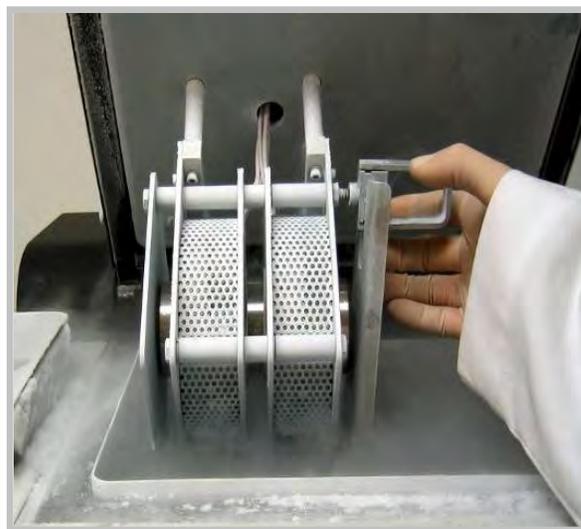
9.3.7.2 Soil and Rock samples are milled in the large milling chamber.

9.3.7.3 Vermiculite samples are milled in quadruplicate using the smaller milling chambers to avoid damaging the larger chamber end caps.

9.3.8 Place the second steel end cap on securely.

9.3.9 Place the vial into the mill, lock the vial in place and pre-cool the sample in the liquid nitrogen bath of the mill for at least two minutes.





9.3.10 Mill the sample at liquid Nitrogen temperature for 4-6 minutes (depending on the matrix). This milling time will allow the majority of the sample to pass through a 75 μ m dry sieve, and has been pre-determined.

9.3.11 After milling is complete, remove the vial from the mill and place in a HEPA or fume hood.

9.3.12 With the vial inside the hood, invert and/or roll the vial to further homogenize the milled powder.

9.3.13 Remove the end cap with the end cap extractor.
Important Note: Sample contents can be under pressure from the temperature differentials and can expel outward upon opening. It is best to open with end cap towards the back of the hood when opening to prevent any possible spillage or exposure.

9.3.14 Transfer the milled sample (in a hood) to a 50 ml disposable centrifuge tube with lid.

9.3.15 Any excess milled material, after the 50 ml vial is filled, can be poured into a large disposable jar within the hood for eventual disposal.

9.3.16 If available, homogenize the sample in the centrifuge tube with a vortex mixer on full power.

9.4 Analysis

9.4.1 Samples of the milled material are observed by stereoscope for homogeneity and preliminary fiber identification.

9.4.2 Remove a pinch aliquot of bulk material from the milled sample and place on a clean microscope slide with a drop or two of 1.550 RI liquid.





- If during the identification process other asbestiforms are suspected to be present due to their morphology, then additional preps will be made with the appropriate RI oils. Evenly distribute the material in the liquid and on the slide with a clean scalpel blade.
- 9.4.3** Add a cover slip on top of the preparation and tap lightly with a clean instrument (probe, pencil eraser, etc.) to expel air bubbles and let the liquid fill all areas under the cover slip.
- 9.4.4** Scan the slide, looking for suspect asbestos fibers.
- 9.4.4.1** If chrysotile is suspected to be present, identify at least the first four (4) chrysotile fibers by the procedures in EMSL's PLM SOP Section 9.4.
- 9.4.4.2** If possible amphibole asbestos fibers are encountered, return to step 9.4.1 and reprep using 1.680 RI liquid. If amosite or crocidolite fibers are then found to be present, identify at least the first four (4) fibers of each type by the procedures in EMSL's PLM SOP Section 9.4.
- 9.4.4.3** If, after observation in 1.680 RI liquid, the suspect fibers are thought to be either tremolite, actinolite or anthophyllite, return to step 9.4.1 and reprep using 1.625 RI liquid. If tremolite, actinolite or anthophyllite fibers are found to be present, identify at least the first four (4) fibers of each type by the procedures in EMSL's PLM SOP Section 9.4.
- 9.4.4.4** If no asbestos is found to be present, return to step 9.4.1 and prepare two (2) additional preps. Identify all fibers in at least 10 fields of view for each prep. If no asbestos is encountered analysis can be terminated; continue with step 9.4.10. If any one fiber is found to be asbestos, continue with step 9.4.5.
- 9.4.5** If asbestos was identified in step 9.4.4 above and the content is estimated to be >10%, proceed to step 9.4.10.
- 9.4.6** Asbestos quantitation is performed by point counting. Return to step 9.4.1 and prepare enough slides of appropriate RI liquid so that a total of at least 8 slides are available for point counting. Slides appropriate for point counting are as follows:
- 9.4.6.1** The preparation should not be heavily loaded.
- 9.4.6.2** The sample should be uniformly dispersed to avoid overlapping particles and allow 25-50% empty area within a field of view.
- 9.4.6.3** Using the correct RI liquid to identify the asbestos fibers present.
- 9.4.7** An ocular reticule with a point count array (Chalkley) or cross hair graticle is superimposed on the microscope field of view. Points are counted only when the point is positioned directly above a particle (non-empty point). Points that are superimposed on empty space (empty point) are not counted. Point counts are recorded on EMSL's PLM Point Count Worksheet.
- 9.4.8** Count 50 non-empty points (125 if performing a 1000 point count) on each sample preparation in at least two (2) randomly selected field of views per slide to yield a total of 400 (alternatively 1000) points.
- 9.4.9** Count points as follows:
- 9.4.9.1** Count and record the number of points that are positioned directly above each particle or fiber type.
- 9.4.9.2** If more than one point is superimposed on any particular particle or fiber, count and record only one (1) point for the particle or fiber in question.



- 9.4.9.3** Count and record the number of points that are positioned on the edge of each particle or fiber type.
- 9.4.9.4** If a point is superimposed on more than one type of particle or fiber, count and record a point for each particle and/or fiber type.
- 9.4.9.5** If a point is superimposed on an "ambiguous" fiber, do not count or record a point. An "ambiguous" fiber is one that cannot be clearly identified as either asbestos or non-asbestos due to poor dispersion colors, fibers size being below workable magnification or other reasons.
- 9.4.9.6** A fiber bundle or mat is considered a fiber and counted and recorded as 1 point.
- 9.4.10** If the sample is suspected to have an asbestos content in excess of 10%, a visual estimate as per NVLAP guidelines (see EMSL PLM SOP) can be used.
- 9.4.11** Sample ID numbers, macroscopic and microscopic sample observations are recoded on EMSL's PLM worksheets that were generated at the time of login.
 - 9.4.11.1** Macroscopic descriptions include color, texture and homogeneity as well as sample treatment.
 - 9.4.11.2** Microscopic descriptions include identification and percentage of fiber types present (both asbestos and non-asbestos) and the type (if applicable) and percentage of non-fibrous material in the sample.
 - 9.4.11.3** Detailed instruction for completing the worksheets is in EMSL's PLM SOP Section 10.0.

10.0 Calculations

All calculations are where:

- A% - percent asbestos
- AP - number of asbestos points counted
- NP - number of non-asbestos points counted
- R% - final residue percent (use 1.0 if no gravimetric reduction was performed)
- RW - residue weight (g)
- OW - original weight (g)

10.1 Final Residue Percent (if optional modification of gravimetric reduction was performed)

$$R\% = \frac{RW}{OW} \times 100 \quad R\% = \frac{0.2200}{0.2500} \times 100 = 88\%$$

10.2 Percent Asbestos

$$A\% = \frac{AP}{(AP + NP)} \times R\% \quad A\% = \frac{10}{(10 + 390)} \times 88 \quad A\% = 0.025 \times 88 = 2.2$$



11.0 Reporting

- 11.1 Identification of each asbestos type in the sample.
- 11.2 Asbestos concentration in % asbestos of each asbestos type in the sample.
- 11.3 Identification of non-asbestos fibers encountered.
- 11.4 Percentage of each non-asbestos fiber type identified.
- 11.5 Percentage and type if available, of non-fibrous material in the sample.
- 11.6 Sample Appearance (color, fibrosity and homogeneity)
- 11.7 Sample Description or Location of the sample in the field if supplied by client.
- 11.8 Client and Lab sample numbers
- 11.9 Client identification and contact information
- 11.10 EMSL Order ID
- 11.11 Client Project information (if supplied)
- 11.12 Analysis date, report date and date received.
- 11.13 Signature of Lab Manager
- 11.14 Report comments
- 11.15 Lab accreditations

12.0 Method Performance

12.1 MDL

The method detection limit is determined by the level of analysis (the extent of the point count.). The method's predetermined point count stopping points are 400 and 1000 points. This will produce detection limits of 0.25 and 0.10% respectively. When combined with the gravimetric reduction of the sample, the analytical sensitivity may be decreased further.

12.2 DOC's

Demonstrations of Capability are required for each analytical method.

12.3 PT's

Proficiency tests do not exist for this procedure at the current time.

12.4 Accuracy

Precision and Accuracy for the point count portion of this procedures are determined using control charts and summarized, on a per lab basis, in the lab's monthly Quality Assurance Summaries. Suggested Acceptable Errors for PLM Analysis based on 400 Point Counts are listed in Section 16 of this procedure.

12.5 Precision

Precision and Accuracy for the point count portion of this procedures are determined using control charts and summarized, on a per lab basis, in the lab's monthly Quality Assurance Summaries. Suggested Acceptable Errors for PLM Analysis based on 400 Point Counts are listed in Section 16 of this procedure.

13.0 Quality Control

- 13.1 All QC data must be maintained and available for easy reference and inspection
- 13.2 Daily contamination checks are performed on a known negative material (min 1/100)
- 13.3 A process blank of known negative soil or sand will be prepared and analyzed when contamination is suspected.
- 13.4 7% Inter-analyst analysis
- 13.5 2% Intra-analyst analysis



14.0 Data Assessment

14.1 Acceptance criteria for QC measures

These are addressed in EMSL's QA Manual Module A section, A.12.6.4

14.1.1 If a sample falls outside the acceptable limits it needs to be reconciled with participating analysts and/or a third analyst when necessary.

14.1.2 The Pass/Fail criteria for inter-analyst QC and formula for R (variance) is:

Pass $-1 \leq R \leq 1$
Fail $R < -1$ or $R > 1$

$$R = \frac{(A - B)}{((A + B)/2)} \quad \text{where } A = \text{analysis 1 and } B = \text{analysis 2}$$

14.1.3 The Pass/Fail criteria for intra-analyst QC and formula for R (variance) is:

Pass $R \leq 1$
Fail $R > 1$

$$R = \frac{|A - B|}{((A + B)/2)} \quad \text{where } A = \text{analysis 1 and } B = \text{analysis 2}$$

14.2 Corrective actions

These policies are addressed fully in the EMSL's QA manual section 13.

14.2.1 All corrective actions should look for the root cause of the error.

14.2.2 All out of control or unacceptable data must be brought to the attention of the Laboratory Manager.

14.2.3 The Laboratory manager is responsible for generating a corrective action including an investigation of calibration procedures, a review of analytical technique and investigation of training policies and compliance.

14.2.4 Corrective actions will be reported to the QA Department by means of the Quarterly Management Report or sooner when appropriate.

14.3 Contingencies for handling out-of control or unacceptable data.

Any quality control requirements not met must have an explanation to their Non-conformance.

15.0 Pollution Prevention / Waste Management

15.1 Pollution Prevention

EMSL Analytical makes all efforts to reduce the volume and toxicity of the waste generated by the laboratory. An effort to manage procurement of hazardous materials has been implemented in order to avoid over ordering. Hazardous waste is classified for proper disposal.

15.2 Waste Management

The waste generated during prep and analysis will be disposed of following safety procedures outlined in the chemical hygiene plan (EMSLChemHygiene 200.0).

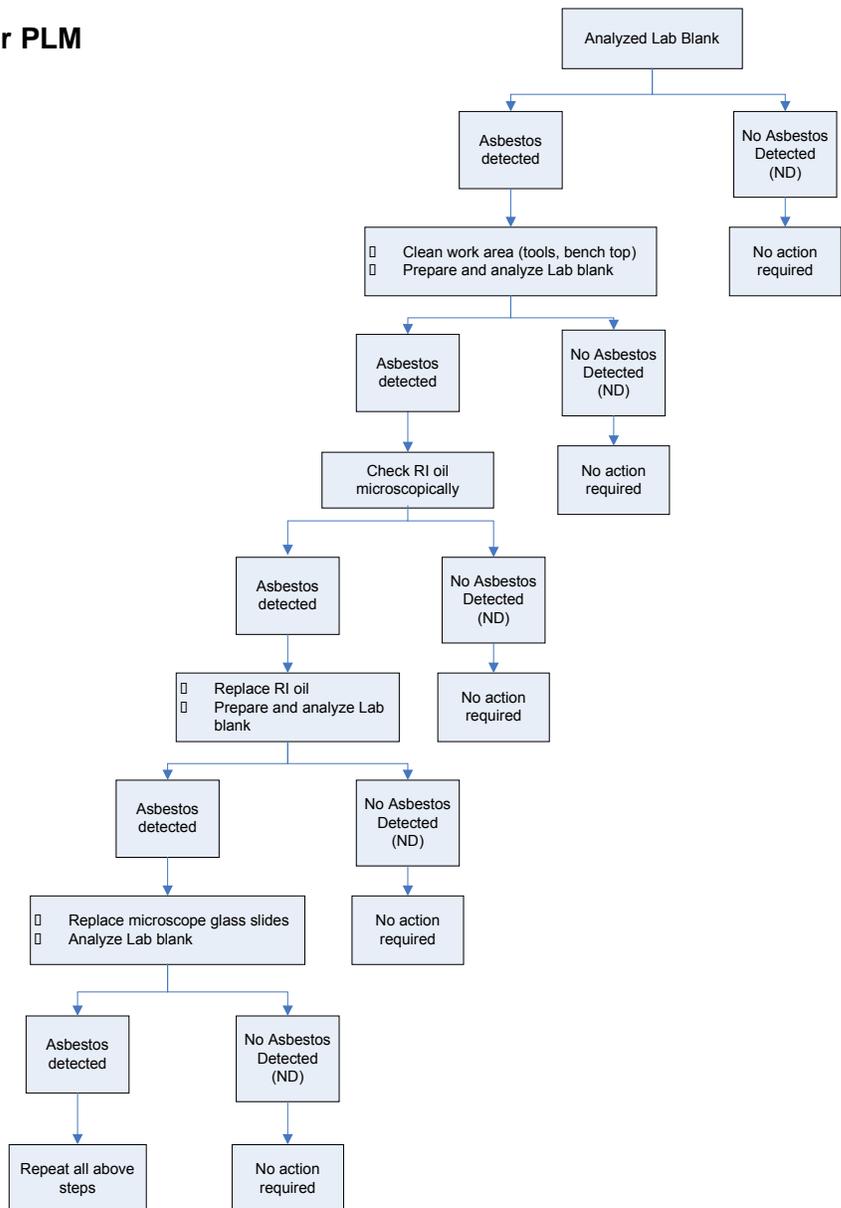


16.0 Tables, Diagrams, Flowcharts, and Validation Data
16.1 Table 2-1 from EPA/600/R-93/116

TABLE 2-1. SUGGESTED ACCEPTABLE ERRORS FOR PLM ANALYSIS
 (Based on 400 point counts of a reasonably homogeneous sample or 100 fields of view for visual estimate)

% Area Asbestos	Acceptable Mean Result	% Area Asbestos	Acceptable Mean Result
1	> 0-3%	50	40-60%
5	> 1-9%	60	50-70%
10	5-15%	70	60-80%
20	10-30%	80	70-90%
30	20-40%	90	80-100%
40	30-50%	100	90-100%

16.2 Contamination Flowchart for PLM





17.0 References

- 17.1 EPA 600/R-93/116
- 17.2 California EPA Air Resources Board - Method 435 " Determination of Asbestos Content of Serpentine Aggregate"
- 17.3 EMSL QA Manual Revision 9 April 2007
- 17.4 EMSL Chemical Hygiene Plan Revision 0, September 2004
- 17.5 Less is Better- Guide to Minimizing Waste in Laboratories prepared by the Task Force on Laboratory Environment, Health and Safety- American Chemical Society 2002.

18.0 Revision History

Revision #	Date	Revision	Initials
1	10/10/2006	Initial Procedure	EC
1.1	11/20/2006	Added much more step by step detail	EC
1.2	05/07/2009	Change milling target grain size from $\leq 250 \mu\text{m}$ to $\leq 75 \mu\text{m}$	EC
2.0	05/07/2009	Reformatted to conform to newer SOP format. Changed section 1.3 reflects milling to $\leq 75 \mu\text{m}$. Section 9.4 (analysis) allows for analysis via EPA 400 or 1000 point count as well as outlining the actual CARB point counting procedure in this section. Stipulated blank are to be process blanks. Updated QC requirements.	KN
3.0	6/15/09	Wording changes to Matrix section, more clearly stated gravimetric reduction as an optional modification to the method, removed vermiculite reference from sample collection section, removed inappropriate air reference from shipment section, changed 250 micron sieve reference to the correct 75 micron in section 9.3.10 And finally, corrected old revision history references.	EC
3.1	7/27/09	Modified Section 13 as follows; Changed QC frequency to 7% inter- and 2% intra-analyst QC to agree with other PLM QC requirements, removed required process blank and replaced with daily (1/100 min) contamination check on know negative sample.	KN
3.2	11/01/12	Section 9.4.4.3 Changed the RI Oil selection from 1.605 to 1.625	LB
3.3	6/26/13	Minor revision - changed the Authorizing Signature date to match the Revision and Effective dates. This change was authorized by Ed Cahill and Ken Najuch.	BS
3.4	9/6/2013	Changed Sample Size for submittal to 4 - 8oz in Section 7.2 Changed requirement to homogenize into a representative subsample for samples over 8oz in Section 9.3.1	KN



Authorizing Signatures

Ken Najuch
Author (print)

Author Signature

09/06/2013
Date

Ed Cahill
Reviewer (print)

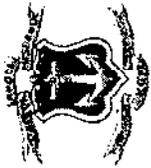
Reviewer Signature

09/06/2013
Date

Ed Cahill
Corporate Approval (print)

Corporate Approval Signature

09/06/2013
Date



State of Rhode Island and Providence Plantations
DEPARTMENT OF HEALTH
HEALTHY ENVIRONMENT TEAM – ASBESTOS PROGRAM
CERTIFICATION

Pursuant to the Asbestos Abatement Act, Chapter 24.5 of Title 23 of the General Laws entitled "Health and Safety" as amended, and the Rules and Regulations for Asbestos Control, this Certificate is hereby issued as designated below. This Certificate is subject to all applicable rules, regulations, orders and notices of the Department of Health now or hereafter in effect and to any conditions specified below.

Certificate Holder: EMSL ANALYTICAL INC

Address: 200 ROUTE 130 NORTH
CINNAMINSON NJ 08077

Certification Number: AAL-075

Expiration Date: 04/30/2014

Type of Certification: Analytical Serv-PLM, PCM, TEM

Except as specifically provided otherwise in this Certificate, Certificate Holders shall conduct their program in accordance with statements, procedures and representations contained in their documents, including any enclosures, listed below. The Rhode Island Rules and Regulations for Asbestos Control shall govern unless the statements representations and procedures in the Certificate Holder's application and correspondence are more restrictive than the regulations.

Rosemary Sheets
Supervising Industrial Hygienist
Health Professionals Regulation



AIHA Laboratory Accreditation Programs, LLC

acknowledges that

EMSL Analytical, Inc.

200 Route 130 North, Cinnaminson, NJ 08077

Laboratory ID: 100194

along with all premises from which key activities are performed, as listed above, has fulfilled the requirements of the AIHA Laboratory Accreditation Programs (AIHA-LAP), LLC accreditation to the ISO/IEC 17025:2005 international standard, *General Requirements for the Competence of Testing and Calibration Laboratories* in the following:

LABORATORY ACCREDITATION PROGRAMS

- | | |
|---|-----------------------------------|
| <input checked="" type="checkbox"/> INDUSTRIAL HYGIENE | Accreditation Expires: 07/01/2014 |
| <input checked="" type="checkbox"/> ENVIRONMENTAL LEAD | Accreditation Expires: 07/01/2014 |
| <input checked="" type="checkbox"/> ENVIRONMENTAL MICROBIOLOGY | Accreditation Expires: 07/01/2014 |
| <input type="checkbox"/> FOOD | Accreditation Expires: |

Specific Field(s) of Testing (FoT)/Method(s) within each Accreditation Program for which the above named laboratory maintains accreditation is outlined on the attached **Scope of Accreditation**. Continued accreditation is contingent upon successful on-going compliance with ISO/IEC 17025:2005 and AIHA-LAP, LLC requirements. This certificate is not valid without the attached **Scope of Accreditation**. Please review the AIHA-LAP, LLC website (www.aihaaccreditedlabs.org) for the most current Scope.

S. D. Allen Iske, PhD, CIH, CSP
Chairperson, Analytical Accreditation Board

Cheryl O. Morton
Managing Director, AIHA Laboratory Accreditation Programs, LLC

Revision 12: 03/29/2012

Date Issued: 07/31/2012



AIHA Laboratory Accreditation Programs, LLC SCOPE OF ACCREDITATION

EMSL Analytical, Inc.
200 Route 130 North, Cinnaminson, NJ 08077

Laboratory ID: **100194**
Issue Date: 07/31/2012

The laboratory is approved for those specific field(s) of testing/methods listed in the table below. Clients are urged to verify the laboratory's current accreditation status for the particular field(s) of testing/Methods, since these can change due to proficiency status, suspension and/or revocation. A complete listing of currently accredited Industrial Hygiene laboratories is available on the AIHA-LAP, LLC website at: <http://www.aihaaccreditedlabs.org>

Industrial Hygiene Laboratory Accreditation Program (IHLAP)

Initial Accreditation Date: 02/01/1989

IHLAP Scope Category	Field of Testing (FoT)	Technology sub-type/ Detector	Published Reference Method/ Title of In-house Method	Method Description or Analyte <i>(for internal methods only)</i>
Chromatography Core	Gas Chromatography	GC/ FID	NIOSH 1003	
			NIOSH 1005	
			NIOSH 1400	
			NIOSH 1500	
			NIOSH 1550	
			NIOSH 1603	
		GC/ECD	NIOSH 5502	
			NIOSH 5503	
			NIOSH 5510	
			OSHA 1010	
	GC/NPD	NIOSH 2551		
	GC/MS		EPA TO-15	
	Gas Chromatography (Diffusive Samplers)		NIOSH 1501	
	Ion Chromatography (IC)		NIOSH 6004	
			NIOSH 6011	
			NIOSH 7903	
OSHA ID-214				
Liquid Chromatography		HPLC/FL	NIOSH 5506	
		HPLC/UV	NIOSH 2016	



IHLAP Scope Category	Field of Testing (FoT)	Technology sub-type/ Detector	Published Reference Method/Title of In-house Method	Method Description or Analyte (for internal methods only)	
Spectrometry Core	Atomic Absorption	CVAA	NIOSH 6009		
			OSHA ID-145	SOP LM-015	
		OSHA ID-145	SOP LM-013		
		FAA	NIOSH 7082		
			GFAA	NIOSH 7105	
	Inductively-Coupled Plasma	ICP/MS	NIOSH 7300 Modified		
		ICP/AES	NIOSH 7300		
	X-ray Diffraction (XRD)		NIOSH 7500		
		OSHA ID-142			
UV/VIS (Colorimetric)		NIOSH 6010			
Asbestos/Fiber Microscopy Core	Polarized Light Microscopy (PLM)		EPA 600/R-93/116		
	Phase Contrast Microscopy (PCM)		NIOSH 7400		
	Transmission Electron Microscopy (TEM)		EPA AHERA - 40 CFR Part 763		
		NIOSH 7402			
Miscellaneous Core	Gravimetric		NIOSH 0500		
			NIOSH 0600		
			NIOSH 5524		
	Thermo-optical Analysis (TOA)		NIOSH 5040		

The laboratory participates in the following AIHA-LAP, LLC-approved proficiency testing programs:

- | | |
|--|--|
| <ul style="list-style-type: none"> ✓ AIHA-PAT Programs, LLC IHPAT Metals ✓ AIHA-PAT Programs, LLC IHPAT Organic Solvents ✓ AIHA-PAT Programs, LLC IHPAT Silica ✓ AIHA-PAT Programs, LLC IHPAT Diffusive Sampler (3M) ☐ AIHA-PAT Programs, LLC IHPAT Diffusive Sampler (SKC) ☐ AIHA-PAT Programs, LLC IHPAT Diffusive Sampler (AT) ✓ AIHA-PAT Programs, LLC IHPAT Asbestos ☐ AIHA-PAT Programs, LLC Bulk Asbestos (BAPAT) ☐ AIHA-PAT Programs, LLC Beryllium (BePAT) ✓ HSE Workplace Analytical Scheme for Proficiency (WASP) (Formaldehyde) ☐ HSE Workplace Analytical Scheme for Proficiency (WASP) (Thermal Desorption Tubes) | <ul style="list-style-type: none"> ☐ Pharmaceutical Round Robin ☐ Compressed/Breathing Air Round Robin ✓ National Voluntary Laboratory Accreditation Program (NVLAP - determined at the time of site assessment) ☐ New York State Department of Health (NYS DOH – PCM and TEM) ✓ ERA Air and Emissions standards for indoor air quality ☐ Institut für Arbeitsschutz der Deutschen Gesetzlichen Unfallversicherung (IFA, formerly BGIA) ☐ Institut de Recherche Robert-Sauvé en Santé et en Sécurité du Travail (IRSST) |
|--|--|

STANDARD OPERATING PROCEDURE FOR
ANALYSIS OF ASBESTOS IN FRIABLE BUILDING MATERIALS BY
POLARIZED LIGHT MICROSCOPY

SOP No.: 33.300.13

Revised Date: November 12, 2012

Author: Nick Ly

Approved by:  Technical Director

1.0 Scope

- 1.1 This method provides for the determination of the presence or absence of six types of asbestos: Chrysotile, Amosite, Crocidolite, Anthophyllite, Tremolite and Actinolite and for the determination of a quantitative estimate of the percent of asbestos in friable building materials.

2.0 Method Summary

- 2.1 Bulk samples of building material taken for asbestos identification are first examined with a low-power stereomicroscope for homogeneity, the presence or absence of fibrous constituents, preliminary fiber identification and an estimate of fiber content. Possible identification of fibers or the confirmation or the absence of fibers is made by analysis of sub samples with the polarized light microscope. An asbestiform mineral is defined as having a minimum length to width aspect ratio of 3:1 or greater (as defined by EPA Test Method 600) for fibers longer than 5 μ m.

3.0 Apparatus

- 3.1 Low-power stereomicroscope (10-45x) with light source
- 3.2 Polarized light microscope with wave retardation plate, 360 degrees graduated rotation stage, substage condenser, lamp and substage iris
- 3.3 Objective lenses: low power (10x), high power (40x); a medium power (20-25x) and very low power (2-5x) are optional
- 3.4 Dispersion staining objective lens (central stop)
- 3.5 Ocular lens (8x minimum)
- 3.6 Eyepiece reticule: cross hair

- 3.7 Compensator (wave retardation plate): 550 nanometer (1st order red or gypsum)
- 3.8 Mortar and pestle
- 3.9 Glassine paper or clean glass plate
- 3.10 Forceps, scalpels, probes
- 3.11 Microscope slides
- 3.12 Cover slips
- 3.13 HEPA-filtered hood
- 3.14 Tissues and baby wipes
- 3.15 Muffle furnace

4.0 Reagents

- 4.1 Index of refraction liquids ND = 1.490-1.720 in increments of 0.002 or 0.004.
- 4.2 Index of refraction liquids for dispersion staining: high dispersion series, ND = 1.550, 1.605 and 1.680
- 4.3 Hydrochloric acid
- 4.4 Organic solvents (THF, Acetone)

5.0 Procedure

- 5.1 Pour sample on glassine paper and examine under stereomicroscope that is contained in a HEPA-filtered hood. Look for homogeneity, presence or absence of fibers and make a preliminary identification and estimate of fiber content. If sample is wet, dry before preparing slide mounts.
- 5.2 Place drop of 1.550 (or other refractive index liquid as indicated by scan) refractive index liquid onto glass slide. Take pinches of representative materials and put them into the liquid. Tease apart or grind up materials into fine particles. Cover with cover slip. Make a minimum of three mounts per sample.

Note: For Non-friable Organically Bound (NOB) samples, such as vinyl flooring, adhesive, mastic, asphaltic and caulking material; further refinement may be necessary to break down the matrix to improve the likelihood of exposing asbestos and other fibrous components. The additional preparation steps include but not limited to pulverizing, grinding, ashing, dissolving in organic solvents and hydrochloric acid to remove any binder or interfering material. For every 20 non-friable samples analyzed, one non-friable non-asbestos containing material shall be processed to comply with DOD requirements.

Remarks: Use 1.550 to check for Chrysotile; 1.680 for Amosite and Crocidolite ; 1.605 for Tremolite, Actinolite and Anthophyllite.

- 5.3 Under polarized light microscope, scan entire area, identifying asbestos, non-asbestos fibers and matrix. Note optical properties of asbestos fibers: Refractive index (alpha and gamma) using central stop dispersion color in accordance with the method by Shu-Chun Su, sign of elongation, morphology, birefringence, extinction angle, color and pleochroism using plane polarized light, crossed polars and compensator plate for determination of characteristics.
- 5.4 Note characteristics of asbestos and non-asbestos fibers and report at least one definitive characteristic of the predominant non-asbestos fiber that identifies it as non-asbestos fiber. Record all optical properties in the fields provided in the database. Identification of asbestos fibers can be verified by using the optical properties as provided by NIST Standard Reference Materials 1866a and 1867. The accuracy of the asbestos fibers reported can be checked against the acceptable limits as established in the tables outlined in the NIST Certificate of Analysis.
- 5.5 Visually estimate percentages of asbestos and non-asbestos fiber content based on what was observed under both the stereoscope and PLM microscope. Compare this with prepared slides of known percentages and content of asbestos for accurate estimation.
- 5.6 Enter macroscopic description of sample, matrix materials, non-asbestos fiber type/percentage and asbestos type/percentage into data base.
- 5.7 All tools and equipment used around the stereoscope and work area must be wipe cleaned using a moist towel before preparing another sample for analysis. Sample slides, cover slips, disposable glassline paper, and dirty towels shall be disposed in a sealed Ziploc bag inside the sample preparation hood for later disposal.

6.0 Quantitation of Asbestos Content

- 6.1 Quantitation of the amount of asbestos present is most readily obtained by visual estimation or comparison of the bulk sample and slide preparations to other reference slide with similar matrix and known amounts of asbestos present in them.
- 6.2 The asbestos-containing layers in each sample must be positively identified by PLM and the optical properties recorded before reporting asbestos is present in any quantity, including trace amount.

6.3 The reported quantity of asbestos, including trace, should be consistent on the slide mount used for quantitation. This assumes that the sample is reasonably homogeneous or homogenized to ensure that each subsample is representative of the composition of the total sample.

6.3.1 A sample containing <1% asbestos is defined as having five or less positively identified asbestos fibers randomly spread over a minimum of three prepared slides above the lab's blank level (in accordance to NVLAP proficiency accreditation program). Our blank level is defined as having zero asbestos fiber.

6.3.2 A sample containing >1% asbestos is defined as having greater than five positively identified asbestos fibers randomly spread over a minimum of three prepared slides above the lab's blank level. Our blank level is defined as having zero asbestos fiber.

6.4 For samples containing ten percent or less of asbestos, the point count method may be used to further refine the quantification of a friable material. If asbestos is counted using the point count technique, report the percentage as follows:

6.4.1 If asbestos is consistently observed, but not counted, report Trace (0.1%). Trace amount of asbestos is defined as having at least three asbestos fibers positively identified spreading over three or more sample slides and no point landed on an asbestos fiber during the point count analysis.

6.4.2 If no asbestos is observed in the sample preparations, report None Detected.

NVL uses calibrated visual estimation technique for quantitation which has demonstrated to be equivalent to point counting. NVL uses bulk standards and prepared slides that have been point-counted for calibration purposes. To demonstrate equivalency, the standard samples were prepared by homogenizing different mixture of asbestos and fiberglass in a mortar and pestle, mount a pinch sample on a microscope slide prior to conducting visual estimation and point counting to determine asbestos concentration in each sample. The following data has been compiled to demonstrate equivalency of calibrated visual estimation to point counting technique:

Sample ID	Asbestos Type	% Asb by Vis Est			Avg. % Asb. by Vis. Est.	No of Asb Points by Pt Counting			Avg. % Asb. by Pt. Count	Acceptable Range
		1	2	3		1	2	3		
#1	Chrysotile	3	2	5	3%	8/400	12/400	15/400	2.9%	1 - 9%
#2	Amosite	2	3	2	2%	5/400	8/400	6/400	1.6%	1 - 9%
#3	Chrysotile	7	5	5	6%	15/400	23/400	18/400	4.7%	1 - 9%
#4	Chrysotile	12	10	15	12%	35/400	49/400	43/400	10.7%	5 - 15%
#5	Amosite	4	5	3	4%	9/400	15/400	10/400	2.9%	1-9%

7.0 Qualitative Analysis of Tape Lift and Wipe samples

- 7.1 **Tape Lift** – Place 2-3 separate drops of 1.550 refractive index liquid onto a glass slide. Cut approximately 2-3 inch length of the tape and gently place the adhesive side over the RI liquid on the glass slide. Place three separate drops of 1.550 refractive index liquid evenly spaced over the surface of the tape. Spread three cover slips over the drops of liquid on the tape prior to examining the prepared slide for presence of asbestos fibers.
- 7.2 **Wipe Sample** – Use a 3 by 1 inch clear adhesive tape to gently rub off any dust or particulates from the wipe. Prepare the sample following procedure specified in Section 7.1.
- 7.3 Under polarized light microscope, scan entire area, identifying asbestos, non-asbestos fibers and matrix. Note optical properties of asbestos fibers: Refractive index (alpha/gamma), sign of elongation, morphology, birefringence, extinction angle, color and pleochroism using plane polarized light, crossed polars and compensator plate for determination of characteristics.
- 7.4 Visually estimate amount of asbestos and non-asbestos fiber content based on relative components observed. Report less than (<) or greater than (>) 1% if asbestos fibers are observed.
- 7.5 Enter macroscopic description of sample, qualitatively list out all non-asbestos fibrous and non-fibrous components without percentage on the test report.
- Interferences
- 1 Cellulose: Has refractive index similar to chrysotile. Cellulose exhibits pinch and swell characteristics along length, has internal cellular structure and lacks splayed ends. Fibers are not composed of bundles of smaller fibers.
 - 2 Polyethylene fibers: Has morphology and refractive index similar to chrysotile, but will melt when exposed to heat. Has higher birefringence than chrysotile.
 - 3 Vermiculite: Has refractive index and extinction characteristics similar to chrysotile. May be colored green or brown and look more tabular than fibrous. No fibrils are present.

- 4 Fibrous talc: Has morphology and refractive index similar to chrysotile, but has a higher birefringence than chrysotile.
- 5 Glass fibers: Glass, while isotropic, may occasionally refract light in such a way as to mimic the morphology of amosite, but it will not show a sign of elongation under the compensator plate and the index of refraction will be different from amosite.

8.0 Documentation of raw data on optical bench sheet

- 8.1 All pertinent physical and optical characteristics for fibrous components must be documented on the optical bench sheet. These observations shall be recorded in the following order: sample color, sample texture, homogeneity, fiber morphology, % asbestos under stereo microscope, refractive index (alpha and gamma), fiber color under PLM, pleochroism, birefringence, extinction, sign of elongation, asbestos and non-asbestos fiber type, % asbestos under PLM and bench temperature.

9.0 Pollution Prevention

Samples shall be prepared in a clean well ventilated HEPA-filtered sample prep hood with minimal foot traffic or disturbance.

10.0 Waste Management

Samples shall be disposed of in accordance with federal, state and local regulations.

11.0 Equipment Maintenance

Daily and regularly maintenance of PLM using appropriate RI liquid and sample media to verify proper optical alignment and illumination.

12.0 Computer Software and Hardware

Data entry and tabulation are performed using Filemaker database to summarize data entry and generate test reports.

13.0 Troubleshooting

- 13.1 Check light source for burnt out bulb or fuse if microscope fails to light
- 13.2 Check and replace light socket or fuse if new bulb fails to light
- 13.3 Center stage and check optical alignment for proper illumination

14.0 References

Interim Method for the Determination of Asbestos in Bulk Insulation Samples, EPA Test Method 600/M4-82-020, 1982

Method for the Determination of Asbestos in Bulk Building Materials, EPA Test Method 600/R-93/116, July 1993

The Optical Microscopic Identification and Quantification of Bulk Asbestos, E.R. Crutcher.

A Rapid and Accurate Procedure for the Determination of Refractive Indices of Regulated Asbestos, Shu-Chun Su, Hercules Inc. Research Center, 1979-1982

Optical Mineralogy, Kerr, Paul F., 1977.

The Asbestos Particle Atlas, McCrone, Walter, 1980

Revision Record

Revision No.	Date	Parameters	Signature
.13	11/12/2012	Added Tape Lift & Wipe Samples & List of documented raw data on bench sheet (Section 5.3) & NOB	



PERRY JOHNSON LABORATORY ACCREDITATION, INC.

Certificate of Accreditation

Perry Johnson Laboratory Accreditation, Inc. has assessed the Laboratory of:

NVL Laboratories

4708 Aurora Avenue North, Seattle, WA 98103

(Hereinafter called the Organization) and hereby declares that Organization has met the requirements of ISO/IEC 17025:2005 “General Requirements for the competence of Testing and Calibration Laboratories” and the DoD Quality Systems Manual for Environmental Laboratories Version 4.1 4/22/2009 and is accredited in accordance with the:

United States Department of Defense Environmental Laboratory Accreditation Program (DoD-ELAP)

***This accreditation demonstrates technical competence for the defined scope:
Environmental Testing
(As detailed in the supplement)***

Accreditation claims for such testing and/or calibration services shall only be made from addresses referenced within this certificate. This Accreditation is granted subject to the system rules governing the Accreditation referred to above, and the Organization hereby covenants with the Accreditation body’s duty to observe and comply with the said rules.

For PJLA:

<i>Initial Accreditation Date:</i>	<i>Issue Date:</i>	<i>Accreditation No.:</i>	<i>Certificate No.:</i>
April 8, 2012	April 8, 2012	72200	L12-50

Tracy Szerszen
President/Operations Manager

Perry Johnson Laboratory
Accreditation, Inc. (PJLA)
755 W. Big Beaver, Suite 1325
Troy, Michigan 48084

The validity of this certificate is maintained through ongoing assessments based on a continuous accreditation cycle. The validity of this certificate should be confirmed through the PJLA website: www.pjilabs.com



Certificate of Accreditation: Supplement

ISO/IEC 17025:2005 and DoD-ELAP

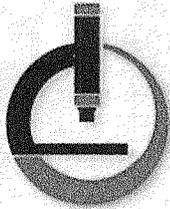
NVL Laboratories

4708 Aurora Avenue North, Seattle, WA 98103
Munaf Khan Phone: 206-547-0100

Accreditation is granted to the facility to perform the following testing:

Matrix	Standard/Method	Technology	Analyte
Air	NIOSH 7300	ICP-AES	Arsenic
Air	NIOSH 7300	ICP-AES	Barium
Air	NIOSH 7300	ICP-AES	Cadmium
Air	NIOSH 7300	ICP-AES	Chromium
Air	NIOSH 7300	ICP-AES	Copper
Air	NIOSH 7300	ICP-AES	Lead
Air	NIOSH 7300	ICP-AES	Nickel
Air	NIOSH 7300	ICP-AES	Selenium
Air	NIOSH 7300	ICP-AES	Silver
Air	NIOSH 7300	ICP-AES	Zinc
Air	NIOSH 7400	PCM	Asbestos
Air	NIOSH 7082	FAA	Lead
Solid	EPA 6010	ICP-AES	Arsenic
Solid	EPA 6010	ICP-AES	Barium
Solid	EPA 6010	ICP-AES	Cadmium
Solid	EPA 6010	ICP-AES	Chromium
Solid	EPA 6010	ICP-AES	Copper
Solid	EPA 6010	ICP-AES	Lead
Solid	EPA 6010	ICP-AES	Nickel
Solid	EPA 6010	ICP-AES	Selenium
Solid	EPA 6010	ICP-AES	Silver
Solid	EPA 6010	ICP-AES	Zinc
Solid	EPA 7471	CVAA	Mercury
Solid	EPA 600/M4-82/020	PLM	Asbestos

Matrix	Standard/Method	Technology	Analyte
Air	EPA 3051	Acid Digestion	Metals Digestion
Solid	EPA 3050B	Acid Digestion	Metals Digestion
Solid	EPA 1311	Leaching	TCLP



**LABORATORY
ACCREDITATION
BUREAU**



Certificate of Accreditation

ISO/IEC 17025:2005

Certificate Number L2223

Katahdin Analytical Services, Inc.

600 Technology Way
Scarborough ME 04074

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

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

Accreditation valid through: February 1, 2016



**R. Douglas Leonard, Jr., President, COO
Laboratory Accreditation Bureau
Presented the 1st of February 2013**

*See the laboratory's Scope of Accreditation for details of accredited parameters

**Laboratory Accreditation Bureau is found to be in compliance with ISO/IEC 17011:2004 and recognized by ILAC (International Laboratory Accreditation Cooperation) and NACLA (National Cooperation for Laboratory Accreditation).

Scope of Accreditation

For

Katahdin Analytical Services, Inc.

600 Technology Way
Scarborough, ME 04074
Leslie Dimond
207-874-2400

In recognition of a successful assessment to ISO/IEC 17025:2005 and the requirements of the DoD Environmental Laboratory Accreditation Program (DoD ELAP) as detailed in the DoD Quality Systems Manual for Environmental Laboratories (DoD QSM v4.2) based on the National Environmental Laboratory Accreditation Conference Chapter 5 Quality Systems Standard (NELAC Voted Revision June 5, 2003), accreditation is granted to Katahdin Analytical Services to perform the following tests:

Accreditation granted through: February 1, 2016

Testing - Environmental

Non-Potable Water		
Technology	Method	Analyte
GC/ECD	EPA 8081B	2, 4'-DDD
GC/ECD	EPA 8081B	2, 4'-DDE
GC/ECD	EPA 8081B	2, 4'-DDT
GC/ECD	EPA 608; EPA 8081B	4, 4'-DDD
GC/ECD	EPA 608; EPA 8081B	4, 4'-DDE
GC/ECD	EPA 608; EPA 8081B	4, 4'-DDT
GC/ECD	EPA 608; EPA 8081B	Aldrin
GC/ECD	EPA 608; EPA 8081B	alpha-BHC (alpha-Hexachlorocyclohexane)
GC/ECD	EPA 8081B	Alpha-Chlordane
GC/ECD	EPA 608; EPA 8081B	beta-BHC (beta-Hexachlorocyclohexane)
GC/ECD	EPA 8081B	Cis-Nonaclor
GC/ECD	EPA 608; EPA 8081B	Chlordane (tech.)
GC/ECD	EPA 608; EPA 8081B	delta-BHC
GC/ECD	EPA 608; EPA 8081B	Dieldrin
GC/ECD	EPA 608; EPA 8081B	Endosulfan I
GC/ECD	EPA 608; EPA 8081B	Endosulfan II

Non-Potable Water		
Technology	Method	Analyte
GC/ECD	EPA 608; EPA 8081B	Endosulfan sulfate
GC/ECD	EPA 608; EPA 8081B	Endrin
GC/ECD	EPA 608; EPA 8081B	Endrin aldehyde
GC/ECD	EPA 8081B	Endrin Ketone
GC/ECD	EPA 8081B	gamma-BHC (Lindane gamma-Hexachlorocyclohexane)
GC/ECD	EPA 8081B	gamma-Chlordane
GC/ECD	EPA 608; EPA 8081B	Heptachlor
GC/ECD	EPA 608; EPA 8081B	Heptachlor epoxide
GC/ECD	EPA 8081B	Hexachlorobenzene
GC/ECD	EPA 8081B	Methoxychlor
GC/ECD	EPA 8081B	Mirex
GC/ECD	EPA 8081B	Oxychlordane
GC/ECD	EPA 608; EPA 8081B	Toxaphene (Chlorinated camphene)
GC/ECD	EPA 8081B	trans-Nonachlor
GC/ECD	EPA 608; EPA 8082A	Aroclor-1016 (PCB-1016)
GC/ECD	EPA 608; EPA 8082A	Aroclor-1221 (PCB-1221)
GC/ECD	EPA 608; EPA 8082A	Aroclor-1232 (PCB-1232)
GC/ECD	EPA 608; EPA 8082A	Aroclor-1242 (PCB-1242)
GC/ECD	EPA 608; EPA 8082A	Aroclor-1248 (PCB-1248)
GC/ECD	EPA 608; EPA 8082A	Aroclor-1254 (PCB-1254)
GC/ECD	EPA 608; EPA 8082A	Aroclor-1260 (PCB-1260)
GC/ECD	EPA 8082A MOD	Aroclor-1262 (PCB-1262)
GC/ECD	EPA 8082A MOD	Aroclor-1268 (PCB-1268)
GC/ECD	EPA 8082A	2,2',3,3',4,4',5,5',6-Nonachlorobiphenyl (BZ 206)
GC/ECD	EPA 8082A	2,2',3,3',4,4',5,6-Octachlorobiphenyl (BZ 195)
GC/ECD	EPA 8082A	2,2',3,3',4,4',5-Heptachlorobiphenyl (BZ 170)
GC/ECD	EPA 8082A	2,2',3,3',4,4'-Hexachlorobiphenyl (BZ 128)
GC/ECD	EPA 8082A	2, 2', 3, 4, 4', 5, 5'-Heptachlorobiphenyl (BZ 180)
GC/ECD	EPA 8082A	2, 2', 3, 4, 4', 5', 6-Heptachlorobiphenyl (BZ 183)
GC/ECD	EPA 8082A	2, 2', 3, 4, 4', 5-Hexachlorobiphenyl (BZ 138)
GC/ECD	EPA 8082A	2, 2', 3, 4, 4', 6, 6'-Heptachlorobiphenyl (BZ 184)

Non-Potable Water		
Technology	Method	Analyte
GC/ECD	EPA 8082A	2, 2', 3, 4', 5, 5', 6-Heptachlorobiphenyl (BZ 187)
GC/ECD	EPA 8082A	2, 2', 3, 4, 5'-Pentachlorobiphenyl (BZ 87)
GC/ECD	EPA 8082A	2, 2', 3, 5'-Tetrachlorobiphenyl (BZ 44)
GC/ECD	EPA 8082A	2, 2', 4, 4', 5, 5'-Hexachlorobiphenyl (BZ 153)
GC/ECD	EPA 8082A	2, 2', 4, 5, 5'-Pentachlorobiphenyl (BZ 101)
GC/ECD	EPA 8082A	2, 2', 4, 5-Tetrachlorobiphenyl (BZ 48)
GC/ECD	EPA 8082A	2, 2', 4, 5'-Tetrachlorobiphenyl (BZ 49)
GC/ECD	EPA 8082A	2, 2', 5, 5'-Tetrachlorobiphenyl (BZ 52)
GC/ECD	EPA 8082A	2, 2', 5-Trichlorobiphenyl (BZ 18)
GC/ECD	EPA 8082A	2, 3, 3', 4, 4', 5-Hexachlorobiphenyl (BZ 156)
GC/ECD	EPA 8082A	2, 3, 3', 4, 4', 5'-Hexachlorobiphenyl (BZ 157)
GC/ECD	EPA 8082A	2, 3, 3', 4, 4'-Pentachlorobiphenyl (BZ 105)
GC/ECD	EPA 8082A	2, 3, 3', 4, 4', 5, 5'-Heptachlorobiphenyl (BZ 189)
GC/ECD	EPA 8082A	2, 3', 4, 4', 5, 5'-Hexachlorobiphenyl (BZ 167)
GC/ECD	EPA 8082A	2, 3', 4, 4', 5-Pentachlorobiphenyl (BZ 118)
GC/ECD	EPA 8082A	2, 3', 4, 4',5'-Pentachlorobiphenyl (BZ 123)
GC/ECD	EPA 8082A	2, 3', 4, 4'-Tetrachlorobiphenyl (BZ 66)
GC/ECD	EPA 8082A	2, 3, 4, 4', 5-Pentachlorobiphenyl (BZ 114)
GC/ECD	EPA 8082A	2, 4, 4'-Trichlorobiphenyl (BZ 28)
GC/ECD	EPA 8082A	2, 4'-Dichlorobiphenyl (BZ 8)
GC/ECD	EPA 8082A	3, 3', 4, 4', 5, 5'-Hexachlorobiphenyl (BZ 169)
GC/ECD	EPA 8082A	3, 3', 4, 4', 5-Pentachlorobiphenyl (BZ 126)
GC/ECD	EPA 8082A	3, 3', 4, 4'-Tetrachlorobiphenyl (BZ 77)
GC/ECD	EPA 8082A	3, 4, 4', 5-Tetrachlorobiphenyl (BZ 81)
GC/ECD	EPA 8082A	Decachlorobiphenyl (BZ 209)
GC/ECD	EPA 8151A	2, 4, 5-T
GC/ECD	EPA 8151A	2, 4-D
GC/ECD	EPA 8151A	2, 4-DB
GC/ECD	EPA 8151A	Dalapon
GC/ECD	EPA 8151A	Dicamba
GC/ECD	EPA 8151A	Dichloroprop

Non-Potable Water		
Technology	Method	Analyte
GC/ECD	EPA 8151A	Dinoseb
GC/ECD	EPA 8151A	MCPA
GC/ECD	EPA 8151A	MCPPP
GC/ECD	EPA 8151A	Pentachlorophenol
GC/ECD	EPA 8151A	Silvex (2, 4, 5-TP)
GC/FID	EPA 8015C/D MOD	Diesel range organics (DRO)
GC/FID	EPA 8015C/D MOD	Total Petroleum Hydrocarbon (TPH)
GC/FID	EPA 8015C/D MOD	Gasoline range organics (GRO)
GC/FID/PID	MA DEP VPH	Volatile Organic Hydrocarbons
GC/FID	MA DEP EPH	Extractable Petroleum Hydrocarbons
GC/FID	CT ETPH	Total Petroleum Hydrocarbons
GC/FID	TNRCC Method 1005	Total Petroleum Hydrocarbons
GC/FID	FL-PRO	Petroleum Range Organics
GC/ECD	EPA 8011; EPA 504	1, 2-Dibromoethane (EDB)
GC/ECD	EPA 8011; EPA 504	1, 2-Dibromo-3-chloropropane
GC/FID	RSK-175	Methane Ethane Ethene
GC/MS	EPA 8260B/C; EPA 524.2	1, 1, 1, 2-Tetrachloroethane
GC/MS	EPA 624; EPA 8260B/C; EPA 524.2	1, 1, 1-Trichloroethane
GC/MS	EPA 624; 8260B/C; EPA 524.2	1, 1, 2, 2-Tetrachloroethane
GC/MS	EPA 8260B/C	1,1,2-Trichloro-1,2,2-trifluoroethane
GC/MS	EPA 624; EPA 8260B/C; EPA 524.2	1, 1, 2-Trichloroethane
GC/MS	EPA 624; EPA 8260B/C; EPA 524.2	1, 1-Dichloroethane
GC/MS	EPA 624; EPA 8260B/C; EPA 524.2	1, 1-Dichloroethene
GC/MS	EPA 8260B/C; EPA 524.2	1, 1-Dichloropropene
GC/MS	EPA 8260B/C; EPA 524.2	1, 2, 3-Trichlorobenzene
GC/MS	EPA 8260B/C; EPA 524.2	1, 2, 3-Trichloropropane
GC/MS	EPA 8260B/C	1,2,3-Trimethylbenzene
GC/MS	EPA 8260B/C; EPA 524.2	1, 2, 4-Trichlorobenzene
GC/MS	EPA 8260B/C; EPA 524.2	1, 2, 4-Trimethylbenzene

Non-Potable Water		
Technology	Method	Analyte
GC/MS	EPA 8260B/C; EPA 524.2	1, 2-Dibromo-3-chloropropane
GC/MS	EPA 8260B/C; EPA 524.2	1, 2-Dibromoethane (EDB)
GC/MS	EPA 624; EPA 8260B/C; EPA 524.2	1, 2-Dichlorobenzene
GC/MS	EPA 624; EPA 8260B/C; EPA 524.2	1, 2-Dichloroethane
GC/MS	EPA 624; EPA 8260B/C; EPA 524.2	1, 2-Dichloropropane
GC/MS	EPA 8260B/C	1,3,5-Trichlorobenzene
GC/MS	EPA 8260B/C; EPA 524.2	1, 3, 5-Trimethylbenzene
GC/MS	EPA 624; EPA 8260B/C; EPA 524.2	1, 3-Dichlorobenzene
GC/MS	EPA 8260B/C; EPA 524.2	1, 3-Dichloropropane
GC/MS	EPA 624; EPA 8260B/C; EPA 524.2	1, 4-Dichlorobenzene
GC/MS	EPA 8260B/C	1, 4-Dioxane
GC/MS	EPA 8260B/C	1-Chlorohexane
GC/MS	EPA 8260B/C; EPA 524.2	2, 2-Dichloropropane
GC/MS	EPA 8260B/C; EPA 524.2	2-Butanone
GC/MS	EPA 624; EPA 8260B/C	2-Chloroethyl vinyl ether
GC/MS	EPA 8260B/C; EPA 524.2	2-Chlorotoluene
GC/MS	EPA 8260B/C; EPA 524.2	2-Hexanone
GC/MS	EPA 8260B/C; EPA 524.2	4-Chlorotoluene
GC/MS	EPA 8260B/C; EPA 524.2	4-Methyl-2-pentanone
GC/MS	EPA 8260B/C; EPA 524.2	Acetone
GC/MS	EPA 8260B/C	Acetonitrile
GC/MS	EPA 624; EPA 8260B/C	Acrolein
GC/MS	EPA 624; EPA 8260B/C; EPA 524.2	Acrylonitrile
GC/MS	EPA 8260B/C; EPA 524.2	Allyl chloride
GC/MS	EPA 624; EPA 8260B/C; EPA 524.2	Benzene
GC/MS	EPA 8260B/C	Benzyl chloride
GC/MS	EPA 8260B/C; EPA 524.2	Bromobenzene
GC/MS	EPA 8260B/C; EPA 524.2	Bromochloromethane

Non-Potable Water		
Technology	Method	Analyte
GC/MS	EPA 624; EPA 8260B/C; EPA 524.2	Bromodichloromethane
GC/MS	EPA 624; EPA 8260B/C; EPA 524.2	Bromoform
GC/MS	EPA 8260B/C; EPA 524.2	Carbon disulfide
GC/MS	EPA 624; EPA 8260B/C; EPA 524.2	Carbon tetrachloride
GC/MS	EPA 624; EPA 8260B/C; EPA 524.2	Chlorobenzene
GC/MS	EPA 624; EPA 8260B/C; EPA 524.2	Chloroethane
GC/MS	EPA 624; EPA 8260B/C; EPA 524.2	Chloroform
GC/MS	EPA 8260B/C	Chloroprene
GC/MS	EPA 8260B/C; EPA 524.2	cis-1, 2-Dichloroethene
GC/MS	EPA 624; EPA 8260B/C; EPA 524.2	cis-1, 3-Dichloropropene
GC/MS	EPA 8260B/C	Cis-1,4-Dichloro-2-butene
GC/MS	EPA 8260B/C	Cyclohexane
GC/MS	EPA 624; EPA 8260B/C; EPA 524.2	Dibromochloromethane
GC/MS	EPA 8260B/C; EPA 524.2	Dibromomethane
GC/MS	EPA 624; EPA 8260B/C; EPA 524.2	Dichlorodifluoromethane
GC/MS	EPA 8260B/C; EPA 524.2	Diethyl ether
GC/MS	EPA 8260B/C	Di-isopropylether
GC/MS	EPA 8260B/C; EPA 524.2	Ethyl methacrylate
GC/MS	EPA 624; EPA 8260B/C; EPA 524.2	Ethylbenzene
GC/MS	EPA 8260B/C	Ethyl-t-butylether
GC/MS	EPA 8260B/C; EPA 524.2	Hexachlorobutadiene
GC/MS	EPA 8260B/C	Iodomethane
GC/MS	EPA 8260B/C	Isobutyl alcohol
GC/MS	EPA 8260B/C	Isopropyl alcohol
GC/MS	EPA 8260B/C; EPA 524.2	Isopropyl benzene
GC/MS	EPA 8260B/C; EPA 524.2	m p-xylenes
GC/MS	EPA 8260B/C	Methyl acetate

Non-Potable Water		
Technology	Method	Analyte
GC/MS	EPA 8260B/C; EPA 524.2	Methacrylonitrile
GC/MS	EPA 624 / 8260B,C	Methyl bromide (Bromomethane)
GC/MS	EPA 624; EPA 8260B/C; EPA 524.2	Methyl chloride (Chloromethane)
GC/MS	EPA 8260B/C; EPA 524.2	Methyl methacrylate
GC/MS	EPA 8260B/C; EPA 524.2	Methyl tert-butyl ether
GC/MS	EPA 8260B/C	Methylcyclohexane
GC/MS	EPA 624; EPA 8260B/C; EPA 524.2	Methylene chloride
GC/MS	EPA 8260B/C; EPA 524.2	Naphthalene
GC/MS	EPA 8260B/C; EPA 524.2	n-Butylbenzene
GC/MS	EPA 8260B/C; EPA 524.2	n-Propylbenzene
GC/MS	EPA 8260B/C; EPA 524.2	o-Xylene
GC/MS	EPA 8260B/C	Pentachloroethane
GC/MS	EPA 8260B/C; EPA 524.2	p-Isopropyltoluene
GC/MS	EPA 8260B/C; EPA 524.2	Propionitrile
GC/MS	EPA 8260B/C; EPA 524.2	sec-butylbenzene
GC/MS	EPA 8260B/C; EPA 524.2	Styrene
GC/MS	EPA 8260B/C	t-Amylmethylether
GC/MS	EPA 8260B/C; EPA 524.2	tert-Butyl alcohol
GC/MS	EPA 8260B/C	tert-Butylbenzene
GC/MS	EPA 624; EPA 8260B/C; EPA 524.2	Tetrachloroethene (Perchloroethylene)
GC/MS	EPA 8260B/C; EPA 524.2	Tetrahydrofuran
GC/MS	EPA 624; EPA 8260B/C; EPA 524.2	Toluene
GC/MS	EPA 624; EPA 8260B/C; EPA 524.2	trans-1, 2-Dichloroethylene
GC/MS	EPA 624; EPA 8260B/C; EPA 524.2	trans-1, 3-Dichloropropylene
GC/MS	EPA 8260B/C; EPA 524.2	trans-1, 4-Dichloro-2-butene
GC/MS	EPA 624; EPA 8260B/C; EPA 524.2	Trichloroethene (Trichloroethylene)
GC/MS	EPA 624; EPA 8260B/C; EPA 524.2	Trichlorofluoromethane
GC/MS	EPA 8260B/C	Vinyl acetate

Non-Potable Water		
Technology	Method	Analyte
GC/MS	EPA 624; EPA 8260B/C; EPA 524.2	Vinyl chloride
GC/MS	EPA 624 / 8260B,C	Xylene
GC/MS	EPA 8260B/C SIM	1,1,1,2-Tetrachloroethane
GC/MS	8260B, C SIM	1,1,1-Trichloroethane
GC/MS	EPA 8260B/C SIM	1,1,2,2-Tetrachloroethane
GC/MS	EPA 8260B/C SIM	1, 1, 2-Trichloroethane
GC/MS	EPA 8260B/C SIM	1,2,3-Trichloropropane
GC/MS	EPA 8260B/C SIM	1,1-Dichloroethane
GC/MS	EPA 8260B/C SIM	1,1-Dichloroethene
GC/MS	EPA 8260B/C SIM	1,2,4-Trichlorobenzene
GC/MS	EPA 8260B/C SIM	1,2,4-Trimethylbenzene
GC/MS	EPA 8260B/C SIM	1,2-Dibromo-3-chloropropane
GC/MS	EPA 8260B/C SIM	1,2-Dibromoethane
GC/MS	EPA 8260B/C SIM	1,2-Dichlorobenzene
GC/MS	EPA 8260B/C SIM	1,2-Dichloroethane
GC/MS	EPA 8260B/C SIM	1,2-Dichloropropane
GC/MS	EPA 8260B/C SIM	1,3-Dichlorobenzene
GC/MS	EPA 8260B/C SIM	1,3-Dichloropropane
GC/MS	EPA 8260B/C SIM	1,4-Dichlorobenzene
GC/MS	EPA 8260B/C SIM	2-Hexanone
GC/MS	EPA 8260B/C SIM	4-Methyl-2-pentanone
GC/MS	EPA 8260B/C SIM	Benzene
GC/MS	EPA 8260B/C SIM	Bromodichloromethane
GC/MS	EPA 8260B/C SIM	Carbon Tetrachloride
GC/MS	EPA 8260B/C SIM	Chloroform
GC/MS	EPA 8260B/C SIM	Chloromethane
GC/MS	EPA 8260B/C SIM	cis-1,2-Dichloroethene
GC/MS	EPA 8260B/C SIM	cis-1,3-Dichloropropene
GC/MS	EPA 8260B/C SIM	Dibromochloromethane
GC/MS	EPA 8260B/C SIM	Ethylbenzene
GC/MS	EPA 8260B/C SIM	Isopropylbenzene

Non-Potable Water		
Technology	Method	Analyte
GC/MS	EPA 8260B/C SIM	Hexachlorobutadiene
GC/MS	EPA 8260B/C SIM	Methylcyclohexane
GC/MS	EPA 8260B/C SIM	m,p-Xylene
GC/MS	EPA 8260B/C SIM	o-Xylene
GC/MS	EPA 8260B/C SIM	Tetrachloroethene
GC/MS	EPA 8260B/C SIM	trans-1,2-Dichloroethene
GC/MS	EPA 8260B/C SIM	Trans-1,3-Dichloropropene
GC/MS	EPA 8260B/C SIM	Trichloroethene
GC/MS	EPA 8260B/C SIM	Trichlorofluoromethane
GC/MS	EPA 8260B/C SIM	Vinyl Chloride
GC/MS	EPA 8260B/C SIM	Xylenes (total)
GC/MS	EPA 8270C/D	1, 2, 4, 5-Tetrachlorobenzene
GC/MS	EPA 625; EPA 8270C/D	1, 2, 4-Trichlorobenzene
GC/MS	EPA 625; EPA 8270C/D	1, 2-Dichlorobenzene
GC/MS	EPA 8270C/D	1, 2-Diphenylhydrazine
GC/MS	EPA 8270C/D	1, 3, 5-Trinitrobenzene
GC/MS	EPA 625; EPA 8270C/D	1, 3-Dichlorobenzene
GC/MS	EPA 8270C/D	1, 3-Dinitrobenzene
GC/MS	EPA 625; EPA 8270C/D	1, 4-Dichlorobenzene
GC/MS	EPA 8270C/D	1, 4-Dioxane
GC/MS	EPA 8270C/D	1, 4-Naphthoquinone
GC/MS	EPA 8270C/D	1, 4-Phenylenediamine
GC/MS	EPA 8270C/D	1-Chloronaphthalene
GC/MS	EPA 8270C/D	1-Methylnaphthalene
GC/MS	EPA 8270C/D	1-Naphthylamine
GC/MS	EPA 8270C/D	2, 3, 4, 6-Tetrachlorophenol
GC/MS	EPA 8270C/D	2, 4, 5-Trochlorophenol
GC/MS	EPA 625; EPA 8270C/D	2, 4, 6-Trichlorophenol
GC/MS	EPA 625; EPA 8270C/D	2, 4-Dichlorophenol
GC/MS	EPA 625; EPA 8270C/D	2, 4-Dimethylphenol
GC/MS	EPA 625; EPA 8270C/D	2, 4-Dinitrophenol

Non-Potable Water		
Technology	Method	Analyte
GC/MS	EPA 625; EPA 8270C/D	2, 4-Dinitrotoluene (2, 4-DNT)
GC/MS	EPA 8270C/D	2, 6-Dichlorophenol
GC/MS	EPA 625; EPA 8270C/D	2, 6-Dinitrotoluene (2, 6-DNT)
GC/MS	EPA 8270C/D	2-Acetylaminofluorene
GC/MS	EPA 625; EPA 8270C/D	2-Chloronaphthalene
GC/MS	EPA 625; EPA 8270C/D	2-Chlorophenol
GC/MS	EPA 625; EPA 8270C/D	2-Methyl-4 6-dinitrophenol
GC/MS	EPA 8270C/D	2-Methylnaphthalene
GC/MS	EPA 8270C/D	2-Methylphenol
GC/MS	EPA 8270C/D	2-Naphthylamine
GC/MS	EPA 8270C/D	2-Nitroaniline
GC/MS	EPA 625; EPA 8270C/D	2-Nitrophenol
GC/MS	EPA 8270C/D	2-Picoline
GC/MS	EPA 8270C/D	3-Methylcholanthrene
GC/MS	EPA 8270C/D	3-Nitroaniline
GC/MS	EPA 8270C/D	4-Aminobiphenyl
GC/MS	EPA 625; EPA 8270C/D	4-Bromophenyl phenyl ether
GC/MS	EPA 625; EPA 8270C/D	4-Chloro-3-methylphenol
GC/MS	EPA 8270C/D	4-Chloroaniline
GC/MS	EPA 625; EPA 8270C/D	4-Chlorophenyl phenylether
GC/MS	EPA 8270C/D	4-Dimethyl aminoazobenzene
GC/MS	EPA 8270C/D	3, 4-Methylphenol
GC/MS	EPA 8270C/D	4-Nitroaniline
GC/MS	EPA 625; EPA 8270C/D	4-Nitrophenol
GC/MS	EPA 8270C/D	4-Nitroquinoline-1-oxide
GC/MS	EPA 8270C/D	5-Nitro-o-toluidine
GC/MS	EPA 8270C/D	7, 12-Dimethylbenz(a)anthracene
GC/MS	EPA 8270C/D	a a-Dimethylphenethylamine
GC/MS	EPA 625; EPA 8270C/D	Acenaphthene
GC/MS	EPA 625; EPA 8270C/D	Acenaphthylene
GC/MS	EPA 8270C/D	Acetophenone

Non-Potable Water		
Technology	Method	Analyte
GC/MS	EPA 8270C/D	Aniline
GC/MS	EPA 625; EPA 8270C/D	Anthracene
GC/MS	EPA 8270C/D	Aramite
GC/MS	EPA 8270C/D	Atrazine
GC/MS	EPA 8270C/D	Azobenzene
GC/MS	EPA 8270C/D	Benzaldehyde
GC/MS	EPA 625; EPA 8270C/D	Benzidine
GC/MS	EPA 625; EPA 8270C/D	Benzo(a)anthracene
GC/MS	EPA 625; EPA 8270C/D	Benzo(a)pyrene
GC/MS	EPA 625; EPA 8270C/D	Benzo(b)fluoranthene
GC/MS	EPA 625; EPA 8270C/D	Benzo(g h i)perylene
GC/MS	EPA 625; EPA 8270C/D	Benzo(k)fluoranthene
GC/MS	EPA 8270C/D	Benzoic Acid
GC/MS	EPA 8270C/D	Benzyl alcohol
GC/MS	EPA 8270C/D	1,1-Biphenyl
GC/MS	EPA 625; EPA 8270C/D	bis(2-Chloroethoxy)methane
GC/MS	EPA 625; EPA 8270C/D	bis(2-Chloroethyl) ether
GC/MS	EPA 625; EPA 8270C/D	bis(2-Chloroisopropyl) ether (2, 2'-Oxybis(1-chloropropane)
GC/MS	EPA 625; EPA 8270C/D	bis(2-Ethylhexyl)adipate
GC/MS	EPA 625; EPA 8270C/D	bis(2-Ethylhexyl) phthalate (DEHP)
GC/MS	EPA 625; EPA 8270C/D	Butyl benzyl phthalate
GC/MS	EPA 8270C/D	Caprolactam
GC/MS	EPA 8270C/D	Carbazole
GC/MS	EPA 8270C/D	Chlorobenzilate
GC/MS	EPA 625; EPA 8270C/D	Chrysene
GC/MS	EPA 8270C/D	Diallate
GC/MS	EPA 8270C/D	Dibenzo(a,j)acridine
GC/MS	EPA 625; EPA 8270C/D	Dibenz(a h)anthracene
GC/MS	EPA 8270C/D	Dibenzofuran
GC/MS	EPA 8270C/D	Diethyladipate
GC/MS	EPA 625; EPA 8270C/D	Diethyl phthalate

Non-Potable Water		
Technology	Method	Analyte
GC/MS	EPA 8270C/D	Dimethoate
GC/MS	EPA 625; EPA 8270C/D	Dimethyl phthalate
GC/MS	EPA 625; EPA 8270C/D	Di-n-butyl phthalate
GC/MS	EPA 625; EPA 8270C/D	Di-n-octyl phthalate
GC/MS	EPA 8270C/D	Dinoseb
GC/MS	EPA 8270C/D	Disulfoton
GC/MS	EPA 8270C/D	Ethyl methanesulfonate
GC/MS	EPA 8270C/D	Ethyl parathion
GC/MS	EPA 8270C/D	Ethyl methacrylate
GC/MS	EPA 8270C/D	Famfur
GC/MS	EPA 625; EPA 8270C/D	Fluoranthene
GC/MS	EPA 625; EPA 8270C/D	Fluorene
GC/MS	EPA 625; EPA 8270C/D	Hexachlorobenzene
GC/MS	EPA 625; EPA 8270C/D	Hexachlorobutadiene
GC/MS	EPA 625; EPA 8270C/D	Hexachlorocyclopentadiene
GC/MS	EPA 625; EPA 8270C/D	Hexachloroethane
GC/MS	EPA 8270C/D	Hexachlorophene
GC/MS	EPA 8270C/D	Hexachloropropene
GC/MS	EPA 625; EPA 8270C/D	Indeno(1, 2, 3-cd)pyrene
GC/MS	EPA 8270C/D	Isodrin
GC/MS	EPA 625; EPA 8270C/D	Isophorone
GC/MS	EPA 8270C/D	Isosafrole
GC/MS	EPA 8270C/D	Kepone
GC/MS	EPA 8270C/D	Methapyriline
GC/MS	EPA 8270C/D	Methy methanesulfonate
GC/MS	EPA 8270C/D	Methyl parathion
GC/MS	EPA 625; EPA 8270C/D	Naphthalene
GC/MS	EPA 625; EPA 8270C/D	Nitrobenzene
GC/MS	EPA 8270C/D	Nitroquinoline-1-oxide
GC/MS	EPA 8270C/D	n-Nitrosodiethylamine
GC/MS	EPA 625; EPA 8270C/D	n-Nitrosodimethylamine

Non-Potable Water		
Technology	Method	Analyte
GC/MS	EPA 8270C/D	n-Nitroso-di-n-butylamine
GC/MS	EPA 625; EPA 8270C/D	n-Nitrosodi-n-propylamine
GC/MS	EPA 625; EPA 8270C/D	n-Nitrosodiphenylamine
GC/MS	EPA 8270C/D	n-Nitrosomethylethylamine
GC/MS	EPA 8270C/D	n-Nitrosomorpholine
GC/MS	EPA 8270C/D	n-Nitrosopiperidine
GC/MS	EPA 8270C/D	n-Nitrosopyrrolidine
GC/MS	EPA 8270C/D	O,O,O-Triethyl phosphorothioate
GC/MS	EPA 8270C/D	o,o-Diethyl o-2pyrazinyl phosphorothioate
GC/MS	EPA 8270C/D	o-Toluidine
GC/MS	EPA 8270C/D	Pentachlorobenzene
GC/MS	EPA 8270C/D	Pentachloronitrobenzene
GC/MS	EPA 625; EPA 8270C/D	Pentachlorophenol
GC/MS	EPA 8270C/D	Phenacetin
GC/MS	EPA 625; EPA 8270C/D	Phenanthrene
GC/MS	EPA 625; EPA 8270C/D	Phenol
GC/MS	EPA 8270C/D	Phorate
GC/MS	EPA 8270C/D	Pronamide
GC/MS	EPA 625; EPA 8270C/D	Pyrene
GC/MS	EPA 8270C/D	Pyridine
GC/MS	EPA 8270C/D	Safrole
GC/MS	EPA 8270C/D	Sulfotepp
GC/MS	EPA 8270C/D	Thionazin
GC/MS	EPA 625; EPA 8270C/D	3, 3'-Dichlorobenzidine
GC/MS	EPA 8270C/D	3, 3'-Dimethylbenzidine
GC/MS	EPA 8270C/D SIM	1,1'-Biphenyl
GC/MS	EPA 8270C/D SIM	1,2,4,5-Tetrachlorobenzene
GC/MS	EPA 8270C/D SIM	1,4-Dioxane
GC/MS	EPA 8270C/D SIM	1-Methylnaphthalene
GC/MS	EPA 8270C/D SIM	2,2'-Oxybis(1-chloropropane
GC/MS	EPA 8270C/D SIM	2,3,4,6-Tetrachlorophenol

Non-Potable Water		
Technology	Method	Analyte
GC/MS	EPA 8270C/D SIM	2,4,5-Trichlorophenol
GC/MS	EPA 8270C/D SIM	2,4,6-Trichlorophenol
GC/MS	EPA 8270C/D SIM	2,4-Dichlorophenol
GC/MS	EPA 8270C/D SIM	2,4-Dimethylphenol
GC/MS	EPA 8270C/D SIM	2,4-Dinitrophenol
GC/MS	EPA 8270C/D SIM	2,4-Dinitrotoluene
GC/MS	EPA 8270C/D SIM	2,6-Dinitrotoluene
GC/MS	EPA 8270C/D SIM	2-Chloronaphthalene
GC/MS	EPA 8270C/D SIM	2-Chlorophenol
GC/MS	EPA 8270C/D SIM	2-Methylnaphthalene
GC/MS	EPA 8270C/D SIM	2-Methylphenol
GC/MS	EPA 8270C/D SIM	2-Nitroaniline
GC/MS	EPA 8270C/D SIM	2-Nitrophenol
GC/MS	EPA 8270C/D SIM	3&4-Methylphenol
GC/MS	EPA 8270C/D SIM	3,3'-Dichlorobenzidine
GC/MS	EPA 8270C/D SIM	3-Nitroaniline
GC/MS	EPA 8270C/D SIM	4,6-Dinitro-2-methylphenol
GC/MS	EPA 8270C/D SIM	4-Bromophenyl-phenylether
GC/MS	EPA 8270C/D SIM	4-Chloro-3-methylphenol
GC/MS	EPA 8270C/D SIM	4-Chloroaniline
GC/MS	EPA 8270C/D SIM	4-Chlorophenyl-phenylether
GC/MS	EPA 8270C/D SIM	4-Nitroaniline
GC/MS	EPA 8270C/D SIM	4-Nitrophenol
GC/MS	EPA 8270C/D SIM	Acenaphthene
GC/MS	EPA 8270C/D SIM	Acenaphthylene
GC/MS	EPA 8270C/D SIM	Acetophenone
GC/MS	EPA 8270C/D SIM	Anthracene
GC/MS	EPA 8270C/D SIM	Atrazine
GC/MS	EPA 8270C/D SIM	Benzaldehyde
GC/MS	EPA 8270C/D SIM	Benzo(a)anthracene
GC/MS	EPA 8270C/D SIM	Benzo(a)pyrene

Non-Potable Water		
Technology	Method	Analyte
GC/MS	EPA 8270C/D SIM	Benzo(b)fluoranthene
GC/MS	EPA 8270C/D SIM	Benzo(g,h,i)perylene
GC/MS	EPA 8270C/D SIM	Benzo(k)fluoranthene
GC/MS	EPA 8270C/D SIM	Bis(2-chloroethoxy)methane
GC/MS	EPA 8270C/D SIM	Bis(2-chloroethyl)ether
GC/MS	EPA 8270C/D SIM	Bis(2-ethylhexyl)phthalate
GC/MS	EPA 8270C/D SIM	Butylbenzylphthalate
GC/MS	EPA 8270C/D SIM	Caprolactam
GC/MS	EPA 8270C/D SIM	Carbazole
GC/MS	EPA 8270C/D SIM	Chrysene
GC/MS	EPA 8270C/D SIM	Dibenzo(a,h)anthracene
GC/MS	EPA 8270C/D SIM	Dibenzofuran
GC/MS	EPA 8270C/D SIM	Diethylphthalate
GC/MS	EPA 8270C/D SIM	Dimethyl phthalate
GC/MS	EPA 8270C/D SIM	Di-n-butylphthalate
GC/MS	EPA 8270C/D SIM	Di-n-octylphthalate
GC/MS	EPA 8270C/D SIM	Fluoranthene
GC/MS	EPA 8270C/D SIM	Fluorene
GC/MS	EPA 8270C/D SIM	Hexachlorobenzene
GC/MS	EPA 8270C/D SIM	Hexachlorobutadiene
GC/MS	EPA 8270C/D SIM	Hexachlorocyclopentadiene
GC/MS	EPA 8270C/D SIM	Hexachloroethane
GC/MS	EPA 8270C/D SIM	Indeno(1,2,3-cd)pyrene
GC/MS	EPA 8270C/D SIM	Isophorone
GC/MS	EPA 8270C/D SIM	Naphthalene
GC/MS	EPA 8270C/D SIM	Nitrobenzene
GC/MS	EPA 8270C/D SIM	n-Nitroso-di-n-propylamine
GC/MS	EPA 8270C/D SIM	n-Nitrosodiphenylamine
GC/MS	EPA 8270C/D SIM	Pentachlorophenol
GC/MS	EPA 8270C/D SIM	Phenanthrene
GC/MS	EPA 8270C/D SIM	Phenol

Non-Potable Water		
Technology	Method	Analyte
GC/MS	EPA 8270C/D SIM	Pyrene
HPLC/UV	EPA 8330A/B	1, 3, 5-Trinitrobenzene
HPLC/UV	EPA 8330A/B	1, 3-Dinitrobenzene
HPLC/UV	EPA 8330A/B	2, 4, 6-Trinitrotoluene
HPLC/UV	EPA 8330A/B	2, 4-Dinitrotoluene
HPLC/UV	EPA 8330A/B	2, 6-Dinitrotoluene
HPLC/UV	EPA 8330A/B	2-Amino-4, 6 -Dinitrotoluene
HPLC/UV	EPA 8330A/B	2-Nitrotoluene
HPLC/UV	EPA 8330A/B	3-Nitrotoluene
HPLC/UV	EPA 8330A/B	3,5-Dinitroaniline
HPLC/UV	EPA 8330A/B	4-Amino-2, 6-Dinitrotoluene
HPLC/UV	EPA 8330A/B	4-Nitrotoluene
HPLC/UV	EPA 8330A/B	Ethylene glycol dinitrate (EGDN)
HPLC/UV	EPA 8330A/B	Hexahydro-1, 3, 5-trinitro-1, 3, 5-triazine (RDX)
HPLC/UV	EPA 8330A/B	Nitrobenzene
HPLC/UV	EPA 8330A MOD	Nitroglycerin
HPLC/UV	EPA 8330B	Nitroglycerin
HPLC/UV	EPA 8330A/B	Octahydro-1, 3, 5, 7-tetrazocine (HMX)
HPLC/UV	EPA 8330A/B	Pentaerythritol Tetranitrate (PETN)
HPLC/UV	EPA 8330A/B	Tetryl
CVAA	EPA 245.1; EPA 7470A	Mercury
CVAF	EPA 1631E	Low Level Mercury
ICP/AES	EPA 200.7; EPA 6010B/C	Aluminum
ICP/AES	EPA 200.7; EPA 6010B/C	Antimony
ICP/AES	EPA 200.7; EPA 6010B/C	Arsenic
ICP/AES	EPA 200.7; EPA 6010B/C	Barium
ICP/AES	EPA 200.7; EPA 6010B/C	Beryllium
ICP/AES	EPA 200.7; EPA 6010B/C	Boron
ICP/AES	EPA 200.7; EPA 6010B/C	Cadmium
ICP/AES	EPA 200.7; EPA 6010B/C	Calcium
ICP/AES	EPA 200.7; EPA 6010B/C	Chromium

Non-Potable Water		
Technology	Method	Analyte
ICP/AES	EPA 200.7; EPA 6010B/C	Cobalt
ICP/AES	EPA 200.7; EPA 6010B/C	Copper
ICP/AES	EPA 200.7; EPA 6010B/C	Iron
ICP/AES	EPA 200.7; EPA 6010B/C	Lead
ICP/AES	EPA 200.7; EPA 6010B/C	Magnesium
ICP/AES	EPA 200.7; EPA 6010B/C	Manganese
ICP/AES	EPA 200.7; EPA 6010B/C	Molybdenum
ICP/AES	EPA 200.7; EPA 6010B/C	Nickel
ICP/AES	EPA 200.7; EPA 6010B/C	Potassium
ICP/AES	EPA 200.7; EPA 6010B/C	Selenium
ICP/AES	EPA 200.7; EPA 6010B/C	Silicon
ICP/AES	EPA 200.7; EPA 6010B/C	Silver
ICP/AES	EPA 200.7; EPA 6010B/C	Sodium
ICP/AES	EPA 6010B/C	Strontium
ICP/AES	EPA 200.7; EPA 6010B/C	Thallium
ICP/AES	EPA 200.7; EPA 6010B/C	Tin
ICP/AES	EPA 200.7; EPA 6010B/C	Titanium
ICP/AES	EPA 200.7; EPA 6010B/C	Vanadium
ICP/AES	EPA 200.7; EPA 6010B/C	Zinc
ICP/MS	EPA 200.8; EPA 6020A	Aluminum
ICP/MS	EPA 200.8; EPA 6020A	Antimony
ICP/MS	EPA 200.8; EPA 6020A	Arsenic
ICP/MS	EPA 200.8; EPA 6020A	Barium
ICP/MS	EPA 200.8; EPA 6020A	Beryllium
ICP/MS	EPA 200.8; EPA 6020A	Boron
ICP/MS	EPA 200.8; EPA 6020A	Cadmium
ICP/MS	EPA 200.8; EPA 6020A	Calcium
ICP/MS	EPA 200.8; EPA 6020A	Chromium
ICP/MS	EPA 200.8; EPA 6020A	Cobalt
ICP/MS	EPA 200.8; EPA 6020A	Copper
ICP/MS	EPA 200.8; EPA 6020A	Iron

Non-Potable Water		
Technology	Method	Analyte
ICP/MS	EPA 200.8; EPA 6020A	Lead
ICP/MS	EPA 200.8; EPA 6020A	Magnesium
ICP/MS	EPA 200.8; EPA 6020A	Manganese
ICP/MS	EPA 200.8; EPA 6020A	Molybdenum
ICP/MS	EPA 200.8; EPA 6020A	Nickel
ICP/MS	EPA 200.8; EPA 6020A	Potassium
ICP/MS	EPA 200.8; EPA 6020A	Selenium
ICP/MS	EPA 200.8; EPA 6020A	Silicon
ICP/MS	EPA 200.8; EPA 6020A	Silver
ICP/MS	EPA 200.8; EPA 6020A	Sodium
ICP/MS	EPA 6020A	Strontium
ICP/MS	EPA 200.8; EPA 6020A	Thallium
ICP/MS	EPA 200.8; EPA 6020A	Tin
ICP/MS	EPA 200.8; EPA 6020A	Titanium
ICP/MS	EPA 200.8; EPA 6020A	Tungsten
ICP/MS	EPA 200.8	Uranium
ICP/MS	EPA 200.8; EPA 6020A	Vanadium
ICP/MS	EPA 200.8; EPA 6020A	Zinc
IC	EPA 300.0; EPA 9056A	Bromide
IC	EPA 300.0; EPA 9056A	Chloride
IC	EPA 300.0; EPA 9056A	Fluoride
IC	EPA 300.0; EPA 9056A	Nitrate as N
IC	EPA 300.0; EPA 9056A	Nitrite as N
IC	EPA 300.0; EPA 9056A	Nitrate + Nitrite
IC	EPA 300.0; EPA 9056A	Orthophosphate as P
IC	EPA 300.0; EPA 9056A	Sulfate
IC	SOP CA-776	Lactic Acid
IC	SOP CA-776	Acetic Acid
IC	SOP CA-776	Propionic Acid
IC	SOP CA-776	Formic Acid
IC	SOP CA-776	Butyric Acid

Non-Potable Water		
Technology	Method	Analyte
IC	SOP CA-776	Pyruvic Acid
IC	SOP CA-776	i-Pentanoic Acid
IC	SOP CA-776	Pentanoic Acid
IC	SOP CA-776	i-Hexanoic Acid
IC	SOP CA-776	Hexanoic Acid
Titration	EPA 310.1; SM 2320B	Alkalinity
Calculation	SM 2340B	Hardness
Gravimetric	EPA 1664A; EPA 9070A	Oil and Grease, Oil and Grease with SGT
Gravimetric	SM 2540B/C/D	Solids
ISE	EPA 120.1; SM 2510B	Conductivity
ISE	SM 2520B	Practical Salinity
ISE	SM 4500F- C	Fluoride
ISE	SM 4500H+ B	pH
ISE	SM 5210B	TBOD / CBOD
Physical	EPA 1010A	Ignitability
Physical	EPA 9040C	pH
Titration	SM 2340C	Hardness
Titration	SM 4500SO ₃ B	Sulfite
Titration	EPA 9034; SM 4500S ²⁻ F	Sulfide
Titration	EPA SW-846 Chapter 7.3.4	Reactive Sulfide
IR	EPA 9060A; SM 5310B	Total organic carbon
Turbidimetric	EPA 180.1; SM 2130B	Turbidity
Turbidimetric	EPA 9038; ASTM 516-02	Sulfate
UV/VIS	EPA 335.4; EPA 9012B; SM 4500-CN G	Amenable cyanide
UV/VIS	EPA 350.1; SM 4500NH ₃ H	Ammonia as N
UV/VIS	SM 3500Fe D	Ferrous Iron
UV/VIS	EPA 351.2	Kjeldahl nitrogen - total
UV/VIS	EPA 353.2; SM 4500NO ₃ F	Nitrate + Nitrite
UV/VIS	EPA 353.2; SM 4500NO ₃ F	Nitrate as N
UV/VIS	EPA 353.2; SM 4500NO ₃ F	Nitrite as N
UV/VIS	EPA 365.2; SM 4500P E	Orthophosphate as P

Non-Potable Water		
Technology	Method	Analyte
UV/VIS	EPA 365.4	Phosphorus total
UV/VIS	EPA 821/R-91-100	AVS-SEM
UV/VIS	EPA 410.4	COD
UV/VIS	EPA 420.1; EPA 9065	Total Phenolics
UV/VIS	SM 4500Cl G	Total Residual Chlorine
UV/VIS	SM 5540C	MBAS
UV/VIS	EPA 7196A; SM 3500-Cr D	Chromium VI
UV/VIS	EPA 9012B; EPA 335.4	Total Cyanide
UV/VIS	EPA 9251; SM 4500Cl E	Chloride
UV/VIS	EPA SW-846 Chapter 7.3.4	Reactive Cyanide

Preparation	Method	Type
Cleanup Methods	EPA 3640A	Gel Permeation Clean-up
Cleanup Methods	EPA 3630C	Silica Gel
Cleanup Methods	EPA 3660B	Sulfur Clean-Up
Cleanup Methods	EPA 3665A	Sulfuric Acid Clean-Up
Organic Preparation	EPA 3510C	Separatory Funnel Extraction
Organic Preparation	EPA 3520C	Continuous Liquid-Liquid Extraction
Inorganic Preparation	EPA 3010A	Hotblock
Volatile Organic Preparation	EPA 5030C	Purge and Trap

Solid and Chemical Waste		
Technology	Method	Analyte
GC/ECD	EPA 8081B	2,4'-DDD
GC/ECD	EPA 8081B	2,4'-DDE
GC/ECD	EPA 8081B	2,4'-DDT
GC/ECD	EPA 8081B	4, 4'-DDD
GC/ECD	EPA 8081B	4, 4'-DDE
GC/ECD	EPA 8081B	4, 4'-DDT
GC/ECD	EPA 8081B	Aldrin

Solid and Chemical Waste		
Technology	Method	Analyte
GC/ECD	EPA 8081B	alpha-BHC (alpha-Hexachlorocyclohexane)
GC/ECD	EPA 8081B	Alpha-Chlordane
GC/ECD	EPA 8081B	beta-BHC (beta-Hexachlorocyclohexane)
GC/ECD	EPA 608; EPA 8081B	Chlordane (tech.)
GC/ECD	EPA 8081B	Cis-Nonachlor
GC/ECD	EPA 8081B	delta-BHC
GC/ECD	EPA 8081B	Dieldrin
GC/ECD	EPA 8081B	Endosulfan I
GC/ECD	EPA 8081B	Endosulfan II
GC/ECD	EPA 8081B	Endosulfan sulfate
GC/ECD	EPA 8081B	Endrin
GC/ECD	EPA 8081B	Endrin aldehyde
GC/ECD	EPA 8081B	Endrin Ketone
GC/ECD	EPA 8081B	gamma-BHC (Lindane gamma-Hexachlorocyclohexane)
GC/ECD	EPA 8081B	gamma-Chlordane
GC/ECD	EPA 8081B	Heptachlor
GC/ECD	EPA 8081B	Heptachlor epoxide
GC/ECD	EPA 8081B	Hexachlorobenzene
GC/ECD	EPA 8081B	Methoxychlor
GC/ECD	EPA 8081B	Mirex
GC/ECD	EPA 8081B	Oxychlordane
GC/ECD	EPA 8081B	Toxaphene (Chlorinated camphene)
GC/ECD	EPA 8081B	Trans-Nonachlor
GC/ECD	EPA 8082A	Aroclor-1016 (PCB-1016)
GC/ECD	EPA 8082A	Aroclor-1221 (PCB-1221)
GC/ECD	EPA 8082A	Aroclor-1232 (PCB-1232)
GC/ECD	EPA 8082A	Aroclor-1242 (PCB-1242)
GC/ECD	EPA 8082A	Aroclor-1248 (PCB-1248)
GC/ECD	EPA 8082A	Aroclor-1254 (PCB-1254)
GC/ECD	EPA 8082A	Aroclor-1260 (PCB-1260)
GC/ECD	EPA 8082A MOD	Aroclor-1262 (PCB-1262)

Solid and Chemical Waste		
Technology	Method	Analyte
GC/ECD	EPA 8082A MOD	Aroclor-1268 (PCB-1268)
GC/ECD	EPA 8082A	2, 2', 3, 3', 4, 4', 5, 5', 6-Nonachlorobiphenyl (BZ 206)
GC/ECD	EPA 8082A	2, 2', 3, 3', 4, 4', 5, 6-Octachlorobiphenyl (BZ 195)
GC/ECD	EPA 8082A	2, 2', 3, 3', 4, 4', 5-Heptachlorobiphenyl (BZ 170)
GC/ECD	EPA 8082A	2, 2', 3, 3', 4, 4'-Hexachlorobiphenyl (BZ 128)
GC/ECD	EPA 8082A	2, 2', 3, 4, 4', 5, 5'-Heptachlorobiphenyl (BZ 180)
GC/ECD	EPA 8082A	2, 2', 3, 4, 4', 5', 6-Heptachlorobiphenyl (BZ 183)
GC/ECD	EPA 8082A	2, 2', 3, 4, 4', 5-Hexachlorobiphenyl (BZ 138)
GC/ECD	EPA 8082A	2, 2', 3, 4, 4', 6, 6'-Heptachlorobiphenyl (BZ 184)
GC/ECD	EPA 8082A	2, 2', 3, 4', 5, 5', 6-Heptachlorobiphenyl (BZ 187)
GC/ECD	EPA 8082A	2, 2', 3, 4, 5'-Pentachlorobiphenyl (BZ 87)
GC/ECD	EPA 8082A	2, 2', 3, 5'-Tetrachlorobiphenyl (BZ 44)
GC/ECD	EPA 8082A	2, 2', 4, 4', 5, 5'-Hexachlorobiphenyl (BZ 153)
GC/ECD	EPA 8082A	2, 2', 4, 5, 5'-Pentachlorobiphenyl (BZ 101)
GC/ECD	EPA 8082A	2, 2', 4, 5-Tetrachlorobiphenyl (BZ 48)
GC/ECD	EPA 8082A	2, 2', 4, 5'-Tetrachlorobiphenyl (BZ 49)
GC/ECD	EPA 8082A	2, 2', 5, 5'-Tetrachlorobiphenyl (BZ 52)
GC/ECD	EPA 8082A	2, 2', 5-Trichlorobiphenyl (BZ 18)
GC/ECD	EPA 8082A	2, 3, 3', 4, 4', 5-Hexachlorobiphenyl (BZ 156)
GC/ECD	EPA 8082A	2, 3, 3', 4, 4', 5'-Hexachlorobiphenyl (BZ 157)
GC/ECD	EPA 8082A	2, 3, 3', 4, 4'-Pentachlorobiphenyl (BZ 105)
GC/ECD	EPA 8082A	2, 3, 3', 4, 4', 5, 5'-Heptachlorobiphenyl (BZ 189)
GC/ECD	EPA 8082A	2, 3', 4, 4', 5, 5'-Hexachlorobiphenyl (BZ 167)
GC/ECD	EPA 8082A	2, 3', 4, 4', 5-Pentachlorobiphenyl (BZ 118)
GC/ECD	EPA 8082A	2, 3', 4, 4',5'-Pentachlorobiphenyl (BZ 123)
GC/ECD	EPA 8082A	2, 3', 4, 4'-Tetrachlorobiphenyl (BZ 66)
GC/ECD	EPA 8082A	2, 3, 4, 4', 5-Pentachlorobiphenyl (BZ 114)
GC/ECD	EPA 8082A	2, 4, 4'-Trichlorobiphenyl (BZ 28)
GC/ECD	EPA 8082A	2, 4'-Dichlorobiphenyl (BZ 8)
GC/ECD	EPA 8082A	3, 3', 4, 4', 5, 5'-Hexachlorobiphenyl (BZ 169)
GC/ECD	EPA 8082A	3, 3', 4, 4', 5-Pentachlorobiphenyl (BZ 126)

Solid and Chemical Waste		
Technology	Method	Analyte
GC/ECD	EPA 8082A	3, 3', 4, 4'-Tetrachlorobiphenyl (BZ 77)
GC/ECD	EPA 8082A	3, 4, 4', 5-Tetrachlorobiphenyl (BZ 81)
GC/ECD	EPA 8082A	Decachlorobiphenyl (BZ 209)
GC/ECD	EPA 8151A	2, 4, 5-T
GC/ECD	EPA 8151A	2, 4-D
GC/ECD	EPA 8151A	2, 4-DB
GC/ECD	EPA 8151A	Dalapon
GC/ECD	EPA 8151A	Dicamba
GC/ECD	EPA 8151A	Dichloroprop
GC/ECD	EPA 8151A	Dinoseb
GC/ECD	EPA 8151A	MCPA
GC/ECD	EPA 8151A	MCPP
GC/ECD	EPA 8151A	Pentachlorophenol
GC/ECD	EPA 8151A	Silvex (2, 4, 5-TP)
GC/FID	EPA 8015C/D	Diesel range organics (DRO)
GC/FID	EPA 8015C/D	Total Petroleum Hydrocarbons (TPH)
GC/FID	EPA 8015C/D	Gasoline range organics (GRO)
GC/FID/PID	MA DEP VPH	Volatile Organic Hydrocarbons
GC/FID	MA DEP EPH	Extractable Petroleum Hydrocarbons
GC/FID	MA DEP EPH EPA 3546	Extractable Petroleum Hydrocarbons Microwave Extraction Preparation
GC/FID	CT-ETPH	Total Petroleum Hydrocarbons
GC/FID	TNRCC Method 1005	Total Petroleum Hydrocarbons
GC/FID	FL-PRO	Petroleum Range Organics
GC/ECD	EPA 8011	1, 2-Dibromoethane (EDB)
GC/ECD	EPA 8011	1, 2-Dibromo-3-chloropropane
GC/MS	EPA 8260B/C	1, 1, 1, 2-Tetrachloroethane
GC/MS	EPA 8260B/C	1,1,2-Trichloro-1,2,2-trifluoroethane
GC/MS	EPA 8260B/C	1, 1, 1-Trichloroethane
GC/MS	EPA 8260B/C	1, 1, 2, 2-Tetrachloroethane
GC/MS	EPA 8260B/C	1, 1, 2-Trichloroethane
GC/MS	EPA 8260B/C	1, 1-Dichloroethane

Solid and Chemical Waste		
Technology	Method	Analyte
GC/MS	EPA 8260B/C	1, 1-Dichloroethylene
GC/MS	EPA 8260B/C	1, 1-Dichloropropene
GC/MS	EPA 8260B/C	1, 2, 3-Trichlorobenzene
GC/MS	EPA 8260B/C	1, 2, 3-Trichloropropane
GC/MS	EPA 8260B/C	1,2,3-Trimethylbenzene
GC/MS	EPA 8260B/C	1, 2, 4-Trichlorobenzene
GC/MS	EPA 8260B/C	1, 2, 4-Trimethylbenzene
GC/MS	EPA 8260B/C	1, 2-Dibromo-3-chloropropane
GC/MS	EPA 8260B/C	1, 2-Dibromoethane
GC/MS	EPA 8260B/C	1, 2-Dichlorobenzene
GC/MS	EPA 8260B/C	1, 2-Dichloroethane
GC/MS	EPA 8260B/C	1, 2-Dichloropropane
GC/MS	EPA 8260B/C	1,3,5-Trichlorobenzene
GC/MS	EPA 8260B/C	1, 3, 5-Trimethylbenzene
GC/MS	EPA 8260B/C	1, 3-Dichlorobenzene
GC/MS	EPA 8260B/C	1, 3-Dichloropropane
GC/MS	EPA 8260B/C	1, 4-Dichlorobenzene
GC/MS	EPA 8260B/C	1, 4-Dioxane
GC/MS	EPA 8260B/C	1-Chlorohexane
GC/MS	EPA 8260B/C	2, 2-Dichloropropane
GC/MS	EPA 8260B/C	2-Butanone
GC/MS	EPA 8260B/C	2-Chloroethyl vinyl ether
GC/MS	EPA 8260B/C	2-Chlorotoluene
GC/MS	EPA 8260B/C	2-Hexanone
GC/MS	EPA 8260B/C	4-Chlorotoluene
GC/MS	EPA 8260B/C	4-Methyl-2-pentanone
GC/MS	EPA 8260B/C	Acetone
GC/MS	EPA 8260B/C	Acetonitrile
GC/MS	EPA 8260B/C	Acrolein
GC/MS	EPA 8260B/C	Acrylonitrile
GC/MS	EPA 8260B/C	Allyl chloride

Solid and Chemical Waste		
Technology	Method	Analyte
GC/MS	EPA 8260B/C	Benzene
GC/MS	EPA 8260B/C	Benzyl chloride
GC/MS	EPA 8260B/C	Bromobenzene
GC/MS	EPA 8260B/C	Bromochloromethane
GC/MS	EPA 8260B/C	Bromodichloromethane
GC/MS	EPA 8260B/C	Bromoform
GC/MS	EPA 8260B/C	Carbon disulfide
GC/MS	EPA 8260B/C	Carbon tetrachloride
GC/MS	EPA 8260B/C	Chlorobenzene
GC/MS	EPA 8260B/C	Chloroethane
GC/MS	EPA 8260B/C	Chloroform
GC/MS	EPA 8260B/C	Chloroprene
GC/MS	EPA 8260B/C	cis-1, 2-Dichloroethene
GC/MS	EPA 8260B/C	cis-1, 3-Dichloropropene
GC/MS	EPA 8260B/C	cis-1,3-Dichloro-2-butene
GC/MS	EPA 8260B/C	Cyclohexane
GC/MS	EPA 8260B/C	Dibromochloromethane
GC/MS	EPA 8260B/C	Dibromomethane
GC/MS	EPA 8260B/C	Dichlorodifluoromethane
GC/MS	EPA 8260B/C	Diethyl ether
GC/MS	EPA 8260B/C	Di-isopropylether
GC/MS	EPA 8260B/C	1,2-Dibromoethane (EDB)
GC/MS	EPA 8260B/C	Ethyl methacrylate
GC/MS	EPA 8260B/C	Ethylbenzene
GC/MS	EPA 8260B/C	Ethyl-t-butylether
GC/MS	EPA 8260B/C	Hexachlorobutadiene
GC/MS	EPA 8260B/C	Iodomethane
GC/MS	EPA 8260B/C	Isobutyl alcohol
GC/MS	EPA 8260B/C	Isopropyl alcohol
GC/MS	EPA 8260B/C	Isopropyl benzene
GC/MS	EPA 8260B/C	m p-xylenes

Solid and Chemical Waste		
Technology	Method	Analyte
GC/MS	EPA 8260B, C	Methyl acetate
GC/MS	EPA 8260B/C	Methacrylonitrile
GC/MS	EPA 8260B/C	Methyl bromide (Bromomethane)
GC/MS	EPA 8260B/C	Methyl chloride (Chloromethane)
GC/MS	EPA 8260B/C	Methyl methacrylate
GC/MS	EPA 8260B/C	Methyl tert-butyl ether
GC/MS	EPA 8260B/C	Methylcyclohexane
GC/MS	EPA 8260B/C	Methylene chloride
GC/MS	EPA 8260B/C	Naphthalene
GC/MS	EPA 8260B/C	n-Butylbenzene
GC/MS	EPA 8260B/C	n-propylbenzene
GC/MS	EPA 8260B/C	o-Xylene
GC/MS	EPA 8260B/C	pentachloroethane
GC/MS	EPA 8260B/C	p-Isopropyltoluene
GC/MS	EPA 8260B/C	Propionitrile
GC/MS	EPA 8260B/C	sec-butylbenzene
GC/MS	EPA 8260B/C	Styrene
GC/MS	EPA 8260B/C	t-Amylmethylether
GC/MS	EPA 8260B/C	tert-Butyl alcohol
GC/MS	EPA 8260B/C	tert-Butylbenzene
GC/MS	EPA 8260B/C	Tetrachloroethylene (Perchloroethylene)
GC/MS	EPA 8260B/C	Tetrahydrofuran
GC/MS	EPA 8260B/C	Toluene
GC/MS	EPA 8260B/C	trans-1, 2-Dichloroethylene
GC/MS	EPA 8260B/C	trans-1, 3-Dichloropropylene
GC/MS	EPA 8260B/C	Trans-1, 4-Dichloro-2-butene
GC/MS	EPA 8260B/C	Trichloroethene (Trichloroethylene)
GC/MS	EPA 8260B/C	Trichlorofluoromethane
GC/MS	EPA 8260B/C	Vinyl acetate
GC/MS	EPA 8260B/C	Vinyl chloride
GC/MS	EPA 8260B/C	Xylene

Solid and Chemical Waste		
Technology	Method	Analyte
GC/MS	EPA 8260B/C SIM	1,1,1,2-Tetrachloroethane
GC/MS	EPA 8260B/C SIM	1,1,1-Trichloroethane
GC/MS	EPA 8260B/C SIM	1,1,2,2-Tetrachloroethane
GC/MS	EPA 8260B/C SIM	1, 1, 2-Trichloroethane
GC/MS	EPA 8260B/C SIM	1,2,3-Trichloropropane
GC/MS	EPA 8260B/C SIM	1,1-Dichloroethane
GC/MS	EPA 8260B/C SIM	1,1-Dichloroethene
GC/MS	EPA 8260B/C SIM	1,2,4-Trichlorobenzene
GC/MS	EPA 8260B/C SIM	1,2,4-Trimethylbenzene
GC/MS	EPA 8260B/C SIM	1,2-Dibromo-3-chloropropane
GC/MS	EPA 8260B/C SIM	1,2-Dibromoethane
GC/MS	EPA 8260B/C SIM	1,2-Dichlorobenzene
GC/MS	EPA 8260B/C SIM	1,2-Dichloroethane
GC/MS	EPA 8260B/C SIM	1,2-Dichloropropane
GC/MS	EPA 8260B/C SIM	1,3-Dichlorobenzene
GC/MS	EPA 8260B/C SIM	1,3-Dichloropropane
GC/MS	EPA 8260B/C SIM	1,4-Dichlorobenzene
GC/MS	EPA 8260B/C SIM	2-Hexanone
GC/MS	EPA 8260B/C SIM	4-Methyl-2-pentanone
GC/MS	EPA 8260B/C SIM	Benzene
GC/MS	EPA 8260B/C SIM	Bromodichloromethane
GC/MS	EPA 8260B/C SIM	Carbon Tetrachloride
GC/MS	EPA 8260B/C SIM	Chloroform
GC/MS	EPA 8260B/C SIM	Chloromethane
GC/MS	EPA 8260B/C SIM	cis-1,2-Dichloroethene
GC/MS	EPA 8260B/C SIM	cis-1,3-Dichloropropene
GC/MS	EPA 8260B/C SIM	Dibromochloromethane
GC/MS	EPA 8260B/C SIM	Ethylbenzene
GC/MS	EPA 8260B/C SIM	Isopropylbenzene
GC/MS	EPA 8260B/C SIM	Hexachlorobutadiene
GC/MS	EPA 8260B/C SIM	Methylcyclohexane

Solid and Chemical Waste		
Technology	Method	Analyte
GC/MS	EPA 8260B/C SIM	m,p-Xylene
GC/MS	EPA 8260B/C SIM	o-Xylene
GC/MS	EPA 8260B/C SIM	Tetrachloroethene
GC/MS	EPA 8260B/C SIM	trans-1,2-Dichloroethene
GC/MS	EPA 8260B/C SIM	Trans-1,3-Dichloropropene
GC/MS	EPA 8260B/C SIM	Trichloroethene
GC/MS	EPA 8260B/C SIM	Trichlorofluoromethane
GC/MS	EPA 8260B/C SIM	Vinyl Chloride
GC/MS	EPA 8260B/C SIM	Xylenes (total)
GC/MS	EPA 8270C/D	1, 2, 4, 5-Tetrachlorobenzene
GC/MS	EPA 8270C/D	1, 2, 4-Trichlorobenzene
GC/MS	EPA 8270C/D	1, 2-Dichlorobenzene
GC/MS	EPA 8270C/D	1, 2-Diphenylhydrazine
GC/MS	EPA 8270C/D	1, 3, 5-Trinitrobenzene
GC/MS	EPA 8270C/D	1, 3-Dichlorobenzene
GC/MS	EPA 8270C/D	1, 3-Dinitrobenzene
GC/MS	EPA 8270C/D	1, 4-Dichlorobenzene
GC/MS	EPA 8270C/D	1, 4-Dioxane
GC/MS	EPA 8270C/D	1, 4-Naphthoquinone
GC/MS	EPA 8270C/D	1, 4-Phenylenediamine
GC/MS	EPA 8270C/D	1,1-Biphenyl
GC/MS	EPA 8270C/D	1-Chloronaphthalene
GC/MS	EPA 8270C/D	1-Methylnaphthalene
GC/MS	EPA 8270C/D	1-Naphthylamine
GC/MS	EPA 8270C/D	2, 3, 4, 6-Tetrachlorophenol
GC/MS	EPA 8270C/D	2, 4, 5-Trochlorophenol
GC/MS	EPA 8270C/D	2, 4, 6-Trichlorophenol
GC/MS	EPA 8270C/D	2, 4-Dichlorophenol
GC/MS	EPA 8270C/D	2, 4-Dimethylphenol
GC/MS	EPA 8270C/D	2, 4-Dinitrophenol
GC/MS	EPA 8270C/D	2, 4-Dinitrotoluene (2 4-DNT)

Solid and Chemical Waste		
Technology	Method	Analyte
GC/MS	EPA 8270C/D	2, 6-Dichlorophenol
GC/MS	EPA 8270C/D	2, 6-Dinitrotoluene (2 6-DNT)
GC/MS	EPA 8270C/D	2-Acetylaminofluorene
GC/MS	EPA 8270C/D	2-Chloronaphthalene
GC/MS	EPA 8270C/D	2-Chlorophenol
GC/MS	EPA 8270C/D	2-Methyl-4, 6-dinitrophenol
GC/MS	EPA 8270C/D	2-Methylnaphthalene
GC/MS	EPA 8270C/D	2-Methylphenol
GC/MS	EPA 8270C/D	2-Naphthylamine
GC/MS	EPA 8270C/D	2-Nitroaniline
GC/MS	EPA 8270C/D	2-Nitrophenol
GC/MS	EPA 8270C/D	2-Picoline
GC/MS	EPA 8270C/D	3, 3'-Dichlorobenzidine
GC/MS	EPA 8270C/D	3, 3'-Dimethylbenzidine
GC/MS	EPA 8270C/D	3,4-Methylphenol
GC/MS	EPA 8270C/D	3-Methylcholanthrene
GC/MS	EPA 8270C/D	3-Nitroaniline
GC/MS	EPA 8270C/D	4-Aminobiphenyl
GC/MS	EPA 8270C/D	4-Bromophenyl phenyl ether
GC/MS	EPA 8270C/D	4-Chloro-3-methylphenol
GC/MS	EPA 8270C/D	4-Chloroaniline
GC/MS	EPA 8270C/D	4-Chlorophenyl phenylether
GC/MS	EPA 8270C/D	4-Dimethyl aminoazobenzene
GC/MS	EPA 8270C/D	4-Nitroaniline
GC/MS	EPA 8270C/D	4-Nitrophenol
GC/MS	EPA 8270C/D	4-Nitroquinoline-1-oxide
GC/MS	EPA 8270C/D	5-Nitro-o-toluidine
GC/MS	EPA 8270C/D	7,12-Dimethylbenz(a)anthracene
GC/MS	EPA 8270C/D	a a-Dimethylphenethylamine
GC/MS	EPA 8270C/D	Acenaphthene
GC/MS	EPA 8270C/D	Acenaphthylene

Solid and Chemical Waste		
Technology	Method	Analyte
GC/MS	EPA 8270C/D	Acetophenone
GC/MS	EPA 8270C/D	Aniline
GC/MS	EPA 8270C/D	Anthracene
GC/MS	EPA 8270C/D	Aramite
GC/MS	EPA 8270C/D	Atrazine
GC/MS	EPA 8270C/D	Azobenzene
GC/MS	EPA 8270C/D	Benzaldehyde
GC/MS	EPA 8270C/D	Benzidine
GC/MS	EPA 8270C/D	Benzo(a)anthracene
GC/MS	EPA 8270C/D	Benzo(a)pyrene
GC/MS	EPA 8270C/D	Benzo(b)fluoranthene
GC/MS	EPA 8270C/D	Benzo(g h i)perylene
GC/MS	EPA 8270C/D	Benzo(k)fluoranthene
GC/MS	EPA 8270C/D	Benzoic Acid
GC/MS	EPA 8270C/D	Benzyl alcohol
GC/MS	EPA 8270C/D	bis(2-Chloroethoxy)methane
GC/MS	EPA 8270C/D	bis(2-Chloroethyl) ether
GC/MS	EPA 8270C/D	bis(2-Chloroisopropyl) ether (2, 2'-Oxybis(1-chloropropane))
GC/MS	EPA 8270C/D	bis(2-Ethylhexyl) phthalate (DEHP)
GC/MS	EPA 625; EPA 8270C/D	Bis(2-Ethylhexyl)adipate
GC/MS	EPA 8270C/D	Butyl benzyl phthalate
GC/MS	EPA 8270C/D	Caprolactam
GC/MS	EPA 8270C/D	Carbazole
GC/MS	EPA 8270C/D	Chlorobenzilate
GC/MS	EPA 8270C/D	Chrysene
GC/MS	EPA 8270C/D	Diallate
GC/MS	EPA 8270C/D	Dibenz(a h)anthracene
GC/MS	EPA 8270C/D	Dibenzo(a,j)acridine
GC/MS	EPA 8270C/D	Dibenzofuran
GC/MS	EPA 8270C/D	Diethyl phthalate
GC/MS	EPA 8270C/D	Diethyladipate

Solid and Chemical Waste		
Technology	Method	Analyte
GC/MS	EPA 8270C/D	Dimethoate
GC/MS	EPA 8270C/D	Dimethyl phthalate
GC/MS	EPA 8270C/D	Di-n-butyl phthalate
GC/MS	EPA 8270C/D	Di-n-octyl phthalate
GC/MS	EPA 8270C/D	Dinoseb
GC/MS	EPA 8270C/D	Disulfoton
GC/MS	EPA 8270C/D	Ethyl methacrylate
GC/MS	EPA 8270C/D	Ethyl methanesulfonate
GC/MS	EPA 8270C/D	Ethyl parathion
GC/MS	EPA 8270C/D	Famfur
GC/MS	EPA 8270C/D	Fluoranthene
GC/MS	EPA 8270C/D	Fluorene
GC/MS	EPA 8270C/D	Hexachlorobenzene
GC/MS	EPA 8270C/D	Hexachlorobutadiene
GC/MS	EPA 8270C/D	Hexachlorocyclopentadiene
GC/MS	EPA 8270C/D	Hexachloroethane
GC/MS	EPA 8270C/D	Hexachlorophene
GC/MS	EPA 8270C/D	Hexachloropropene
GC/MS	EPA 8270C/D	Indeno(1, 2, 3-cd)pyrene
GC/MS	EPA 8270C/D	Isodrin
GC/MS	EPA 8270C/D	Isophorone
GC/MS	EPA 8270C/D	Isosafrole
GC/MS	EPA 8270C/D	Kepone
GC/MS	EPA 8270C/D	Methapyriline
GC/MS	EPA 8270C/D	Methyl methanesulfonate
GC/MS	EPA 8270C/D	Methyl parathion
GC/MS	EPA 8270C/D	Naphthalene
GC/MS	EPA 8270C/D	Nitrobenzene
GC/MS	EPA 8270C/D	n-Nitrosodiethylamine
GC/MS	EPA 8270C/D	n-Nitrosodimethylamine
GC/MS	EPA 8270C/D	n-Nitroso-di-n-butylamine

Solid and Chemical Waste		
Technology	Method	Analyte
GC/MS	EPA 8270C/D	n-Nitrosodi-n-propylamine
GC/MS	EPA 8270C/D	n-Nitrosodiphenylamine
GC/MS	EPA 8270C/D	n-Nitrosomethylethylamine
GC/MS	EPA 8270C/D	n-Nitrosomorpholine
GC/MS	EPA 8270C/D	n-Nitrosopiperidine
GC/MS	EPA 8270C/D	n-Nitrosopyrrolidine
GC/MS	EPA 8270C/D	O, O, O-Triethyl phosphorothioate
GC/MS	EPA 8270C/D	o,o-Diethyl o-2-pyrazinyl phosphorothioate
GC/MS	EPA 8270C/D	o-Toluidine
GC/MS	EPA 8270C/D	Pentachlorobenzene
GC/MS	EPA 8270C/D	Pentachloronitrobenzene
GC/MS	EPA 8270C/D	Pentachlorophenol
GC/MS	EPA 8270C/D	Phenacetin
GC/MS	EPA 8270C/D	Phenanthrene
GC/MS	EPA 8270C/D	Phenol
GC/MS	EPA 8270C/D	Phorate
GC/MS	EPA 8270C/D	Pronamide
GC/MS	EPA 8270C/D	Pyrene
GC/MS	EPA 8270C/D	Pyridine
GC/MS	EPA 8270C/D	Safrole
GC/MS	EPA 8270C/D	Sulfotepp
GC/MS	EPA 8270C/D	Thionazin
GC/MS	EPA 8270C/D SIM	1,1'-Biphenyl
GC/MS	EPA 8270C/D SIM	1,2,4,5-Tetrachlorobenzene
GC/MS	EPA 8270C/D SIM	1,4-Dioxane
GC/MS	EPA 8270C/D SIM	1-Methylnaphthalene
GC/MS	EPA 8270C/D SIM	2,2'-Oxybis(1-chloropropane
GC/MS	EPA 8270C/D SIM	2,3,4,6-Tetrachlorophenol
GC/MS	EPA 8270C/D SIM	2,4,5-Trichlorophenol
GC/MS	EPA 8270C/D SIM	2,4,6-Trichlorophenol
GC/MS	EPA 8270C/D SIM	2,4-Dichlorophenol

Solid and Chemical Waste		
Technology	Method	Analyte
GC/MS	EPA 8270C/D SIM	2,4-Dimethylphenol
GC/MS	EPA 8270C/D SIM	2,4-Dinitrophenol
GC/MS	EPA 8270C/D SIM	2,4-Dinitrotoluene
GC/MS	EPA 8270C/D SIM	2,6-Dinitrotoluene
GC/MS	EPA 8270C/D SIM	2-Chloronaphthalene
GC/MS	EPA 8270C/D SIM	2-Chlorophenol
GC/MS	EPA 8270C/D SIM	2-Methylnaphthalene
GC/MS	EPA 8270C/D SIM	2-Methylphenol
GC/MS	EPA 8270C/D SIM	2-Nitroaniline
GC/MS	EPA 8270C/D SIM	2-Nitrophenol
GC/MS	EPA 8270C/D SIM	3&4-Methylphenol
GC/MS	EPA 8270C/D SIM	3,3'-Dichlorobenzidine
GC/MS	EPA 8270C/D SIM	3-Nitroaniline
GC/MS	EPA 8270C/D SIM	4,6-Dinitro-2-methylphenol
GC/MS	EPA 8270C/D SIM	4-Bromophenyl-phenylether
GC/MS	EPA 8270C/D SIM	4-Chloro-3-methylphenol
GC/MS	EPA 8270C/D SIM	4-Chloroaniline
GC/MS	EPA 8270C/D SIM	4-Chlorophenyl-phenylether
GC/MS	EPA 8270C/D SIM	4-Nitroaniline
GC/MS	EPA 8270C/D SIM	4-Nitrophenol
GC/MS	EPA 8270C/D SIM	Acenaphthene
GC/MS	EPA 8270C/D SIM	Acenaphthylene
GC/MS	EPA 8270C/D SIM	Acetophenone
GC/MS	EPA 8270C/D SIM	Anthracene
GC/MS	EPA 8270C/D SIM	Atrazine
GC/MS	EPA 8270C/D SIM	Benzaldehyde
GC/MS	EPA 8270C/D SIM	Benzo(a)anthracene
GC/MS	EPA 8270C/D SIM	Benzo(a)pyrene
GC/MS	EPA 8270C/D SIM	Benzo(b)fluoranthene
GC/MS	EPA 8270C/D SIM	Benzo(g,h,i)perylene
GC/MS	EPA 8270C/D SIM	Benzo(k)fluoranthene

Solid and Chemical Waste		
Technology	Method	Analyte
GC/MS	EPA 8270C/D SIM	Bis(2-chloroethoxy)methane
GC/MS	EPA 8270C/D SIM	Bis(2-chloroethyl)ether
GC/MS	EPA 8270C/D SIM	Bis(2-ethylhexyl)phthalate
GC/MS	EPA 8270C/D SIM	Butylbenzylphthalate
GC/MS	EPA 8270C/D SIM	Caprolactam
GC/MS	EPA 8270C/D SIM	Carbazole
GC/MS	EPA 8270C/D SIM	Chrysene
GC/MS	EPA 8270C/D SIM	Dibenzo(a,h)anthracene
GC/MS	EPA 8270C/D SIM	Dibenzofuran
GC/MS	EPA 8270C/D SIM	Diethylphthalate
GC/MS	EPA 8270C/D SIM	Dimethyl phthalate
GC/MS	EPA 8270C/D SIM	Di-n-butylphthalate
GC/MS	EPA 8270C/D SIM	Di-n-octylphthalate
GC/MS	EPA 8270C/D SIM	Fluoranthene
GC/MS	EPA 8270C/D SIM	Fluorene
GC/MS	EPA 8270C/D SIM	Hexachlorobenzene
GC/MS	EPA 8270C/D SIM	Hexachlorobutadiene
GC/MS	EPA 8270C/D SIM	Hexachlorocyclopentadiene
GC/MS	EPA 8270C/D SIM	Hexachloroethane
GC/MS	EPA 8270C/D SIM	Indeno(1,2,3-cd)pyrene
GC/MS	EPA 8270C/D SIM	Isophorone
GC/MS	EPA 8270C/D SIM	Naphthalene
GC/MS	EPA 8270C/D SIM	Nitrobenzene
GC/MS	EPA 8270C/D SIM	n-Nitroso-di-n-propylamine
GC/MS	EPA 8270C/D SIM	n-Nitrosodiphenylamine
GC/MS	EPA 8270C/D SIM	Pentachlorophenol
GC/MS	EPA 8270C/D SIM	Phenanthrene
GC/MS	EPA 8270C/D SIM	Phenol
GC/MS	EPA 8270C/D SIM	Pyrene
HPLC/UV	EPA 8330A	1,3,5-Trinitrobenzene
HPLC/UV	EPA 8330A	1,3-Dinitrobenzene

Solid and Chemical Waste		
Technology	Method	Analyte
HPLC/UV	EPA 8330A	2, 4, 6-Trinitrotoluene
HPLC/UV	EPA 8330A	2, 4-Dinitrotoluene
HPLC/UV	EPA 8330A	2, 6-Dinitrotoluene
HPLC/UV	EPA 8330A	2-Amino-4, 6-dinitrotoluene
HPLC/UV	EPA 8330A	2-Nitrotoluene
HPLC/UV	EPA 8330A	3-Nitrotoluene
HPLC/UV	EPA 8330A	3,5-Dinitroaniline
HPLC/UV	EPA 8330A	4-Amino-2,6-dinitrotoluene
HPLC/UV	EPA 8330A	4-Nitrotoluene
HPLC/UV	EPA 8330A	Ethylene glycol dinitrate (EGDN)
HPLC/UV	EPA 8330A	Hexahydr-1, 3, 5-trinitro-1, 3, 5-triazine (RDX)
HPLC/UV	EPA 8330A	Nitrobenzene
HPLC/UV	EPA 8330A MOD	Nitroglycerin
HPLC/UV	EPA 8330A	Octahydro-1, 3, 5, 7-tetrazocine (HMX)
HPLC/UV	EPA 8330A	Pentaerythritol Tetranitrate (PETN)
HPLC/UV	EPA 8330A	Tetryl
HPLC/UV	8330B (W/O Soil Grinding)	1, 3, 5-Trinitrobenzene
HPLC/UV	8330B (W/O Soil Grinding)	1, 3-Dinitrobenzene
HPLC/UV	8330B (W/O Soil Grinding)	2, 4, 6-Trinitrotoluene
HPLC/UV	8330B (W/O Soil Grinding)	2, 4-Dinitrotoluene
HPLC/UV	8330B (W/O Soil Grinding)	2, 6-Dinitrotoluene
HPLC/UV	8330B (W/O Soil Grinding)	2-Amino-4, 6 –Dinitrotoluene
HPLC/UV	8330B (W/O Soil Grinding)	2-Nitrotoluene
HPLC/UV	8330B (W/O Soil Grinding)	3-Nitrotoluene
HPLC/UV	8330B (W/O Soil Grinding)	3,5-Dinitroaniline
HPLC/UV	8330B (W/O Soil Grinding)	4-Amino-2,3-Dinitrotoluene
HPLC/UV	8330B (W/O Soil Grinding)	4-Nitrotoluene
HPLC/UV	8330B (W/O Soil Grinding)	Ethylene glycol dinitrate (EGDN)
HPLC/UV	8330B (W/O Soil Grinding)	Hexahydr-1, 3, 5-trinitro-1, 3, 5-triazine (RDX)
HPLC/UV	8330B (W/O Soil Grinding)	Nitrobenzene
HPLC/UV	8330B (W/O Soil Grinding)	Nitroglycerin

Solid and Chemical Waste		
Technology	Method	Analyte
HPLC/UV	8330B (W/O Soil Grinding)	Octahydro-1, 3, 5, 7-tetrazocine (HMX)
HPLC/UV	8330B (W/O Soil Grinding)	Pentaerythritol Tetranitrate (PETN)
HPLC/UV	8330B (W/O Soil Grinding)	Tetryl
CVAA	EPA 7471B	Mercury
CVAF	EPA 1631E	Low Level Mercury
ICP/AES	EPA 6010B/C	Aluminum
ICP/AES	EPA 6010B/C	Antimony
ICP/AES	EPA 6010B/C	Arsenic
ICP/AES	EPA 6010B/C	Barium
ICP/AES	EPA 6010B/C	Beryllium
ICP/AES	EPA 6010B/C	Boron
ICP/AES	EPA 6010B/C	Cadmium
ICP/AES	EPA 6010B/C	Calcium
ICP/AES	EPA 6010B/C	Chromium
ICP/AES	EPA 6010B/C	Cobalt
ICP/AES	EPA 6010B/C	Copper
ICP/AES	EPA 6010B/C	Iron
ICP/AES	EPA 6010B/C	Lead
ICP/AES	EPA 6010B/C	Magnesium
ICP/AES	EPA 6010B/C	Manganese
ICP/AES	EPA 6010B/C	Molybdenum
ICP/AES	EPA 6010B/C	Nickel
ICP/AES	EPA 6010B/C	Potassium
ICP/AES	EPA 6010B/C	Selenium
ICP/AES	EPA 6010B/C	Silicon
ICP/AES	EPA 6010B/C	Silver
ICP/AES	EPA 6010B/C	Sodium
ICP/AES	EPA 6010B/C	Strontium
ICP/AES	EPA 6010B/C	Thallium
ICP/AES	EPA 6010B/C	Tin
ICP/AES	EPA 6010B/C	Titanium

Solid and Chemical Waste		
Technology	Method	Analyte
ICP/AES	EPA 6010B/C	Vanadium
ICP/AES	EPA 6010B/C	Zinc
ICP/MS	EPA 6020A	Aluminum
ICP/MS	EPA 6020A	Antimony
ICP/MS	EPA 6020A	Arsenic
ICP/MS	EPA 6020A	Barium
ICP/MS	EPA 6020A	Beryllium
ICP/MS	EPA 6020A	Boron
ICP/MS	EPA 6020A	Cadmium
ICP/MS	EPA 6020A	Calcium
ICP/MS	EPA 6020A	Chromium
ICP/MS	EPA 6020A	Cobalt
ICP/MS	EPA 6020A	Copper
ICP/MS	EPA 6020A	Iron
ICP/MS	EPA 6020A	Lead
ICP/MS	EPA 6020A	Magnesium
ICP/MS	EPA 6020A	Manganese
ICP/MS	EPA 6020A	Molybdenum
ICP/MS	EPA 6020A	Nickel
ICP/MS	EPA 6020A	Potassium
ICP/MS	EPA 6020A	Selenium
ICP/MS	EPA 6020A	Silver
ICP/MS	EPA 6020A	Sodium
ICP/MS	EPA 6020A	Strontium
ICP/MS	EPA 6020A	Thallium
ICP/MS	EPA 6020A	Tin
ICP/MS	EPA 6020A	Titanium
ICP/MS	EPA 6020A	Tungsten
ICP/MS	EPA 6020A	Vanadium
ICP/MS	EPA 6020A	Zinc
IC	EPA 9056A	Chloride

Solid and Chemical Waste		
Technology	Method	Analyte
IC	EPA 9056A	Fluoride
IC	EPA 9056A	Nitrate as N
IC	EPA 9056A	Nitrite as N
IC	EPA 9056A	Orthophosphate
IC	EPA 9056A	Sulfate
Gravimetric	EPA 9071A; EPA 9071B	Oil and Grease, Oil and Grease with SGT
Physical	EPA 1010A	Ignitability
Physical	EPA 9045D	pH
Titration	EPA SW-846 Chapter 7.3.4	Reactive Sulfide
Titration	Walkley-Black	Total Organic Carbon
IR	Lloyd Kahn	Total organic carbon
Turbidimetric	EPA 9038; ASTM 516-02	Sulfate
UV/VIS	EPA 350.1; SM 4500NH3 H	Ammonia as N
UV/VIS	EPA 9251; SM 4500Cl E	Chloride
UV/VIS	EPA SW-846 Chapter 7.3.4	Reactive Cyanide
UV/VIS	EPA 821/R-91-100	AVS-SEM
UV/VIS	SM 3500Fe D	Ferrous Iron
Cleanup Methods	EPA 3630C	Silica Gel
UV/VIS	EPA 7196	Chromium VI
UV/VIS	EPA 7196A	Chromium VI
UV/VIS	EPA 9012B	Total cyanide
Preparation	Method	Type
Preparation	EPA 1311	Toxicity Characteristic Leaching Procedure
Preparation	EPA 1312	Synthetic Precipitation Leaching Procedure
Cleanup Methods	EPA 3660B	Sulfur Clean-up
Cleanup Methods	EPA 3620C	Florsil Clean-up
Cleanup Methods	EPA 3630C	Silica Gel Clean-up
Cleanup Methods	EPA 3640A	GPC Clean-up
Organic Preparation	EPA 3540C	Soxhlet Extraction
Organic Preparation	EPA 3545A	Pressurized Fluid Extraction

Solid and Chemical Waste		
Technology	Method	Analyte
Organic Preparation	EPA 3546	Microwave Extraction Preparation for EPA 8082A, 8081B and 8270C, D
Organic Preparation	EPA 3550C	Sonication
Inorganics Preparation	EPA 3050B	Hotblock
Inorganics Preparation	EPA 3060A	Alkaline Digestion
Volatile Organics Preparation	EPA 5035/5035A	Closed System Purge and Trap

Air		
Technology	Method	Analyte
GC/MS	EPA TO-15	Propene
GC/MS	EPA TO-15	1, 1, 1-Trichloroethane
GC/MS	EPA TO-15	1, 1, 2, 2-Tetrachloroethane
GC/MS	EPA TO-15	1, 1, 2-Trichloroethane
GC/MS	EPA TO-15	1, 1-Dichloroethane
GC/MS	EPA TO-15	1, 1-Dichloroethylene
GC/MS	EPA TO-15	1, 2, 4-Trichlorobenzene
GC/MS	EPA TO-15	1, 2, 4-Trimethylbenzene
GC/MS	EPA TO-15	1, 2-Dibromoethane (EDB)
GC/MS	EPA TO-15	1,2-Dichloro-1,1,2,2-tetrafluoroethane (Freon 114)
GC/MS	EPA TO-15	1, 2-Dichlorobenzene
GC/MS	EPA TO-15	1, 2-Dichloroethane
GC/MS	EPA TO-15	1, 2-Dichloroethenes (Total)
GC/MS	EPA TO-15	1, 2-Dichloropropane
GC/MS	EPA TO-15	1, 3, 5-Trimethylbenzene
GC/MS	EPA TO-15	1, 3-Butadiene
GC/MS	EPA TO-15	1, 3-Dichlorobenzene
GC/MS	EPA TO-15	1, 4-Dichlorobenzene
GC/MS	EPA TO-15	1,4-Difluorobenzene
GC/MS	EPA TO-15	1, 4-Dioxane
GC/MS	EPA TO-15	2-Butanone
GC/MS	EPA TO-15	2-Hexanone

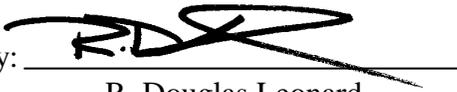
Air		
Technology	Method	Analyte
GC/MS	EPA TO-15	2-Propanol
GC/MS	EPA TO-15	4-Ethyltoluene
GC/MS	EPA TO-15	4-Methyl-2-pentanone
GC/MS	EPA TO-15	Acetone
GC/MS	EPA TO-15	Acrolein
GC/MS	EPA TO-15	Benzene
GC/MS	EPA TO-15	Benzyl chloride
GC/MS	EPA TO-15	Bromochloromethane
GC/MS	EPA TO-15	Bromodichloromethane
GC/MS	EPA TO-15	Bromoform
GC/MS	EPA TO-15	Carbon disulfide
GC/MS	EPA TO-15	Carbon tetrachloride
GC/MS	EPA TO-15	Chlorobenzene
GC/MS	EPA TO-15	Chloroethane
GC/MS	EPA TO-15	Chloroform
GC/MS	EPA TO-15	Cis-1, 2-Dichloroethene
GC/MS	EPA TO-15	Cis-1, 3-Dichloropropene
GC/MS	EPA TO-15	Cyclohexane
GC/MS	EPA TO-15	Dibromochloromethane
GC/MS	EPA TO-15	Dichlorodifluoromethane (Freon 12)
GC/MS	EPA TO-15	Ethanol
GC/MS	EPA TO-15	Ethyl acetate
GC/MS	EPA TO-15	Ethylbenzene
GC/MS	EPA TO-15	Hexachlorobutadiene
GC/MS	EPA TO-15	Isopropyl alcohol
GC/MS	EPA TO-15	m, p-Xylene
GC/MS	EPA TO-15	Methyl bromide (Bromomethane)
GC/MS	EPA TO-15	Methyl chloride (Chloromethane)
GC/MS	EPA TO-15	Methyl methacrylate
GC/MS	EPA TO-15	Methyl tert-butyl ether
GC/MS	EPA TO-15	Methylene chloride

Air		
Technology	Method	Analyte
GC/MS	EPA TO-15	Naphthalene
GC/MS	EPA TO-15	n-Heptane
GC/MS	EPA TO-15	n-Hexane
GC/MS	EPA TO-15	o-Xylene
GC/MS	EPA TO-15	Styrene
GC/MS	EPA TO-15	Tetrachloroethylene (Perchloroethylene)
GC/MS	EPA TO-15	Tetrahydrofuran
GC/MS	EPA TO-15	Toluene
GC/MS	EPA TO-15	trans-1, 2-Dichloroethylene
GC/MS	EPA TO-15	trans-1, 3-Dichloropropylene
GC/MS	EPA TO-15	Trichloroethene (Trichloroethylene)
GC/MS	EPA TO-15	Trichlorofluoromethane (Freon 11)
GC/MS	EPA TO-15	1,1,2-Trichloro1,2,2-trifluoroethane (Freon 113)
GC/MS	EPA TO-15	Vinyl acetate
GC/MS	EPA TO-15	Vinyl chloride
GC/MS	EPA TO-15	Xylenes (Total)
GC/MS	MA DEP APH	Aliphatic C5-C8 range
GC/MS	MA DEP APH	Aliphatic C9-C12 range
GC/MS	MA DEP APH	Aromatic C9-C10 range
GC/MS	MA DEP APH	1,3-Butadiene
GC/MS	MA DEP APH	Benzene
GC/MS	MA DEP APH	Ethylbenzene
GC/MS	MA DEP APH	m+p-Xylene
GC/MS	MA DEP APH	Methyl tert-butyl ether
GC/MS	MA DEP APH	Naphthalene
GC/MS	MA DEP APH	o-Xylene
GC/MS	MA DEP APH	Toluene

Notes:

- 1) This laboratory offers commercial testing service.



Approved by: 
R. Douglas Leonard
Chief Technical Officer

Date: March 13, 2013

Re-issued: 2/1/13 Revised: 3/13/13

Appendix C

Information related to EM/GPR survey limitations

Appendix C

Information related to EM/GPR survey limitations

Based on the typical 400 MHz GPR antenna's physical size, usable GPR data cannot be relied on from within approximately 1 to 2 feet of any aboveground obstruction (e.g. walls, curbs, fences, raised slabs, shrubs, rocks, lampposts, equipment, etc.). GPR antennas also require a relatively smooth surface (e.g. mowed grass, flat dirt, asphalt, concrete, etc.) to clearly differentiate reflections produced by buried objects from those caused by topographic variations. Therefore, areas with irregular ground surface (landscaping, dirt piles, and overgrown vegetation) should be avoided.

GPR signal penetration is site specific. It is determined by dielectric properties of local soil or fill materials. GPR signals will propagate to the greatest depth in dry granular soils; GPR signal-penetration depths may be significantly reduced by concrete pavement, reinforcing steel, buried rubble, residual de-icing salts, saline groundwater, or electrically conductive soils (e.g. clay). Objects deeper than the GPR signal's maximum penetration depth will remain undetected. If the borehole clearance survey is performed in winter, when the roads and other asphalt surfaces are covered with a layer of salt, GPR signal penetration depths may be reduced in those areas.

Buried debris zones can often be interpreted from GPR data if they are large enough, and if they exhibit an electrical-property contrast with the surrounding soil/fill (or underlying bedrock). Groups of boulders can also resemble buried debris. Backfilled areas also sometimes exhibit reflections resembling the sloping sides of a trench, if the surrounding area is undisturbed. Small piles of debris may not cause a large enough reflection to be interpreted as an anomaly on the GPR records, especially if located near or directly on the shallow bedrock surface at this site.

GPR interpretations are subjective, based on identifying reflection patterns that may not uniquely represent a subsurface object. Profiling along perpendicular traverses helps determine the size and shape of buried objects or the lateral extent of rubble zones. GPR interpretation is more subjective than most geophysical methods, and anomaly confirmation via test pits, borings, or other direct means is strongly recommended.

In addition, note that a pipe's diameter must increase approximately one inch for every foot below ground surface in order for the GPR technique to detect that pipe. For instance, a pipe buried 12 feet below ground surface must be at least 12 inches in diameter to produce a recognizable GPR reflection. Note that the shallowest buried object in any given location (i.e. closest to the ground surface) is most likely to be detected, and deeper objects directly below will be more difficult to detect. Therefore, if pipes are situated on top of one another, only the shallowest may be identified, unless the deeper pipe is considerably wider.

Note that GPR cannot penetrate metallic surfaces (e.g. a manhole cover or buried hatch), standing water (i.e. puddles or melting snow), or water-saturated soils. GPR is most likely to detect buried concrete or metallic pipes. Plastic or vitreous clay pipes, or fiberglass tanks, are less likely to be detected with GPR.

Varying a GPR antenna's speed along a survey traverse can cause slight errors in horizontal distance interpolations and inferred object positions. Distance interpolation errors will be minimized during this survey by using distance-measuring survey wheels.

GPR is most likely to detect concrete or metallic objects. PVC, plastic or vitreous clay pipes, or fiberglass tanks, are less likely to be detected with GPR.

EM data values may be adversely affected by power lines, or aboveground metal objects (including reinforced concrete) located within approximately 5 to 10 feet (EM61) or 20 to 30 feet (EM31) of a survey traverse. EM anomalies caused by buried metal objects within those regions may be difficult to distinguish from anomalies caused by aboveground objects.

EM interpretations are based on identifying anomaly patterns that may not uniquely represent a subsurface object. Anomaly confirmation via test pits, borings or other direct means is recommended.

Pipe- and cable-locating instruments work best when linear objects being traced are separated by some distance. Closely-spaced pipes or conduits are often perceived as one linear object by a pipe locator. In addition, both induced and passive currents can "jump" to other nearby metallic pipes, including other conduits, grounding wires, or water or steam lines. Rusted or electrically discontinuous pipes may not conduct a signal well enough to be traced.

Pipe- and cable-locating instruments can only trace metallic pipes or conduits that are electrically continuous. For example, rubber (or other electrically non-conductive) gaskets at pipe joints will prevent tracing an induced electrical signal beyond the gasket closest to the transmitter. Non-metallic pipes (e.g. concrete or PVC drain lines or water lines) cannot be traced with these instruments. Plastic gas lines can be traced only if tracer wires are present. In addition, an induced current will often spread out over a reinforcing mesh or rebar mat within concrete surfaces, preventing pipe locating beneath these surfaces.