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FINAL UNIFORM FEDERAL POLICY SAMPLING AND ANALYSIS PLAN FOR SITE UXO-22 BATTERY DISPOSAL AREA INVESTIGATION FOR A NON-TIME CRITICAL REMOVAL ACTION MCB CAMP LEJEUNE NC

2/1/2014

CH2M HILL

Final

Sampling and Analysis Plan
Site UXO-22 Battery Disposal Area Investigation for a Non-Time Critical Removal Action

Marine Corps Installations East—Marine Corps Base Camp Lejeune
North Carolina

Contract Task Order WE1A

February 2014

Prepared for

Department of the Navy
Naval Facilities Engineering Command
Mid-Atlantic

Under the

NAVFAC CLEAN 8012 Program
Contract N62470-11-D-8012

Prepared by

CH2MHILL

Charlotte, North Carolina

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SAP Worksheet #1—Title and Approval Page

Final

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Site UXO-22 Battery Disposal Area Investigation for a Non-Time Critical Removal Action

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Prepared by:
CH2M HILL
11301 Carmel Commons Blvd
Charlotte, North Carolina 28226

Prepared under:
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Contract Task Order WE1A

QA Review:

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Dave Cleland
Navy Remedial Project Manager / Date

2/26/2014

Gena Townsend
USEPA Project Manager / Date

2/26/14

Randy McElveen
NCDENR Project Manager / Date

Executive Summary

This document serves as a guideline for the field activities and data quality assessment for the battery disposal area investigation at Munitions Response Program (MRP) Site UXO-22, Former Munitions Disposal Area, located at Marine Corps Installations East - Marine Corps Base Camp Lejeune (MCIEAST-MCB CAMLEJ), North Carolina.

CH2M HILL prepared this document under the Department of the Navy, Naval Facilities Engineering Command (NAVFAC) Mid-Atlantic, Comprehensive Long-Term Environmental Action - Navy (CLEAN) 8012 Contract N62470-11-D-8012, Contract Task Order WE1A. This Uniform Federal Policy Sampling and Analysis Plan (UFP-SAP) is being submitted to the MCIEAST-MCB CAMLEJ Environmental Restoration Partnering Team, which consists of representatives from NAVFAC Mid-Atlantic, MCIEAST-MCB CAMLEJ, United States Environmental Protection Agency (USEPA) Region 4, and North Carolina Department of Environment and Natural Resources (NCDENR). This document was prepared in accordance with the Navy's UFP-SAP format to facilitate that environmental data collected are scientifically sound, of known and documented quality, and suitable for intended uses.

Based on the results of the Site UXO-22 Preliminary Assessment/Site Inspection (PA/SI) (CH2M HILL, 2012a), a Remedial Investigation (RI) was recommended at Site UXO-22 to further characterize the nature and extent of munitions and explosives of concern (MEC). The PA/SI also recommended further evaluation of soil in an ephemeral drainage at the site because of potential unacceptable ecological risks caused by exposure to metals. This investigation is being conducted to evaluate the extent of a battery disposal area identified within the ephemeral drainage and to characterize the soil beneath the disposed batteries in preparation for an engineering evaluation and cost analysis (EE/CA) and non-time critical removal action (NTCRA) to address the batteries as a potential continuing source of metals in soil.

This UFP-SAP was prepared in accordance with the following guidance documents:

- *EPA Guidance for Quality Assurance Project Plans* (USEPA, 2002)
- *Uniform Federal Policy for Quality Assurance Project Plans: Evaluating, Assessing, and Documenting Environmental Data Collection and Use Programs* (USEPA, 2005)
- *USEPA Guidance on Systematic Planning Using the Data Quality Objectives Process* (USEPA, 2006)

This UFP-SAP consists of 37 worksheets specific to the UFP-SAP. Tables are embedded within the worksheets. Figures are included at the end of the document. Field standard operating procedures are provided in **Attachment 1**. The laboratory's Department of Defense Environmental Laboratory Accreditation Program letter is presented in **Attachment 2**. **Attachment 3** presents the Environmental Protection Plan. A Technical Management Plan (TMP) is provided in **Attachment 4**. A Geophysical Survey Work Plan is provided in **Attachment 5**.

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2 DoD ELAP Letter -Analytical Laboratory
3 Environmental Protection Plan
4 Technical Management Plan
5 Geophysical Survey Work Plan

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1 Base Location Map
2 Site Map
3 MEC Items Discovered at UXO-22

Acronyms and Abbreviations

°C	degrees Celsius
%R	percent recovery
AES	atomic emission spectroscopy
AM	Activity Manager
amsl	above mean sea level
AQM	Activity Quality Manager
Baker	Baker Environmental, Inc.
bgs	below ground surface
CA	corrective action
CAS	Chemical Abstracts Service
CCV	continuing calibration verification
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CLEAN	Comprehensive Long-term Environmental Action—Navy
CSM	conceptual site model
DFOW	definable feature of work
DGM	digital geophysical mapping
DL	detection limit
DoD	Department of Defense
DQI	data quality indicator
DRMO	Defense Reutilization and Marketing Office
DQO	data quality objective
EE/CA	engineering evaluation and cost analysis
ELAP	Environmental Laboratory Accreditation Program
EMD	Environmental Management Division
ERS	ecological risk screening
ESS	Explosives Safety Submission
FP	Follow-up Phase
FTL	Field Team Leader
ft	feet/foot
FTP	file transfer protocol
FS	Feasibility Study
g	gram(s)
GFAA	graphite furnace atomic adsorption
GIS	geographic information system
GPS	global positioning system
H&S	Health and Safety
HE	high explosive
HEAT	high explosive anti-tank
HHRS	human health risk screening
HSP	Health and Safety Plan
IAW	in accordance with
IC	Ion Chromatography
ICAL	initial calibration

ICP	inductively coupled plasma
ICS	Interference Check Solutions
ID	Identification
IP	Initial Phase
IR	Installation Restoration
LCL	lower confidence limit
LCS	laboratory control sample
LTM	long-term monitoring
LOD	limit of detection
LOQ	limit of quantitation
LUC	land use control
MC	munitions constituents
MCIEAST-MCB CAMLEJ	Marine Corps Installations East – Marine Corps Base Camp Lejeune
MDAS	material documented as safe
MEC	munitions and explosives of concern
mg/kg	milligrams per kilogram
ml	milliliter(s)
mm	millimeter
MPPEH	material potentially presenting an explosive hazard
MR	munitions response
MRP	Munitions Response Program
MS	mass spectrometer
MS/MSD	matrix spike/matrix spike duplicate
NA	not applicable
NAVFAC	Naval Facilities Engineering Command
Navy	Department of the Navy
NCDENR	North Carolina Department of Environment and Natural Resources
NCSSL	North Carolina soil screening level
NIRIS	Naval Installation Restoration Information System
NTCRA	non-time critical removal action
NTR	Navy Technical Representative
OHM	OHM Remediation Services Corporation
OU	operable unit
PA	preliminary assessment
PAL	project action limit
PC	Project Chemist
PM	Project Manager
POC	point of contact
PP	Preparatory Phase
PQL	project quantitation limit
PQO	project quality objective
QA	quality assurance
QAO	Quality Assurance Officer
QC	quality control
QL	quantitation level
QSM	Quality Systems Manual

Rhea	Rhea Engineers and Consultants, Inc.
RI	remedial investigation
RPD	relative percent difference
RPM	Remedial Project Manager
RSL	regional screening level
SAP	Sampling and Analysis Plan
SDG	sample delivery group
SI	site inspection
SOP	standard operating procedure
SSC	Site Safety Coordinator
STC	Senior Technical Consultant
SUXOS	Senior UXO Supervisor
TAL	target analyte list
TBD	to be determined
TCLP	toxicity characteristic leaching procedure
TMP	Technical Management Plan
UCL	upper confidence limit
UFP	Uniform Federal Policy
USACE	United States Army Corps of Engineers
USEPA	United States Environmental Protection Agency
UV VIS	ultraviolet visible spectroscopy
UXO	unexploded ordnance
UXOQCS	Unexploded Ordnance Quality Control Specialist
UXOSO	UXO Safety Officer
VOC	volatile organic compound

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SAP Worksheet #2—SAP Identifying Information

Site Name/Number: UXO-22 – Former Munitions Disposal Area

Operable Unit: Operable Unit 2

Contractor Name: CH2M HILL

Contract Number: N62470-11-D-8012, Contract Task Order WE1A

Contract Title: Comprehensive Long-term Environmental Action—Navy (CLEAN) 8012

1. **This Uniform Federal Policy Sampling and Analysis Plan (UFP-SAP) was prepared in accordance with (IAW) the requirements of the following documents:**
   - *Uniform Federal Policy for Quality Assurance Project Plans: Evaluating, Assessing, and Documenting Environmental Data Collection and Use Programs* (United States Environmental Protection Agency [USEPA], 2005)
   - USEPA *Guidance for Quality Assurance Project Plans, USEPA QA/G-5, Quality Assurance Management Section* (USEPA, 2002)
   - USEPA *Guidance on Systematic Planning Using the Data Quality Objectives Process* (USEPA, 2006)
2. **Identify regulatory program:**
   - Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)
3. **This is a <u>project-specific</u> UFP-SAP for the battery disposal area investigation at Site UXO-22.**
4. **List dates of scoping sessions that were held:**

Scoping Session	Date
Partnering Team Scoping Session – Battery Disposal Area Investigation Approach	August 21, 2013

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

Title	Author/Date
Site-specific Work Plan Addendum for Intrusive Investigation Activities at UXO-22 Marine Corps Base Camp Lejeune, Jacksonville, North Carolina	CH2M HILL, August 2010a
Sampling and Analysis Plan (Field Sampling Plan and Quality Assurance Project Plan) Preliminary Assessment/Site Inspection; Military Munitions Response Program Site UXO-22 – Former Munitions Disposal Area, Marine Corps Base Camp Lejeune, North Carolina.	CH2M HILL, March 2012b
Sampling and Analysis Plan Field Sampling Plan and Quality Assurance Project Plan for Munitions Response Remedial Investigation at Site UXO-22 – Former Munitions Disposal Area Marine Corps Installations East - Marine Corps Base Camp Lejeune, North Carolina.	CH2M HILL, August 2013

6. **List organizational partners (stakeholders) and connection with lead organization:**
   - Department of the Navy (Navy) – Naval Facilities Engineering Command (NAVFAC) (lead organization)
   - Marine Corps Installations East – Marine Corps Base Camp Lejeune (MCIEAST-MCB CAMLEJ) (facility)
   - USEPA Region IV (regulatory stakeholder)
   - North Carolina Department of Environment and Natural Resources (NCDENR) (regulatory stakeholder)

SAP Worksheet #2—SAP Identifying Information (continued)

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

The crosswalk table is excluded; all required information is provided in this UFP-SAP.

SAP Worksheet #3—Distribution List

Name of UFP-SAP Recipients	Title/Role	Organization	Telephone Number	E-mail Address or Mailing Address
Dave Cleland	Navy Technical Representative (NTR)	NAVFAC Mid-Atlantic	(757) 322-4851	david.t.cleland@navy.mil
Charity Delaney	Base Environmental Management Division (EMD) Environmental Engineer	MCIEAST – MCB CAMLEJ	(910) 451-9385	charity.rychak@usmc.mil
Patti Vanture	Base EMD Environmental Engineer	MCIEAST – MCB CAMLEJ	(910) 451-9641	patricia.vanture@usmc.mil
Gena Townsend	Remedial Project Manager (RPM)	USEPA	(404) 562-8538	townsend.gena@epa.gov
Randy McElveen	RPM	NCDENR	(919) 707-8341	randy.mcelveen@ncdenr.gov
Matt Louth	Activity Manager (AM)	CH2M HILL	(757) 671-6240	matt.louth@CH2M.com
Kim Henderson	Deputy Activity Manager	CH2M HILL	(757) 671-6231	kimberly.henderson@CH2M.com
Jessica Skeean	Activity Quality Manager (AQM)	CH2M HILL	(704) 543-3284	jessica.skeean@CH2M.com
Dan Hockett	Project Manager (PM)	CH2M HILL	(704) 543-3264	daniel.hockett@CH2M.com
Timothy Garretson	Munitions Response Program (MRP) Technical Lead	CH2M HILL	(904) 374-5633	timothy.garretson@CH2M.com
Tom Roth	Senior Technical Consultant (STC)	CH2M HILL	(404) 474-7640	tom.roth@CH2M.com
George DeMetropolis	Munitions Response (MR) Safety & Quality Control Officer	CH2M HILL	(619) 564-9627	george.demetropolis@CH2M.com
Matt Barner	Project Geophysicist	CH2M HILL	(704) 543-3273	matthew.barner@CH2M.com
Roni Warren	Human Health Risk Assessor	CH2M HILL	(814) 364-2454	roni.warren@CH2M.com
Kelly Taylor	Ecological Risk Assessor	CH2M HILL	(720) 935-3395	kelly.taylor2@CH2M.com
Daniel Brown	Task Manager	CH2M HILL	(704) 544-5164	daniel.brown@CH2M.com
To be determined (TBD)	Unexploded ordnance (UXO) Qualified Personnel	CH2M HILL	TBD	TBD
Anita Dodson	Navy CLEAN Program Chemist	CH2M HILL	(757) 671-6218	anita.dodson@CH2M.com
Bianca Kleist	Project Chemist	CH2M HILL	(704) 543-3274	bianca.kleist@ch2m.com

SAP Worksheet #3—Distribution List (continued)

Name of UFP-SAP Recipients	Title/Role	Organization	Telephone Number	E-mail Address or Mailing Address
Carl Woods	Health & Safety (H&S) Manager	CH2M HILL	(513) 889-5771	carl.woods@CH2M.com
Jennifer Obrin	PM/Laboratory	Katahdin	(207) 874-2400	jobrin@katahdinlab.com
Deb Patton	PM/Laboratory	ALS Rochester	(585) 288 5380	deb.patton@alsglobal.com
Doug Weaver	Data Validator	Environmental Data Services	(757) 564-0090	dweaver@env-data.com
TBD	Utility Locator	TBD	TBD	TBD
TBD	Surveyor	TBD	TBD	TBD

SAP Worksheet #4—Project Personnel Sign-Off Sheet

Name	Organization/Title/Role	Telephone Number (optional)	Signature/email Receipt	SAP Section Reviewed	Date SAP Read
Dave Cleland	Navy NTR	(757) 322-4851			
Tom Roth	CH2M HILL/STC	(404) 474-7640			
Matt Louth	CH2M HILL/AM	(757) 671-6240			
Jessica Skeean	CH2M HILL/AQM	(704) 543-3284			
Dan Hockett	CH2M HILL/PM	(704) 543-3264			
Anita Dodson	CH2M HILL/Navy CLEAN Program Chemist	(757) 671-6218			
Jennifer Obrin	Laboratory (Katahdin)/PM	(207) 874-2400			
Deb Patton	Laboratory (ALS)/PM	(585) 288 5380			
Doug Weaver	Data Validator/PM	(757) 564-0090			

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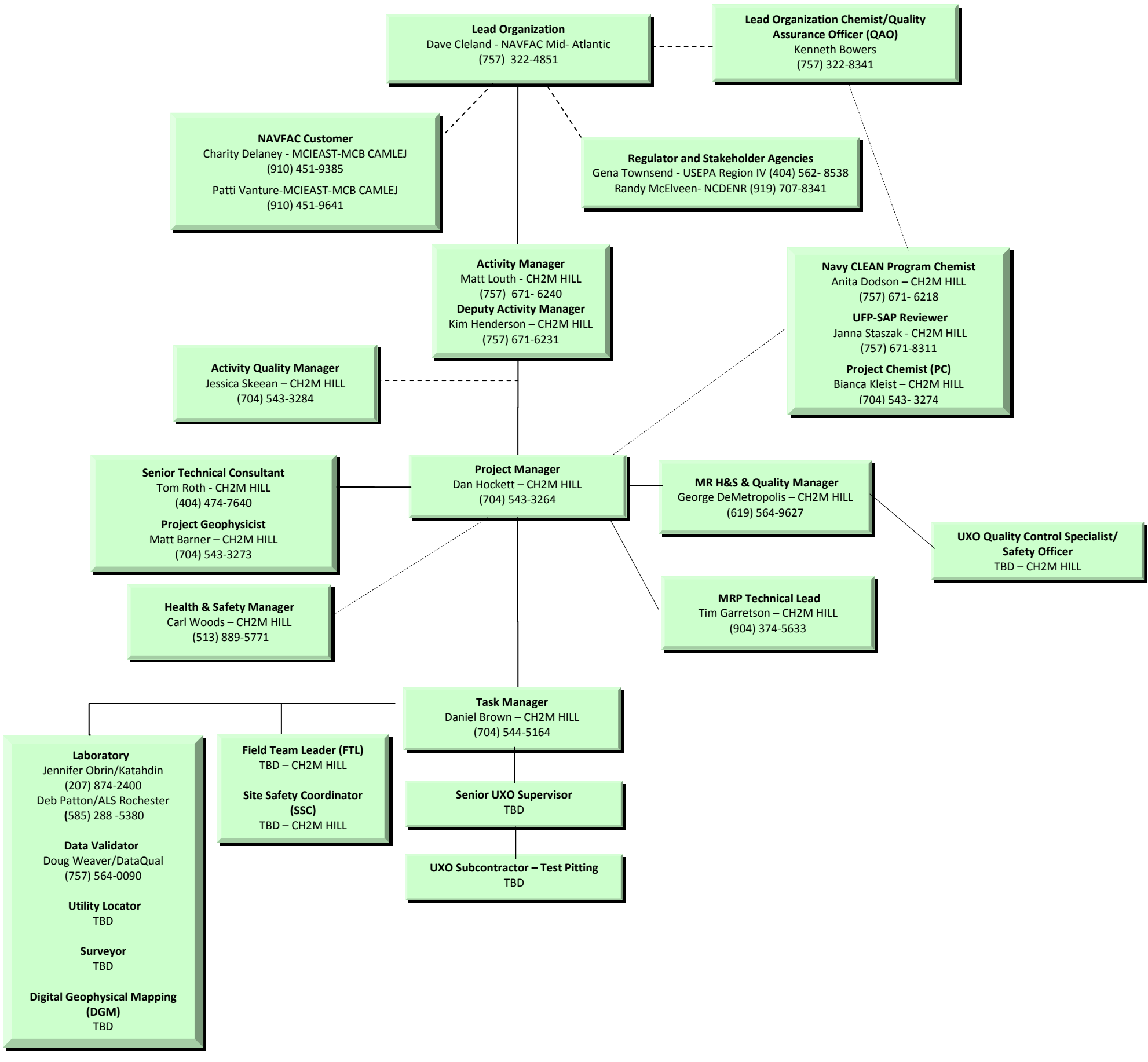
SAP Worksheet #5—Project Organizational Chart



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SAP Worksheet #6—Communication Pathways

Communication Drivers	Responsible Affiliation	Name	Phone Number and/or E-mail	Procedure
Communication with Navy (lead agency)	Navy NTR	Dave Cleland	(757) 322-4851 david.t.cleland@navy.mil	Primary point of contact (POC) for Navy; can delegate communication to other internal or external POCs. NTR will notify USEPA and NCDENR via email or telephone call within 24 hours if field changes affecting the scope or implementation of the design occur. Navy will have 30 days for work plan review. All field data will be presented and discussed during partnering meetings.
Communication with MCIEAST – MCB CAMLEJ	Base EMD	Charity Delaney Patti Vanture	(910) 451-9385 charity.rychak@usmc.mil (910) 451-9641 patricia.vanture@usmc.mil	Primary POC for the Base EMD; can delegate communication to other internal or external POCs. NTR will notify the Base EMD via e-mail or telephone call within 24 hours for field changes affecting the scope. All data results will be presented and discussed during partnering meetings.
Communication with USEPA Region IV	USEPA RPM	Gena Townsend	(404) 562-8538 townsend.gena@epa.gov	Primary POC for USEPA; can delegate communication to other internal or external POCs. Upon notification of field changes, USEPA will have 24 hours to approve or comment on the field changes. All data results will be presented and discussed during partnering meetings.
Communication with NCDENR	NCDENR RPM	Randy McElveen	(919) 707-8341 randy.mcelveen@ncdenr.gov	Project POC for NCDENR; can delegate communication to other internal or external POCs. Upon notification of field changes, NCDENR will have 24 hours to approve or comment on the field changes.
Communication regarding overall project status and implementation and primary POC with Navy RPM, USEPA, and NCDENR	CH2M HILL AM and Deputy AM	Matt Louth and Kim Henderson	(757) 671-6240 matt.louth@CH2M.com (757) 671-6231 kimberly.henderson@CH2M.com	Oversees project and will be informed of project status by the PM. If field changes occur, AM will work with the Navy RPM to communicate any field changes to the team via email within 24 hours. All data results will be communicated to the project team during the first partnering meeting following data receipt.
Quality issues during project implementation and data interpretation	CH2M HILL AQM	Jessica Skeean	(704) 543-3284 jessica.skeean@CH2M.com	Contact the AQM regarding quality issues during project implementation. The AQM will report to the AM and the NAVY NTR.
Technical communications for project implementation, and data interpretation	CH2M HILL STC/Subject Matter Expert	Tom Roth	(404) 474-7640 tom.roth@CH2M.com	Contact STC regarding questions/issues encountered in the field, input on data interpretation, as needed. STC will have 24 hours to respond to technical field questions as necessary. Additionally, STC will review the data as necessary before partnering team discussion and reporting review.

SAP Worksheet #6—Communication Pathways (continued)

Communication Drivers	Responsible Affiliation	Name	Phone Number and/or E-mail	Procedure
Communications regarding project management and implementation	CH2M HILL PM	Dan Hockett	(704) 543-3264 daniel.hockett@CH2M.com	All information and materials about the project will be forwarded to the Navy NTR, AM, and STC as necessary. POC for field sampling team. Responsible for field team members' and subcontractors' adherence to work plan.
H&S	CH2M HILL MR H&S & Quality Manager and H&S Manager	George DeMetropolis and Carl Woods	(619) 564-9627 george.demetropolis@CH2M.com (513) 889-5771 carl.woods@CH2M.com	Responsible for adherence of safety plans to appropriate H&S standards. Will coordinate with PM about H&S incidents/near-losses and any activity hazard analysis to PM.
H&S Field Operations	CH2M HILL SSC	TBD	TBD	Responsible for the final approval of site safety requirements described in the Site-specific Health and Safety Plan (HSP). Will coordinate with PM regarding H&S incidents, near-losses, and potential activity hazards.
Communication regarding comparisons to risk screening levels	Human Health and Ecological Risk Screening	Roni Warren (Human Health) Kelly Taylor (Ecological)	(814) 364-2454 roni.warren@CH2M.com (720) 935-3395 kelly.taylor2@CH2M.com	Responsible for comparing soil sample metals data to risk screening levels.
Work Plan or SAP changes in field/ Field Progress Reports	Field Team Leader (FTL)	TBD	TBD	Documentation of deviations from the Work Plan will be made in the field logbook (made with the approval of AM and/or Quality Assurance Officer [QAO]) and the PM will be notified immediately. Provide daily progress reports to PM. Deviations will be made only with approval from the PM.
Field corrective actions (CAs)	CH2M HILL FTL	TBD	TBD	The need for CA for field and analytical issues will be determined by the FTL and AQM. The AQM will make sure UFP-SAP requirements are met by field staff. The FTL will notify the PM of any needed field CAs. The Navy RPM will be notified of any field data quality issues.
Geophysical Data tracking from collection through upload	CH2M HILL Project Geophysicist	Matt Barner	(704) 543-3273 matthew.barner@CH2M.com	The Project Geophysicist will track data from collection through upload for review to make sure Work Plan requirements are met by geophysical survey field staff. The Project Geophysicist will act as the main POC for the geophysical survey subcontractor on all data-related issues.

SAP Worksheet #6—Communication Pathways (continued)

Communication Drivers	Responsible Affiliation	Name	Phone Number and/or E-mail	Procedure
Geophysical Field and Data Collection	CH2M HILL Project Geophysicist	Matt Barner	(704) 543-3273 matthew.barner@CH2M.com	Any CAs for field and data collection issues will be determined by the FTL and/or the Project Geophysicist and reported to the PM.
Reporting Geophysical Data Quality Issues	Geophysical Survey subcontractor	TBD	TBD	All geophysical quality assurance/quality control (QA/QC) issues with project data will be reported to the PM.
Technical communications for project implementation and data interpretation	MRP Technical Lead	Tim Garretson	(904) 374-5633	Contact MRP technical lead regarding questions and issues encountered in the field and input on data interpretation, as needed. AQM and/or MRP technical lead will respond to technical field questions as necessary. Responses will be communicated to the PM via e-mail or phone.
Field and analytical CAs/ Release of Analytical Data; Data tracking from field collection to database upload	Project Chemist (PC)	Bianca Kleist	(704) 543-3274	Any CAs for field and analytical issues will be determined by the FTL and/or the PC and reported to the PM. The PM will notify the Navy RPM of any field quality issues that would negatively impact data quality or schedule. The PM will have 24 hours to respond to the request for field CA. CA with laboratories will be coordinated by PC. The Navy RPM and Navy Chemist may be notified of any lab issues that render data quality objectives (DQOs) unattainable or cause delivery issues such that project schedule cannot be met No analytical data can be released until validation of the data is completed and has been approved by the PC. The PC will review analytical results within 7 days of receipt for release to the project team; on a daily basis, tracks data from sample collection through database upload.
Generation of figures	Project Geographic Information System (GIS) Manager	Mary Beth Artese	(757) 671-6228	Provides support as needed for field activities and evaluation of data by generating figures using GIS.
Reporting Lab Data Quality Issues	Laboratory PM	Jennifer Obrin/ Katahdin Deb Patton/ ALS Rochester	(207) 874-2400 (585) 288 5380	All QA/QC issues with project field samples will be reported within 2 days to the PC by the laboratory.
Reporting Data Validation Issues	Data Validator	Doug Weaver	(757) 564-0090	All data validation issues (missing lab data worksheets, calculations, etc.) will be relayed to PC if there is inadequate lab response within 2 days of initial inquiry.

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SAP Worksheet #7—Personnel Responsibilities Table

Name	Title/Role	Organizational Affiliation	Responsibilities
Dave Cleland	NTR	NAVFAC	Oversees project.
Charity Delaney	Environmental Engineer, Base EMD	MCIEAST-MCB CAMLEJ	Oversees project.
Patti Vanture	Environmental Engineer, Base EMD	MCIEAST-MCB CAMLEJ	Base POC.
Gena Townsend	USEPA RPM	USEPA	USEPA POC.
Randy McElveen	NCDENR RPM	NCDENR	NCDENR POC.
Matt Louth	AM	CH2M HILL	Oversees project activities.
Kim Henderson	Deputy AM	CH2M HILL	Oversees project activities.
Jessica Skeean	AQM	CH2M HILL	Oversees project quality.
Dan Hockett	PM	CH2M HILL	Manages project and coordinates project tasks and project staff.
Timothy Garretson	MRP Technical Lead	CH2M HILL	Provides review and approval for all MRP-related issues for the project.
Janna Staszak	Navy CLEAN Program UFP-SAP Reviewer	CH2M HILL	Navy CLEAN Program UFP-SAP Reviewer.
Tom Roth	STC (MRP)	CH2M HILL	Provides oversight and review of all MRP-related activities.
Matt Barner	Project Geophysicist	CH2M HILL	Provides oversight and review of all geophysical survey-related activities. Coordinates with geophysical survey subcontractor for data review.
Carl Woods	H&S Manager	CH2M HILL	Prepares HSP; manages H&S for all field activities.
George DeMetropolis	CH2M HILL/MR Safety & Quality Control Officer	CH2M HILL	Provides MR H&S and quality guidance for all field activities.
TBD	UXO Qualified Personnel	CH2M HILL	Supervises munitions-related field activities, including munitions and explosives of concern (MEC) avoidance procedures.
TBD	FTL/Site Safety Coordinator (SSC)	CH2M HILL	Provides technical oversight and support for UFP-SAP revisions and fieldwork implementation, supervises and coordinates field activities, and oversees H&S for field activities.
TBD	Geophysical Survey Subcontractor Team	TBD	Manages geophysical data and maintains communication with CH2M HILL PM and Project Geophysicist.
Anita Dodson	Navy CLEAN Program Chemist	CH2M HILL	Provides UFP-SAP project delivery support, provides senior review of UFP-SAP before submittal to Navy, and performs data evaluation and QA oversight.

SAP Worksheet #7—Personnel Identification and Responsibilities Table (Continued)

Name	Title/Role	Organizational Affiliation	Responsibilities
Bianca Kleist	NTR	CH2M HILL	Responsible for data management and coordinate with laboratories.
Mary Beth Artese	Environmental Engineer, Base EMD	Critigen	GIS support and field data evaluation.
Jennifer Obrin	Laboratory PM	Katahdin	Responsible for data analysis/coordination.
Deb Patton	Laboratory PM	ALS Rochester	Responsible for data analysis/coordination.
Doug Weaver	Data Validator PM	DataQual	Responsible for data validation for environmental samples.

SAP Worksheet #8—Special Personnel Training Requirements Table

Project Function	Specialized Training By Title or Description of Course	Training Provider	Training Date	Personnel / Groups Receiving Training	Personnel Titles / Organizational Affiliation	Location of Training Records / Certificates
Fieldwork	MEC Awareness Training	CH2M HILL UXO Qualified Personnel	Before mobilization	FTL (TBD), field team members (TBD), SSC (TBD), subcontractor(s)	Field team members and SSCs from CH2M HILL Field team members from subcontractor(s)	HSP file, project folder
Explosives Safety	Explosives Ordnance Disposal or UXO Formal Training Course	Graduate of a military EOD school of the United States; or a graduate of a military EOD school of Canada, Great Britain, Germany, or Australia; or a graduate of a commercial formal UXO Technician I course		UXO qualified personnel and UXO technicians	Senior UXO Supervisor (SUXOS), UXO Quality Control Specialist (UXOQCS), UXO Safety Officer (UXOSO), UXO Technician (All Levels)/ CH2M HILL, USAE	CH2M HILL HSE

Training records for CH2M HILL personnel are available on the CH2M HILL Virtual Office.

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SAP Worksheet #9—Project Scoping Session Participants Sheet

Project Name: UXO-22 Battery Disposal Area Investigation **Projected Date(s) of Investigation**: 2013 **PM**: Dan Hockett/CH2M HILL	**Site Name**: UXO-22 **Site Location**: MCIEAST – MCB CAMLEJ, NC
Date of Session: August 21, 2013 **Scoping Session Purpose:** Discuss the path forward for UXO-22 Battery Disposal Area Investigation and reach consensus for the UFP-SAP.	

Name	Title/Project Role	Affiliation	Phone #	E-mail Address
Dave Cleland	NTR	NAVFAC Mid-Atlantic	(757) 322-4851	dave.t.cleland@navy.mil
Charity Delaney	RPM	MCIEAST- MCB CAMLEJ EMD	(910) 451-9385	charity.rychak@usmc.mil
Patti Vanture	RPM	MCIEAST- MCB CAMLEJ EMD	(910) 451-9641	patricia.vanture@usmc.mil
Gena Townsend	RPM	USEPA	(404) 562-8358	townsend.gena@epa.gov
Randy McElveen	RPM	NCDENR	(919) 707-8341	randy.mcelveen@ncdenr.gov
Matt Louth	AM	CH2M HILL	(757) 671-6240	matt.louth@ch2m.com
Kim Henderson	Deputy AM	CH2M HILL	(757) 671-6231	kimberly.henderson@ch2m.com
Tom Roth	STC	CH2M HILL	(404) 474-7640	tom.roth@ch2m.com

Comments and Decisions

The Team discussed the approach for delineating the battery disposal area prior to the EE/CA. The following consensus statement was approved by the partnering team:

Consensus Statement

The Team agrees with the following investigation approach to evaluate the horizontal and vertical extent of battery disposal:

- Conduct geophysical evaluation of approximately 1 acre
- Excavate test pits to evaluate depth of battery disposal
- Collect up to four soil samples from test pits for metals analysis and up to three samples for toxicity characteristic leaching procedure (TCLP) analysis to assist in evaluation of potential soil remedial actions.

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SAP Worksheet #10—Conceptual Site Model

Site Location and Description

MCIEAST-MCB CAMLEJ covers approximately 236 square miles in Onslow County, North Carolina, and is bisected by the New River, which flows in a southeasterly direction toward the Atlantic Ocean (**Figure 1**). Construction of the Base began in 1941 and has since been the home of "Expeditionary Forces in Readiness" (MCIEAST-MCB CAMLEJ, 2012).

Site UXO-22 consists of portions of Installation Restoration (IR) sites 6 and 82, which are part of Operable Unit (OU) 2, located in the 'Mainside' portion of MCIEAST – MCB CAMLEJ. Site UXO-22 encompasses approximately 75 acres of partially developed land that includes Lot 201 and the former Defense Reutilization and Marketing Office (DRMO) Storage Lot 203. Site UXO-22 is accessible by an unnamed dirt and gravel road that bisects the site from east to west and connects Holcomb Boulevard to Piney Green Road. The battery disposal area, located just outside the northeast corner of the former DRMO lot, generally consists of compacted gravel or bare ground with debris (including disposed batteries) scattering the ground surface (**Figure 2**).

Site History

The earliest documentation of land use at the site is from archival aerial photography taken in 1948 that shows cleared land and the unnamed gravel road between Holcomb Boulevard and Piney Green Road.

Since 1983, numerous phases of environmental investigation and remediation have been conducted at OU2. These investigations identified potential unacceptable risks from exposure to pesticides, polychlorinated biphenyls, and metals in soil, and volatile organic compounds (VOCs) and metals in groundwater at sites 6 and 82. A Record of Decision was signed in 1993 (Baker, 1993a) and identified the selected remedy as excavation of soil to achieve levels acceptable for industrial use, groundwater extraction and treatment to address VOCs in groundwater, long-term monitoring (LTM) to monitor groundwater and potential migration, and land use controls (LUCs) to prevent exposure to affected soil and groundwater, prevent non-industrial land use, and prevent aquifer use (Baker, 1993a). The remedies are in place at sites 6 and 82, and supplemental investigations and actions have been conducted and are ongoing to delineate the nature and extent of chlorobenzene contamination at Site 6, further evaluate source areas, delineate the vertical and lateral extent of VOC contamination at Site 82, and conduct additional groundwater evaluation for metals at sites 6 and 82. During the previous and ongoing investigation and remediation activities, MEC and material potentially presenting an explosive hazard (MPPEH) have been discovered at the site. Following the discovery of a burial pit containing MPPEH between the former DRMO and Base Scales in 2008, Site UXO-22 was incorporated into the MRP in May 2010.

A preliminary assessment/site inspection (PA/SI) was conducted at Site UXO-22 and included the collection of soil and groundwater samples and evaluation of MEC and MPPEH found to-date (CH2M HILL, 2012a). Several explosives residues and metals were detected at concentrations in exceedance of regulatory standards in soil and groundwater. Ten MEC items and more than 2,000 MPPEH items have been discovered on the ground surface or in the shallow subsurface during previous investigations. The following MEC items have been discovered (with quantities noted) (**Figure 3**):

- M43 81-millimeter (mm) high explosive (HE) mortar shell (fuzed) (1)
- M49 60-mm HE mortar shell (no fuze) (1)
- M28 high explosive anti-tank (HEAT) rocket (1)
- MK II hand grenades (7)

The results of the human health and ecological risk screenings indicated potential unacceptable risks to the following receptors:

SAP Worksheet #10— Conceptual Site Model (continued)

- Future child and lifetime residents from exposure to hexavalent chromium in one subsurface soil sample
- Current and future contact by child trespassers/visitors, primarily from exposure to thallium in the ephemeral drainage soil
- Terrestrial ecological receptors from exposure to metals (antimony, cadmium, hexavalent chromium, chromium, copper, lead, manganese, mercury, selenium, thallium, and zinc) in soil and/or dry sediment in the ephemeral drainage.
- Unauthorized site visitors or site workers who venture outside typical site work areas who could encounter MEC/MPPEH, primarily in the wooded areas where MEC surface clearance has not been performed

No unacceptable risks were identified from exposure to explosives residues in soil or from metals in groundwater. Metals were detected in soil samples collected from areas across the site, including in areas where MPPEH and MEC were not discovered and, the samples containing the highest metal concentrations were collected in the ephemeral drainage where a potential source of metals (disposed batteries) was observed. The metals exceedances are likely associated with the long-term use as a historical storage and waste disposal area rather than with the presence of MPPEH and MEC. LUCs that encompass Site UXO-22 are in place for OU 2 to prevent non-industrial land use and restrict intrusive activities, and the Base provides MEC Awareness Training to site workers to mitigate potential hazards from MEC/MPPEH.

Based on the results of the PA/SI, a remedial investigation (RI), which is currently underway, was recommended at Site UXO-22 to further characterize the nature and extent of MEC. MEC surface clearance was also recommended in the wooded areas and in the former DRMO area to minimize explosive risks, and is currently being conducted. The PA/SI also recommended further evaluation of the subsurface soil and surface soil from the ephemeral drainage, where disposed batteries were observed because of potential unacceptable ecological risks. This UFP-SAP addresses the evaluation of the disposed batteries for the preparation of an EE/CA.

Site Geology

The former DRMO lot, adjacent to the battery disposal area, is underlain by light-colored, fine-grained sands extending to depths of at least 50 ft below ground surface (bgs), with discontinuous silty or clayey sand lenses occurring at depths from 10 to 50 ft bgs. Beneath the finer-grained lenses lie massive fine-grained sands and occasional cemented limestone beds of the River Bend and Castle Hayne formations, extending to more than 200 ft bgs.

Hydrogeology

Two aquifers are present beneath the battery disposal area: the surficial aquifer, and the Castle Hayne aquifer. The surficial aquifer is part of the Undifferentiated Formation, which consists of unconsolidated silt, sand, and clays to approximately 25 ft bgs. The water table is encountered at approximately 10 ft bgs in the northern portion of the former DRMO lot adjacent to the battery disposal area. The surficial aquifer is typically underlain by the Belgrade Formation or Castle Hayne Confining Unit, but this unit is absent from beneath Site UXO-22. The River Bend Formation (Castle Hayne Aquifer) underlies the Undifferentiated Formation and consists of cemented sands, silt, shells, fossil fragments, and trace amounts of clay, with limestone content increasing with depth (Cardinell, et al., 1993). The Castle Hayne Aquifer is composed of two hydrostratigraphic units: the Upper Castle Hayne Aquifer, and the Middle Castle Hayne Aquifer. The Upper Castle Hayne Aquifer extends from approximately 25 ft bgs to 60 ft bgs at Site 82 (the southern border of the battery disposal area). The Middle Castle Hayne Aquifer extends from 60 to 310 ft bgs at Site 82.

SAP Worksheet #10— Conceptual Site Model (continued)

Surface Water Hydrology

The site elevation ranges between approximately 20 and 30 feet above mean sea level (ft amsl). The topography within the battery disposal area slopes gently toward Wallace Creek, where a narrow ravine forms an ephemeral drainage that conveys stormwater runoff from the former DRMO lot and battery disposal area to Wallace Creek. Wallace Creek ultimately drains into the New River.

Ecological Setting

Coniferous woodlands are present in the eastern portion and along the northern boundary of Site UXO-22. The former DRMO area is predominantly open field, with the remainder of the site generally consisting of compacted gravel or bare ground. An ephemeral drainage extends northwest from the former DRMO and discharges into Wallace Creek. Site soils are predominantly sandy, and surface water generally infiltrates into the ground. As a result, surface water is not typically retained within the ephemeral drainage, and therefore would not support aquatic receptors. Stormwater runoff discharges into the ephemeral drainage located at the northern edge of the former DRMO.

Human Health and Ecological Exposure Pathway Components

A complete human health exposure pathway associated with the Site UXO-22 battery disposal area has two components:

- Site visitors, trespassers, or MCIEAST-MCB CAMLEJ personnel who may be exposed to disposed batteries and/or metal-contaminated surface or subsurface soils through dermal contact and/or accidental ingestion
- Site visitors, trespassers, or MCIEAST-MCB CAMLEJ personnel who may be exposed to MEC. The potential MEC exposure pathway is being addressed by the UXO-22 remedial investigation/feasibility study process which is currently underway. A separate UFP-SAP was prepared for the UXO-22 RI.

A complete ecological receptor exposure pathway associated with the Site UXO-22 battery disposal area has three components:

- Ecological receptors exposed to metal-contaminated soil and/or decomposing batteries
- Transport of metals to surface water (either through groundwater discharge, dissolution of metals into surface water runoff, or transport of surface soil to surface water) where ecological receptors could be exposed.
- Leaching of metals to groundwater with subsequent discharge to surface water

Potential unacceptable ecological risks associated with exposure to metals in soil and the transport of metals into surface waters and sediment exists, but these are related to the waste disposal activities associated with OU2 and will be addressed as part of the ongoing IR sites 6 and 82 supplemental investigations.

Potential Source Areas

The potential source area of metals is the disposed batteries, based on historical soil sample results and the presence of visible batteries and debris. However, since the investigation area is located within an MMRP site, the potential for encountering MEC also exists; therefore, contingency management of MEC/MPPEH is included.

Exposure Pathways

An exposure pathway describes the mechanisms whereby receptors come into contact with batteries, MEC/MPPEH, or metals in the soil. Exposure, and therefore potential risk, can only occur if complete exposure pathways exist.

SAP Worksheet #10— Conceptual Site Model (continued)

A potential exposure pathway exists for human and/or ecological receptors to come into contact with disposed batteries and/or metal-contaminated soil through dermal contact or incidental ingestion during site visits or potential future site activities. Another pathway for human receptors is accidental contact with MEC/MPPEH. Food chain effects, such as uptake of metals into vegetation and subsequent ingestion of vegetation by wildlife, present another potential exposure pathway for ecological receptors.

A complete exposure pathway requires both access and interaction. The receptor must not only have access to an area that contains the metal-contaminated soil or MEC/MPPEH, but the receptor's activities must be such that there is interaction with the batteries, soil, or MEC/MPPEH. Access to many areas of Site UXO-22 is restricted by either fencing or vegetation and terrain; however, the investigation area can be accessed by walking around the existing fencing and travelling up the ephemeral drainage. Therefore, unauthorized site visitors or site workers who venture outside their typical work areas could potentially encounter soil with metals or MEC/MPPEH.

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

Problem Statement/What is the Environmental Question that is being answered?

The purpose of the investigation is to evaluate the extent of a battery disposal area identified within the ephemeral drainage and to characterize the soil beneath the disposed batteries in preparation for an EE/CA and NTCRA to address the batteries as a potential continuing source of metals in soil.

The following environmental questions will be answered by the battery disposal area investigation:

- **What is the horizontal and vertical extent of battery disposal in the investigation area?**

  The data from the geophysical investigation will be used to evaluate the horizontal extent of battery disposal at the investigation area. In order to evaluate the vertical extent of the battery disposal area, up to five test pits will be excavated. The locations of the test pits will be based on the visible presence of batteries and digital geophysical mapping (DGM) data collected during the geophysical investigation. Test pits will be placed in the areas of greatest geophysical response and in areas where batteries are visible on the ground surface. Because there is a potential explosives hazard at the site, the most current Explosives Safety Submission (ESS) (CH2M HILL, 2010b) must be followed during the investigation, including oversight by properly trained UXO technicians and the establishment of exclusion zones whenever test pit excavation is performed.

- **What is the concentration of metals in soil underneath the battery disposal area?**

  A total of four soil samples will be collected during the investigation and analyzed for TAL metals and hexavalent chromium to assist in the evaluation of potential soil remedial actions. The soil sample results for metals will be compared to human health, ecological risk screening values and Base background values as part of the evaluation of EE/CA alternatives. The metals results will also be used to assist in calculating soil stabilization amendment dosing rates during the EE/CA. In order to calculate the dosing rates, the total metal concentrations must be known to account for competition of binding sites in the amendment. Therefore, samples will be analyzed for TAL metals.

- **If releases are identified through environmental sampling and analysis, what is the appropriate next step?**

  This determination will be made based on an evaluation of the analytical data in accordance with the steps outlined in **Worksheet #11**. An EE/CA is planned to evaluate alternatives to remove the disposed batteries and associated soil.

This section presents the project quality objectives for the battery disposal area investigation.

Who will use the data?

- The data will be used by CH2M HILL and the MCIEAST-MCB CAMLEJ Partnering Team to answer the questions previously listed.

What are the project action limits (PALs)?

- Soil samples analyzed for TAL metals and hexavalent chromium will be compared to the most conservative of the following criteria: North Carolina Soil Screening Levels (February 2012),the most current adjusted industrial and residential regional screening levels (RSLs, May 2013), and Base background values for undeveloped subsurface soil types.

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

For what will the data be used?

Data collected during this investigation will be used to evaluate the nature and extent of the battery disposal area to assist with preparation of a proposed EE/CA. Specific data uses are outlined below.

DGM data collected will be used to:

- Identify geophysical anomalies that represent a potential battery disposal area.
- Evaluate the horizontal extent of the potential battery disposal area.
- Assist in planning the potential remedial actions.

Test pit data will be used to:

- Evaluate the nature of the disposed debris.
- Evaluate the vertical extent of the disposed material.

Soil data will be used to:

- Evaluate the nature of soil contamination beneath the disposed batteries in preparation for the EE/CA and NTCRA.
- Evaluate if soil associated with the batteries can be managed as non-hazardous waste during a potential EE/CA and NTCRA.
- Compare total metals soil sample results to human health and ecological risk screening values and Base background values as part of the evaluation of EE/CA alternatives.
- Evaluate appropriateness and dosing requirements of potential soil stabilization reagents that could chemically bind and immobilize metals present in the soil during preparation of the EE/CA and NTCRA.

What types of data are needed?

- Because the purpose of this investigation is to evaluate the battery disposal area and assist in the evaluation of potential removal actions, the TAL will include TAL metals and hexavalent chromium, and TCLP analysis.
- Subsurface soil sample locations will be recorded using hand-held global positioning system (GPS) devices during environmental sampling activities within the test pit excavations.
- Project information (such as personnel, teams, instrument serial numbers, grid identification numbers, and locations).
- FTL notes (such as safety meetings, log books, and field requests to management).
- QC records (such as QC on notes, processing, data, and comparison of DGM results to intrusive results and field activities).
- DGM data are required to identify geophysical anomalies representing a potential battery disposal area. Test pits will be excavated based on the DGM data, and the visible presence of batteries on the surface. Refer to **Worksheet #11** and the **Geophysical Survey Work Plan** in **Attachment 5** for further information.

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

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

- The DGM positional data must be of sufficient accuracy to allow for the selection of test pit locations in areas where metal is detected. Measurement performance criteria are described in the **Geophysical Survey Work Plan (Attachment 5).**
- Subsurface soil samples collected from excavated pits will be from vadose zone soil and in areas of visible staining and contaminant impact (if observed). Sampling activities involving excavations will be conducted in accordance with "Field Standard Operating Procedures—CH2M HILL" (**Attachment 1**).
- During the investigation, QA/QC samples will be collected along with the various media samples as a check on sampling and analytical protocol. **Worksheet #20** describes the QA/QC quantities and analyses for this UFP-SAP.
- The specific QC audit procedures for the definable features of work (DFOWs) to be employed at the battery disposal investigation area, including the phase during which it is performed, the frequency of performance, the pass/fail criteria, and actions to take if failure occurs, are presented in the **Geophysical Survey Work Plan (Attachment 5)**.
- Laboratory analytical data will be distributed to a third-party validator for data quality evaluation. Data validation procedure requirements are detailed in **Worksheet #36**. The data must be of sufficient quality for determining the concentrations of constituents in media samples collected at the site with a level of confidence that the project objectives can be achieved.

How much data should be collected?

- DGM will be performed across approximately 1 acre of the site (**Figure 2**).
- Up to four soil samples will be collected from the excavated test pit floor and will be analyzed for TAL metals and hexavalent chromium.
- Up to three soil samples will be collected from the excavated test pit floor and will be analyzed by TCLP.

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

- DGM will be performed across accessible areas of the approximately 1 acre battery disposal investigation area using a Geonics EM31-MK2 and a Geometrics G-858 Gradiometer. The data will be used to identify geophysical anomalies and areas representing potential subsurface waste disposal areas. See the **Geophysical Survey Work Plan (Attachment 5)** for more details.
- The soil samples will be collected from the base of four of the five test pits as explained in **Worksheet #14**.
- The schedule of activities is presented in **Worksheet #16**.
- Data will be collected and generated IAW the procedures outlined in this UFP-SAP. Specifically, see the **Technical Management Plan (TMP)** (**Attachment 4**) for more details.

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

- DGM data will be collected and reported by a qualified geophysical operator (TBD). Geophysical data will be provided via a secure file transfer protocol (FTP) site maintained by CH2M HILL. Data will also be provided on digital video disk or compact disk with the final report, as detailed in the **Geophysical Survey Work Plan** (**Attachment 5**).

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

- The test pit investigation will be conducted by qualified UXO subcontractors supervised by CH2M HILL UXO personnel IAW **Section 3** of the **TMP** (**Attachment 4**).
- CH2M HILL staff will collect the environmental samples as outlined in **Worksheet #18.**
- Samples will be shipped for analysis via overnight courier to an offsite, Navy-approved laboratory under subcontract to CH2M HILL.
- Laboratory analyses will be performed by Katahdin Analytical Laboratories and ALS Rochester. Katahdin is the primary subcontractor. Both laboratories possess Department of Defense (DoD) Environmental Laboratory Accreditation Program (ELAP) certification for the analyses they are to perform for this project.
- Once generated, all analytical data will be submitted to DataQual for validation against the analytical methodology requirements and measurement performance criteria presented in this UFP-SAP.
- CH2M HILL will receive validated data and upload the data into a centralized electronic database used for Navy projects (Naval Installation Restoration Information System [NIRIS]) by the project team(s).
- All data will be reported in a summary technical memorandum report that will be submitted to the Navy and Base as a draft for review before distribution to NCDENR and USEPA for review and approval.

How will the data be archived?

- Data will be archived according to procedures dictated via the Navy CLEAN program and contract. The data will also be loaded into NIRIS. At the end of the project, paper copies of archived laboratory data and validation reports will be returned to the Navy.

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

The data to be collected during this investigation is not intended for a quantitative risk-based decision. Data from this investigation may be used during future project activities to further develop PQOs for additional investigations or activities. PQOs are provided as follows, in the form of if/then statements, to summarize the objectives of this investigation.

- If the intrusive investigation identifies MPPEH, the item will be managed IAW the ESS (CH2M HILL, 2010b). MPPEH will be visually inspected and independently reinspected for explosive hazards. MPPEH that cannot be classified as material documented as safe (MDAS) will be disposed of in the same manner as MEC. MDAS will be transported offsite. The location of MPPEH will be recorded using a hand-held GPS unit so the coordinate data can be entered into the NIRIS database for reporting purposes.

SAP Worksheet #12-1—Measurement Performance Criteria Table

Matrix: Subsurface Soil Samples
Analytical Group: TAL Metals
Concentration Level: Medium

QC Sample	Analytical Group	Frequency	DQIs	MPC	QC Sample Assesses Error for Sampling (S), Analytical (A), or both (S + A)
Equipment Rinseate Blank	TAL Metals	One per day of sampling	Bias/Contamination	No analyte detected > 1/2 LOQ	S + A
Cooler Temperature Blank		One per cooler to the laboratory	Accuracy/Representativeness	0-6°C	S
Field Duplicate		One per 10 samples per matrix	Precision	RPD < 35%	S + A

SAP Worksheet #12-1—Measurement Performance Criteria Table (continued)

DFOW with Auditable Function	Responsible Person(s)[1]	Audit Procedure[2]	QC Phase[3]	Freq. of Audit	Pass/Fail Criteria	Action if Failure Occurs
Geophysical Survey Work Plan Execution	PM, Project Geophysicist	Verify DQOs established in Geophysical Survey Work Plan have been accomplished.	PP/IP	O	DQOs identified in Geophysical Survey Work Plan have been achieved.	Continue with Geophysical Survey Work Plan until DQOs are achieved.
DGM Survey	Project Geophysicist	Verify DGM survey conducted IAW Geophysical Survey Work Plan and DGM standard operating procedures (SOPs): EM31-MK2 electrical conductivity survey Geometrics G-858 Gradiometer magnetic gradient survey Geophysical Surveying with EM31-MK2 Survey and mark corners of a local grid system Collect data using fiducial methods to determine the spatial location of the collected data Field Methodology and Survey Setup	IP/FP	O/D	DGM survey conducted IAW Geophysical Survey Work Plan and DGM SOPs.	Stop activity until full compliance can be assured and any activities not performed within compliance criteria are re-evaluated and re-performed if necessary.
DGM Survey	Project Geophysicist	Check results of QC tests performed as specified in the Quality Control Plan and DGM SOPS.	FP	E	QC tests must pass IAW standards determined during the Geophysical System Verification and referenced SOPs.	If a QC test does not pass, a root cause analysis must be performed and the project team must meet to discuss and determine appropriate action.
DGM Survey	Project Geophysicist	Confirm that DGM survey DQOs established during Geophysical Survey Work Plan are being met.	FP	E	DGM survey DQOs are being met.	If the DQOs are not being met, a root cause analysis must be performed and the project team must meet to discuss and determine appropriate action.
DGM Data processing	Project Geophysicist	Verify data checks specified in Quality Control Plan and SOPs: EM31-MK2 Data Processing and Database management Uploading and Downloading Data to the FTP Site	FP	E	Data checks must pass IAW standards determined during the Geophysical System Verification and referenced SOPs.	If a QC test does not pass, a root cause analysis must be performed and the project team must meet to discuss and determine appropriate action.
Excavate test pits	UXOQCS	Verify equipment tested IAW the Work Plan.	IP/FP	D	Equipment testing performed and tests passed.	Repair or replace instrument.
Excavate test pits	UXOQCS	Verify team separation distance is as established per the ESS.	IP/FP	D	Team separation distance is appropriate for work being performed	Stop activities until appropriate separation distance is being followed.
Excavate Test Pits	UXOQCS	Verify operations are conducted IAW ESS, TMP, Geophysical Survey Work Plan, MEC Removal SOPs, and the HSP: - Analog Detection and Removal Actions - DGM Investigation - Disposal/Demolition Operations - Scrap Inspection Operations	IP/FP	D	Work performed IAW Work Plan, referenced MEC SOPs, and the HSP.	Stop activity until full compliance can be assured and any activities not performed within compliance criteria are re-evaluated and re-performed if necessary.
MPPEH Management	UXOQCS	Verify inspections conducted IAW ESS.	IP/FP	D/E	Inspections being conducted IAW the SAP.	Stop activity until full compliance can be assured and any activities not performed within compliance criteria are re-evaluated and re-performed if necessary.

SAP Worksheet #12-1—Measurement Performance Criteria Table (continued)

DFOW with Auditable Function	Responsible Person(s)[1]	Audit Procedure[2]	QC Phase[3]	Freq. of Audit	Pass/Fail Criteria	Action if Failure Occurs
MPPEH Management	UXOQCS	Verify certification conducted IAW ESS.	IP/FP	D/E	Certification is conducted IAW the TMP.	Stop activity until full compliance can be confirmed and any activities not performed within compliance criteria are re-evaluated and re-performed if necessary.
MPPEH Management	UXOQCS	Verify disposal is conducted IAW ESS.	IP/FP	D/E	Disposal is conducted IAW the TMP.	Stop activity until full compliance can be confirmed and any activities not performed within compliance criteria are re-evaluated and re-performed if necessary.
Site Restoration	Site Manager	Verify the damage caused by excavation is backfilled and laid to original grade and completed IAW the TMP.	FP	O	Damage caused by excavation and removal of anomalies is backfilled and laid to original grade.	Make sure that damage caused by excavation and removal of anomalies is backfilled and laid to original grade.
Demobilization	PM	Verify facilities support infrastructures are dismantled and shipped to appropriate location and area is returned to original condition.	FP	O	Facilities support infrastructures are dismantled and shipped to appropriate location and site is returned to original condition.	Make sure that all support facilities are removed and that the site is returned to original condition.
Final Project Reports and Closeout						
Tech Memo preparation and approval	PM	Verify all phases of environmental investigation were performed correctly and are complete.	FP	O	Investigation performed is accurate and complete.	Investigation performed is accurate and complete.
Archiving	GIS Manager	Verify data back-up systems are in place.	IP	O	Data back-up systems are in place.	Be sure data back-up systems are in place.
Project Closeout	PM	Verify purchase orders have been closed out.	IP	O	Purchase orders have been closed out.	Be sure purchase orders are closed out.
Project Closeout	PM	Verify invoices completed and approved.	IP	O	Invoices completed and approved.	Be sure invoices are completed and approved.

Notes:

QC Phase	Frequency
PP = Preparatory Phase	O = Once
IP = Initial Phase	D = Daily
FP = Follow-up Phase	W = Weekly
	E = Each occurrence

[1] The responsible person (if other than the UXOQCS) is the individual with whom the UXOQCS will coordinate to ensure compliance with requirements and to verify that any necessary follow-up actions are taken.

[2] Where appropriate, a reference has been included referring the reader to a more-detailed description of the procedures being audited.

[3] Documentation to be IAW the three-phase control process as outlined in the Quality Control Plan.

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SAP Worksheet #13—Secondary Data Criteria and Limitations Table

Secondary Data	Data Source	Data Generator (s)	How Data Will Be Used	Limitations on Data Use
Locations and types of MEC found	Baker Environmental, Inc. (Baker). 1993b. *Remedial Investigation Report for Operable Unit No. 2, MCIEAST – MCB CAMLEJ, North Carolina.*	Baker, environmental sampling to assess the nature and extent of impacts in all site media resulting from historical site use.	Report lists MPPEH and/or MEC items discovered at the site	MEC list may not be inclusive of all potential MEC at Site UXO-22
	OHM Remediation Services Corporation (OHM). 1997. *Final Contractor's Closeout Report for Sites 6 and 82 Source Removal, Operable Unit No. 2, MCB CAMLEJ, North Carolina.*	Baker and OHM, conducted source removal from areas within IR Site 6 and IR Site 82.		
	CH2M HILL. 2010c. *Final Site 6 Chlorobenzene Investigation Summary Report, MCIEAST – MCB CAMLEJ, North Carolina.*	CH2M HILL, conducted plume delineation and geophysical survey to detect source.		
	Rhea Engineers and Consultants, Inc. (Rhea), 2010. *Final Phase II Lot 203 Environmental Condition of Property DRMO Area, MCIEAST – MCB CAMLEJ, North Carolina.*	Rhea, evaluated whether environmental problems exist (before beginning lease renewal negotiations).		
	Earth Resources Technology, Inc. 2010. *Draft After Action Report—Results of Excavation Activities at OU 2, Site 82, MCIEAST – MCB CAMLEJ, North Carolina.*	Rhea and Earth Resources Technology Conducted an intrusive investigation to identify the nature of the geophysical anomalies discovered north of water treatment plant during Phase II Environmental Condition of Property.		
	CH2M HILL. 2011. *Final Time-Critical Removal Action Summary, Site 6-Storage Lots 201 and 203, Technical Memorandum, MCIEAST – MCB CAMLEJ, North Carolina.*	CH2M HILL, expanded and removed all MPPEH from burial pit discovered during the chlorobenzene investigation.		
	CH2M HILL. 2012a. *Preliminary Assessment Site Inspection Report, Site UXO-22 – Former Munitions Disposal Area, MCIEast – MCB CAMLEJ North Carolina*.	CH2M HILL, assessed the presence of munitions constituents (MC) and metals downgradient of MEC/MPPEH point sources.		

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SAP Worksheet #14—Summary of Project Tasks

Activities to be performed at this site have been divided into DFOWs as well as the tasks to be completed for each of these definable features. Procedures for these tasks, including QC checks, recording and correcting data, data processing, data management, and information management, will be performed in accordance with the **TMP (Attachment 4)** listed in **Worksheet #23** of this UFP-SAP.

DFOW	Tasks
Pre-mobilization Activities	GIS Setup Document Management and Control Data Management Subcontractor Procurement
Mobilization and Site Preparation	Mobilize Crew and Equipment Onsite Document Review Communications and Logistics Establishment Site-specific Training
Geophysical Investigation	Equipment Testing Review of Work Methods Geophysical Survey (EM31-MK2) Geometrics G-858 Gradiometer Data Transfer/Upload to FTP Site
Data Evaluation	QC Review of Field Data Pre-processing of Data Geophysical Data Processing and Interpretation QC of Final Data Selection of anomalies for locating test pits
Test Pit Investigation	Select locations based on DGM data and visual signs of batteries on the surface Destroy MEC items by detonation Confirm that all MPPEH has been documented as MDAS with all required documentation. MDAS will be transported offsite for thermal destruction.
Soil Sample Collection	Collect soil samples from the floor of test pit excavations IAW SOPs (**Attachment 1**). Ship soil samples to laboratory for analysis.
Demobilization	Demobilize Crew and Equipment
Final Report and Closeout	Data Compiling and Reporting Report Preparation Data Archiving Procurement Closeout

Pre-mobilization Activities

This UFP-SAP has been developed to provide detail for how the project will be performed and the quality standards to which it will be compared. Before mobilization to the site, this plan will be reviewed and approved by CH2M HILL, the Navy, the Base, and the regulators. Additionally, coordination will be made to be sure GIS information and equipment are available and updated for project activities, document and data management procedures are in place, and all subcontractors have been procured. Subcontractor qualifications, certifications, and licenses will be reviewed before selection.

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

Mobilization and Site Preparation

All required field personnel, equipment, and materials will be mobilized to the battery disposal area at Site UXO-22. Onsite personnel will review this UFP-SAP and all applicable SOPs and appendices. Appropriate site-specific training, including H&S review for site activities, and MEC Awareness Training, will be verified or performed. Minimum training requirements are listed in **Worksheet #8**. Additionally, a daily morning safety meeting will be conducted to review the tasks to be performed that day and any potential hazards present.

All equipment will be inspected upon arrival at the site, will be tested for functionality, and will be repaired or replaced as necessary to ensure quality performance. Equipment inspections will also be performed daily throughout the project to ensure proper functionality and prevent any damage. Good housekeeping procedures will be followed to reduce the risk of equipment damage. Other equipment and requirements will be outlined in the site-specific HSP.

The FTL will make sure that onsite communications (such as mobile phones, two-way radios) have been established among team members. The FTL will also make sure that the MCIEAST-MCB CAMLEJ Environmental Manager and NCDENR have been notified of site activities and have in place proper emergency response actions.

Before the geophysical survey is conducted, vegetation clearing will be performed to facilitate site access. The geophysical survey area will cover approximately 1 acre of area around the battery disposal area (**Figure 2**). UXO qualified personnel will implement MEC avoidance measures to prevent unintentional contact with potential MEC during land surveying and vegetation clearing activities.

Geophysical Survey

After site setup activities have been completed, DGM will be performed at the site. Note that required QC checks of the equipment, as described in **Worksheet #12-1** and **Attachment 5**, will be performed throughout the survey process.

See the **Geophysical Survey Work Plan**, **Attachment 5,** for geophysical survey details.

Geophysical Data Processing and Interpretation

See the **Geophysical Survey Work Plan**, **Attachment 5,** for geophysical survey details. Once QC review of the geophysical data has been performed, the data will be evaluated for selection of targets that may represent potential battery disposal piles or potential MEC/MPPEH as detailed in **Section 3** of the **TMP**, **Attachment 4**.

Test Pit Investigation

Geophysical data may indicate the presence of potential battery disposal areas. The proposed DGM survey may also identify potential battery disposal areas that may also contain MEC/MPPEH. If battery disposal areas are identified, the disposal area will be investigated with the intent of characterizing the contents, rather than remediating the disposal area by complete excavation.

The UXO team performing intrusive investigation will be composed of qualified UXO technicians supervised by a UXO Technician III. MR work will take place under the guidance of a SUXOS. Safety will be overseen by a UXOSO, and QC requirements will be implemented by a UXOQCS. The intrusive investigation will be performed as detailed in **Section 3** of the **TMP** (**Attachment 4**).

Soil Sample Collection

The four test pits containing the greatest concentration of batteries based on visual observations in the field will be assessed by collecting soil samples from the base of the excavation. If the concentration of batteries in each of the test pits appears similar, then test pits selected for soil sampling will be based on evenly distributing the sampling across the area containing batteries. The samples will be analyzed for TAL metals. At three of the test

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

pit locations selected for soil sampling, TCLP samples will also be collected from beneath the batteries. These three locations will be based on greatest concentration of batteries based on visual observations in the field.

Demobilization

Full demobilization will occur when the project is completed and appropriate QA/QC checks have been performed. Personnel no longer needed during field operations may be demobilized prior to the final project completion date. The following will occur prior to demobilization:

- Chain-of-custody records will be reviewed to ensure that all samples were collected as planned and submitted for appropriate analyses.
- Restoration of the site to an appropriate level (e.g., repair of deep ruts) will be verified by the CH2M HILL Field Team Leader (FTL).
- All equipment will be inspected, packaged, and returned to the appropriate location.

Final Report and Closeout

At the conclusion of all field activities and data processing and interpretation, a draft technical memorandum report will be prepared. The report will be submitted electronically for concurrent review by NAVFAC and MCIEAST-MCB CAMLEJ. Following receipt of review comments, CH2M HILL will issue a revised draft technical memorandum report to NAVFAC, MCIEAST-MCB CAMLEJ, USEPA and NCDENR for review. A final report will be prepared that will address all comments received on the draft document. The report will summarize the site history, all field activities, geophysical data, and the findings of the test pit and soil sampling results.

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SAP Worksheet #15—Reference Limits and Evaluation Table

Matrix: Soil

Analytical Group: Metals

Analyte	Chemical Abstracts Service (CAS) Number	PAL [1]				Project Quantitation Limit (PQL) Goal[2] (mg/kg)	Laboratory-Specific Limits		
		North Carolina Soil Screening Level (NCSSL) (Feb. 2012) (mg/kg)	Adjusted Industrial RSLs (May 2013) (mg/kg)	Adjusted Residential RSLs for soil (May 2013) (mg/kg)	Base Background - Undeveloped SB Combined Soil Types (mg/kg)		LOQ (mg/kg)	LOD (mg/kg)	DL (mg/kg)
Aluminum	7429-90-5	NC	99000	7700	19000	3850	30	4	0.51
Antimony	7440-36-0	0.9	41	3.1	1.1	0.45	0.1	0.05	0.02
Arsenic	7440-38-2	5.8	2.4	0.61	5.09	0.305	0.5	0.4	0.15
Barium	7440-39-3	580	19000	1500	28.3	14.15	0.2	0.1	0.037
Beryllium	7440-41-7	63	200	16	0.332	0.166	0.1	0.02	0.0041
Cadmium	7440-43-9	3	80	7	0.208	0.104	0.1	0.02	0.0076
Calcium	7440-70-2	NC	NC	NC	1530	765	10	8	3.83
Chromium	7440-47-3	3.8	5.6	0.29	27.6	0.145	0.4	0.3	0.05
Chromium (Hexavalent)	18540-29-9	3.8	5.6	0.29	3.74	0.145	0.4	0.2	0.106
Cobalt	7440-48-4	0.9	30	2.3	1.36	0.45	0.1	0.03	0.0054
Copper	7440-50-8	700	4100	310	6.05	3.025	0.3	0.2	0.071
Iron	7439-89-6	150	72000	5500	12700	75	10	6	2.4
Lead	7439-92-1	270	800	400	11.2	5.6	0.1	0.05	0.007
Magnesium	7439-95-4	NC	NC	NC	776	388	10	8	1.37
Manganese	7439-96-5	65	2300	180	18.3	9.15	0.2	0.1	0.042
Mercury	7439-97-6	1	31	2.3	0.0852	0.0426	0.033	0.017	0.0052
Nickel	7440-02-0	130	2000	150	7.08	3.54	0.2	0.12	0.026

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

Matrix: Soil

Analytical Group: Metals

Analyte	Chemical Abstract Service (CAS) Number	PAL [1]				Project Quantitation Limit PQL Goal[2] (mg/kg)	Laboratory-Specific Limits		
		North Carolina Soil Screening Level (NCSSL) (Feb. 2012) (mg/kg)	Adjusted Industrial RSLs (May 2013) (mg/kg)	Adjusted Residential RSLs for soil (May 2013) (mg/kg)	Base Background - Undeveloped SB Combined Soil Types (mg/kg)		LOQ (mg/kg)	LOD (mg/kg)	DL (mg/kg)
Potassium	7440-09-7	NC	NC	NC	620	310	100	40	4.6
Selenium	7782-49-2	2.1	510	39	0.736	0.368	0.5	0.3	0.039
Silver	7440-22-4	NC	510	39	0.198	0.099	0.1	0.04	0.0066
Sodium	7440-23-5	3.4	NC	NC	NC	1.7	100	40	2.6
Thallium	7440-28-0	0.28	1	0.078	NC	0.039	0.1	0.04	0.0094
Vanadium	7440-62-2	6	510	39	35.6	3	0.5	0.4	0.11
Zinc	7440-66-6	1200	31000	2300	14.1	7.05	1	0.8	0.13

[1] PALs were developed to be protective of human health and the environment.

[2] PQL goals are half of the minimum PAL.

DL = detection limit

LOD = limit of detection

LOQ = limit of quantitation

mg/kg = milligrams per kilogram

NCSSLs are from NCDENR (February 2012).

Industrial and Residential Soil RSL values were adjusted from the USEPA RSLs Table (May 2013).

Base background values are from the MCIEAST-MCB CAMLEJ background values for undeveloped combined soil types as applicable to subsurface soil.

Shading represents instances where the PAL is lower than the limit of detection LOD. Non-detects will not be treated as exceedances, although they will be reported at a value greater than the PAL.

SAP Worksheet #15A—QC Acceptance Limits

Matrix: Soil
Analytical Group: Metals

Analyte	CAS Number	LCS, MS, and MSD %R Limits		
		LCL		
Aluminum	7429-90-5	80	120	20
Antimony	7440-36-0	80	120	20
Arsenic	7440-38-2	80	120	20
Barium	7440-39-3	80	120	20
Beryllium	7440-41-7	80	120	20
Cadmium	7440-43-9	80	120	20
Calcium	7440-70-2	80	120	20
Chromium	7440-47-3	80	120	20
Chromium (Hexavalent)	18540-29-9	80	120	20
Cobalt	7440-48-4	80	120	20
Copper	7440-50-8	80	120	20
Iron	7439-89-6	80	120	20
Lead	7439-92-1	80	120	20
Magnesium	7439-95-4	80	120	20
Manganese	7439-96-5	80	120	20
Mercury	7439-97-6	80	120	20
Nickel	7440-02-0	80	120	20
Potassium	7440-09-7	80	120	20
Selenium	7782-49-2	80	120	20
Silver	7440-22-4	80	120	20

SAP Worksheet #15A—QC Acceptance Limits (continued)

Matrix: Soil

Analytical Group: Metals

Analyte	CAS Number	LCS, MS, and MSD %R Limits		
		LCL		
Sodium	7440-23-5	80	120	20
Thallium	7440-28-0	80	120	20
Vanadium	7440-62-2	80	120	20

%R = percent recovery

LCS – laboratory control sample

MS – matrix spike

MSD – matrix spike duplicate

LCL – lower confidence limit

UCL – upper confidence limit

SAP Worksheet #16—Project Schedule / Timeline Table

Activities	Organization	Dates		Deliverable	Deliverable Due Date
		Anticipated Date of Initiation	Anticipated Date of Completion		
UFP-SAP					
Pre-Draft UFP-SAP	CH2M HILL	08/26/2013	11/29/2013	Pre-Draft UFP-SAP	12/3/2013
Navy/Navy Chemist/Base MR Review	NAVFAC	12/3/2013	12/17/2013	Comments on Pre-Draft UFP-SAP	
Draft SAP	CH2M HILL	12/18/2013	01/20/2014	Draft UFP-SAP	01/21/2014
Partnering Team Review	NAVFAC, MCIEAST-MCB CAMLEJ, NCDENR, USEPA, CH2M HILL	01/21/2014	02/04/2014	Comments on Draft UFP-SAP	
Final SAP	CH2M HILL	02/10/2014	02/17/2014	Final UFP-SAP	02/20/2014
Field Investigation					
Subcontractor Procurement	CH2M HILL	12/15/2013	02/14/2014		
Field Investigation	CH2M HILL, subcontractors (TBD)	03/03/2014	03/26/2014		

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SAP Worksheet #17—Sampling Design and Rationale

General Approach

The general sampling approach was developed in accordance with the Navy, USEPA, and NCDENR data collection requirements for soil sampling. The objective of the investigation is to evaluate the horizontal and vertical extent of the disposed batteries and to characterize the soil beneath the disposed batteries for purposes of developing cost estimates for the EE/CA. The rationale for selecting soil sample locations is presented in the soil sample collection section of WS #14. The soil samples will be collected from test pits excavated within the geophysical survey area (**Figure 2**).

Sample Matrices

Sample matrices will consist of subsurface soil samples from the vadose zone of excavated test pits. Soil samples will also be collected from excavated soil.

Analytical Groups

Analytical groups will include TAL metals (SW-846 6020), hexavalent chromium (SW-846 7199) and TCLP analysis (SW-846 1311) for disposal purposes only.

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SAP Worksheet #18—Sampling Locations and Methods/Standard Operating Procedure Requirements Table

Data collection activities performed at the site will include a geophysical investigation as indicated on **Figure 2**.

Location	Exclusion Areas	Matrix	Depth relative to Ground Surface	Survey Methodology	Degree of Investigation or Coverage	SOP Reference
Site UXO-22	None	Soil	Unknown	Geonics EM31-MK2	Approximately 1 acre of area	SOP Electromagnetic Induction
Site UXO-22	None	Soil	Unknown	Geometrics G-858 Gradiometer	Approximately 1 acre of area	SOP, Magnetometry

Soil samples will be collected from select test pits as follows:

Sample ID and Location[1]	Matrix	Analytical Group	Number of Samples	Sampling SOP Reference
Site UXO-22				See **Worksheet #21**
MR22-SB99-TB-BD-14A through MR24-SB103-TB-BD-14A	Subsurface Soil	TAL Metals and Hexavalent Chromium	Up to 5	

TB – Top depth

BD- Bottom depth

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SAP Worksheet #19—Analytical SOP Requirements Table

Matrix	Analytical Group	Analytical and Preparation Method/ SOP Reference[1]	Containers	Sample Volume	Preservation Requirements (Chemical, Temperature, Light Protected)	Maximum Holding Time (Preparation/Analysis)[2]
Soil	TAL Metals	SW846 3050B, SW846 6020C/CA-605, CA-627	One 2-oz wide-mouth jar	2 grams (g)	None	6 months to analysis
	Mercury	SW846 7471A/CA-611	One 2-oz wide-mouth jar	0.6 g	Cool to ≤ 6 degrees Celsius (°C)	28 days to analysis
	Hexavalent Chromium	SW846 7199/GEN-7199	One 4-ounce wide-mouth jar	2.5 g	Cool to ≤ 6 °C	30 days to digestion, 7 days until pH adjustment and analysis
Aqueous (Blanks)	TAL Metals	SW846 3010A, 6020A/CA-604, CA-627	One 250-milliliter (ml) polyethylene bottle	50 ml	Nitric Acid to pH<2	6 months to analysis
	Mercury	SW7470A/CA-615	One 250-ml polyethylene bottle	25 ml	Nitric Acid to pH<2	28 days to analysis
	Hexavalent Chromium	SW846 7199/GEN-7199	One 250-ml high-density polyethylene bottle	10 ml	Cool to ≤ 6 °C	24 hours

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SAP Worksheet #20—Field Quality Control Sample Summary Table

Matrix	Analytical Group	No. of Sampling Locations	No. of Field Duplicates	No. of MS/MSD	No. of Field Blanks	No. of Equip. Blanks	Total No. of Samples to Lab
Soil	TAL Metals	4	1	1/1	--	1	8
	Hexavalent Chromium	4	1	1/1	--	1	8

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SAP Worksheet #21—Project Sampling SOP References Table

Reference Number	Title, Revision Number and/or Date	Organization	Equipment Type	Modified for Project Work?	Comments
SOP-001	Completing Log Books, rev. 8/2013	CH2M HILL	Log book, indelible pen	No	
SOP-002	Decontamination of Personnel and Equipment, rev. 8/2013		Reusable sampling equip.		
SOP-003	Equipment Blank and Field Blank Preparation, rev. 8/2013		Lab-provided blank liquid and sample bottles		
SOP-004	Chain-of-Custody, rev. 08/2013		Chain-of-Custody Form		
SOP-005	Magnetometry, rev. 08/2013		Geometrics G-858 Gradiometer		
SOP-006	Electromagnetic Induction, rev. 08/2013		Geonics EM31-MK2		
SOP-007	Shallow Soil Sampling, rev. 08/2013		Stainless steel spoon and bowls		Soil sampling will be done by hand method
SOP-008	GPS, rev. 08/2013		Trimble GPS unit		
SOP-009	Test Pit/Trenching		Hand tools		Due to MR requirements, test pits will be excavated by hand

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

See also **Worksheet #12-1b**.

Field Equipment	Activity[a]	Frequency	Acceptance Criteria	CA	Responsible Person	SOP Reference	Comments
DGM Equipment Warm-up	Verification	At the beginning of each work day.	System has warmed up for a minimum of 10 minutes (longer in cold weather).	Repair/replace equipment components until functioning properly.	Equipment operator	GEOPHYSICAL SURVEY WORK PLAN (**Attachment 5**)	QC Project Geophysicist to evaluate whether warm-up period was sufficient through data collection notes
DGM System Personnel Test	Testing	At the beginning of each work day.	Data spikes no greater than 2 millivolts, or 2 nanoteslas from the mean, for the EM61-MK2.	Operator checks self for sources of metallic interference (such as cell phone, steel-toe boots); repair/replace equipment components until functioning properly.	Equipment operator	GEOPHYSICAL SURVEY WORK PLAN (**Attachment 5**)	QC Project Geophysicist to evaluate test compliance during daily data review
DGM System Cable Shake Test	Testing	At the beginning of each work day.	Data spikes no greater than 2 millivolts, or 2 nanoteslas from the mean, for the EM61-MK2.	Repair/replace equipment components until functioning properly.	Equipment operator	GEOPHYSICAL SURVEY WORK PLAN (**Attachment 5**)	QC Project Geophysicist to evaluate test compliance during daily data review

[a] Activities may include calibration, verification, testing and/or maintenance.

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SAP Worksheet #23—Analytical SOP References Table

Lab SOP Number	Title, Revision Date, and/or Number	Last Reviewed	Definitive or Screening Data	Matrix and Analytical Group	Instrument	Organization Performing Analysis	Variance to QSM	Modified for Project Work (Y/N)
CA-605	Acid Digestion of Solid Samples by USEPA Method 3050 for Metals by ICP-AES and GFAA, 09/2010, Revision 5.	02/2013	Definitive	Soils/TAL Metals	NA (prep - digestion)	Katahdin	None	N
CA-611	Digestion and Analysis of Solid Samples for Mercury by USEPA Method 7471, 04/2012, Revision 9.	02/2013	Definitive	Soils/Mercury	Mercury Analyzer	Katahdin	None	N
CA-615	Digestion and Analysis of Aqueous Samples for Mercury by USEPA Method 7470, 04/2012, Revision 7.	02/2013	Definitive	Aqueous/Mercury	Mercury Analyzer	Katahdin	None	N
CA-627	Trace Metals Analysis By ICP-MS Using USEPA Method 6020, 04/2012, Revision 8.	02/2013	Definitive	Aqueous and Soil/TAL Metals and TAL Metal	ICP– Mass Spectrometer	Katahdin	None	N
SD-902	Sample Receipt and Internal Control, 08/2013, Revision 9.	08/2013	NA	NA	NA	NA	None	N
SD-903	Sample Disposal, 06/13, Revision 5.	06/2013	NA	NA	NA	NA	None	N
GEN-7199	Hexavalent Chromium by Ion Chromatography, 6/2012, Revision 5.	Currently under review	Definitive	Aqueous and Soil/Hexavalent Chromium	Ion Chromatography (IC)	ALS Rochester	None	N
GEN-3060	Alkaline Digestion for Hexavalent Chromium in Soil, 3/2013, Revision 3.	3/2013	Definitive	Aqueous and Soil/Hexavalent Chromium	NA (prep - digestion)	ALS Rochester	None	N
SMO-GEN	Sample Receiving, 11/2012, Revision 8.	11/2013	NA	NA	NA	ALS Rochester	None	N
SMO-SPLDIS	Sample Disposal, 01/2013, Revision 5.	01/2013	NA	NA	NA	ALS Rochester	None	N

ICP-AES = inductively coupled plasma-atomic emission spectroscopy

GFAA = graphite furnace atomic adsorption

MS = mass spectrometer

NA = not applicable

QSM = Quality Systems Manual

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SAP Worksheet #24—Analytical Instrument Calibration Table

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	CA	Person Responsible for CA	SOP Reference
ICP-MS -Metals	Initial Calibration (ICAL)	Before beginning a sample sequence, after every 10 samples and at end of the analysis sequence.	No analytes detected > LOD. For negative blanks, absolute value < LOD.	Correct problem. Re-prep and reanalyze calibration blank. All samples following the last acceptable calibration blank must be reanalyzed.		
	Continuing Calibration Verification (CCV)	After every 10 samples and at the end of each run sequence.	%R must be within 90-110% for all project compounds.	Correct problem, rerun calibration verification. If that fails, then repeat ICAL. Reanalyze all samples since the last successful calibration verification.		
	Low-level Calibration Check Standard (if using one-point ICAL)	Daily after one-point ICAL.	%R must within 80%-120% for all project compounds.	Correct problem, then reanalyze.		
	Interference Check Solutions (ICS) - ICSA & ICSB	Daily, before sample injections.	ICSA recoveries must be less than the absolute value of the LOD and ICSB %Rs must be within 80-120%.	Correct the problem, then re-prepare checks and reanalyze all affected samples.		
Mercury Analyzer - Mercury	ICAL - 5 points plus a calibration blank	Upon instrument receipt, major instrument change, at the start of each day.	Correlation coefficient (r) must be ≥ 0.995.	Recalibrate and/or perform necessary equipment maintenance. Check calibration standards.	Analyst, Department Manager	CA-611
	ICAL verification	Once after each ICAL, before beginning a sample run.	%R must be within 90-110%	Correct problem and verify second source standard. Rerun ICAL verification. If that fails, correct problem and repeat ICAL.		
	CCB	Before beginning a sample sequence, after every 10 samples, and at end of the analysis sequence. For negative blanks, absolute value < LOD.	No analytes detected > LOD.	Correct problem. Re-prepare and reanalyze calibration blank. All samples following the last acceptable calibration blank must be reanalyzed.		
	CCV	Beginning and end of each run sequence, and every 10 samples.	%R must be within 80-120%	Correct problem, rerun calibration verification. If that fails, then repeat ICAL. Reanalyze all samples since the last successful calibration verification.		

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

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	CA	Person Responsible for CA	SOP Reference
IC /UV VIS (Ultraviolet Visible Spectroscopy) - Hexavalent Chromium	ICAL	Before sample analysis	CC > 0.999	Correct problem then repeat ICAL	Analyst/Supervisor	GEN-7199
	ICV	After each ICAL	90-110%R	Correct problem and verify second source standard. Rerun ICV. If that fails, correct problem and repeat ICAL.		
	CCV	At the beginning of the analytical sequence; after each 10 field samples; at the end of the analytical sequence	90-110%R	Correct problem, rerun CCV. If that fails, then repeat ICAL. Reanalyze all samples since the last acceptable CCV.		

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

Instrument/ Equipment	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	CA	Responsible Person	SOP Reference
ICP-MS - Metals	Clean torch assembly and spray chamber when discolored or when degradation in data quality is observed. Clean nebulizer, check argon, and replace peristaltic pump tubing as needed. Other maintenance specified in lab Equipment Maintenance SOP.	TAL Metals	Torch, nebulizer chamber, pump, pump tubing.	Before ICAL and as necessary.	Acceptable calibration or CCV	Correct the problem and repeat calibration or CCV	Analyst, Department Manager	CA-627
Mercury Analyzer - Mercury	Replace peristaltic pump tubing, replace mercury lamp, replace drying tube, clean optical cell and/or clean liquid/gas separator as needed. Other maintenance specified in lab Equipment Maintenance SOP.	Mercury	Tubing, sample probe, optical cell.	Before ICAL and as necessary.	Acceptable calibration or CCV	Correct the problem and repeat calibration or CCV	Analyst, Department Manager	CA-611
IC/UV VIS - Hexavalent Chromium	Change column bed supports	Hexavalent Chromium	Change column bed supports	Monthly or as needed.	Must meet initial and/or continuing calibration criteria	Repeat maintenance activity or remove from service	Analyst/Supervisor	GEN-7199
	Clean column	Hexavalent Chromium	Clean column	Monthly or as needed.				
	Change column	Hexavalent Chromium	Change column	Every 6 months or as needed.				
	Change tubing	Hexavalent Chromium	Change tubing	Annually or as needed.				

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SAP Worksheet #26—Sample Handling System

Sample Handling System

SAMPLE COLLECTION, PACKAGING, AND SHIPMENT
Sample Collection (Personnel/Organization): TBD/CH2M HILL
Sample Packaging (Personnel/Organization): TBD/CH2M HILL
Coordination of Shipment (Personnel/Organization): TBD/CH2M HILL
Type of Shipment/Carrier: Overnight Carrier/FedEx
SAMPLE RECEIPT AND ANALYSIS
Sample Receipt (Personnel/Organization): Sample Receipt & Login Personnel/Katahdin, Sample Receipt & Login Personnel/ALS Rochester
Sample Custody and Storage (Personnel/Organization): Sample Receipt & Login Personnel/Katahdin, Sample Receipt & Login Personnel/ALS Rochester
Sample Preparation (Personnel/Organization): Metals Department Analyst or Department Manager/Katahdin, Department Supervisor/ALS Rochester
Sample Determinative Analysis (Personnel/Organization): Metals Department Analyst or Department Manager/Katahdin, Department Supervisor/ALS Rochester
SAMPLE ARCHIVING
Field Sample Storage (No. of days from sample collection): 90 days after delivery of report
Sample Extract/Digestate Storage (No. of days from extraction/digestion): 90 days after delivery of report
Biological Sample Storage (No. of days from sample collection): n/a
SAMPLE DISPOSAL
Personnel/Organization: Sample Disposal Personnel/Katahdin, Sample Disposal Personnel/ALS Rochester
Number of Days from Analysis: 14-28 days after release from archives

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SAP Worksheet #27—Sample Custody Requirements Table

Sample Labeling Procedures

Sample labels will include, at a minimum, client name, site, sample identification (ID), date/time collected, preservative, analysis group or method, and sampler's initials. A standardized nomenclature system will be used to ensure accurate data retrieval of all samples collected. Each sample will be designated by an alphanumeric code that will identify the facility, site, station ID, matrix sampled, and/or date and depth sampled. QA/QC samples will have a unique sample designation. Nomenclature for samples and field QA/QC is specified on **Worksheet #18**. The field logbook will identify the sample ID with the location, depth, date/time collected, and the parameters requested.

Field Sample Custody Procedures (Sample Collection, Packaging, Shipment, and Delivery to Laboratory)

Field samples will be collected by the field team members under the supervision of the FTL. As samples are collected, they will immediately be placed in the appropriate containers and labeled, as outlined above. The labels will be filled out in the field by the field crew at the time of sample collection and checked before being placed into the cooler, at which time the sample will be logged in on the chain-of-custody form and field logbook. The integrity of the sample labels will be maintained by placing sample containers in watertight, resealable plastic bags.

Sample containers will be cushioned with packaging material and placed into coolers containing enough ice to keep the samples below 6 °C until they are received by the laboratory. The chain-of-custody will also be placed into the cooler. Coolers will be shipped to the laboratory via FedEx, with the airbill number indicated on the chain-of-custody (to relinquish custody). The FTL is responsible for the care and custody of samples until they are shipped or otherwise delivered to the laboratory custodian as described in Section 4.3 of the Master Project Plans (CH2M HILL, 2008). Upon delivery, the laboratory will log in each cooler and report the status of the samples, discussed as follows.

Chain-of-custody Procedures

Chains-of-custody will include, at a minimum, laboratory contact information, client contact information, sample information, and relinquished by/received by information. Sample information will include sample ID, date/time collected, number and type of containers, preservative information, analysis method, and comments. The chain-of-custody will also have the sampler's name and signature. The chain-of-custody will link location of the sample from the field logbook to the laboratory receipt of the sample. The laboratory will use the sample information to populate the Laboratory Information Management System database for each sample.

A copy of Katahdin's COC can be found below.

SAP Worksheet #27—Sample Custody Requirements Table (continued)

Katahdin ANALYTICAL SERVICES

600 Technology Way
P.O. Box 540
Scarborough, ME 04070
Tel: (207) 874-2400
Fax: (207) 775-4029

Chain of Custody

Client:	Contact:	Phone #: ( )	Fax #: ( )
Address:	City:	State:	Zip Code:
Purchase Order #:	Proj. Name/No.:		Katahdin Quote #:
Bill (if different than above):		Address:	
Sampler (Print/Sign):			Copies To:

LAB USE ONLY	Work Order #: Katahdin Project Number		
Remarks:			
Shipping Info:	FEDEX	UPS	CLIENT
Airbill No:			
Temp C	Temp Blank	Intact	Not Intact

*	Sample Description	Date/Time Collected	Matrix	No. of Containers	Analysis and Container Type Preservatives									
					Filt. Y / N	Filt. Y / N	Filt. Y / N	Filt. Y / N	Filt. Y / N	Filt. Y / N	Filt. Y / N	Filt. Y / N	Filt. Y / N	Filt. Y / N

COMMENTS:

Relinquished By:	Date/Time	Received By:	Relinquished By:	Date/Time	Received By:
Relinquished By:	Date/Time	Received By:	Relinquished By:	Date/Time	Received By:

The terms and conditions on the following page hereof shall govern services, except when a signed contractual agreement exists.

SAP Worksheet #27—Sample Custody Requirements Table (continued)

Laboratory Sample Custody Procedures (Receipt of Samples, Archiving, Disposal)

The laboratories receiving samples will comply with all sample custody requirements outlined in the laboratory SOPs referenced in **Worksheet #23**. Samples to be analyzed for TAL metals will be shipped to Katahdin in Scarborough, ME; samples to be analyzed for hexavalent chromium will be shipped to ALS in Rochester, NY.

Sample Integrity

A sample tracking system will be followed to ensure sample authenticity and data defensibility. The PC will notify the laboratory of upcoming field sampling activities and the subsequent transfer of samples to the laboratory. The project delivery manager will make sure samples arrive at the lab in the appropriate timeframe and that the condition of samples upon receipt is satisfactory. If samples are not delivered to the lab in the acceptable timeframe or condition, the PM will be notified and a decision will be made whether to re-collect samples.

The PC is responsible for checking the chain-of-custody forms against the field logbook and field project instructions to verify that the sample ID, times, analyses, and methods are correct on the chain-of-custody form. Any discrepancies will be resolved with the field team and relayed to the lab. These actions will be documented by both the lab and the PC. The lab is responsible for providing the PC with sample login sheets the day of sample receipt in order for the PC to verify the lab has accounted for all samples shipped and has correctly logged the samples into its software system.

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SAP Worksheet #28-1—Laboratory QC Samples Table

Matrix: Soil

Analytical Group: Metals (excluding Mercury)

Analytical Method/SOP Reference: SW846 6020/CA-608

QC Sample:	Frequency/Number	Method/SOP QC Acceptance Limits	CA	Person(s) Responsible for CA	Data Quality Indicator (DQI)	Measurement Performance Criteria
Method Blank	One per digestion batch of 20 or fewer samples of similar matrix.	No target metals> ½ 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.	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	No target metals> ½ 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.
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 **Worksheet #15A**.	Re-digest and reanalyze all associated samples for affected analyte.		Accuracy/Bias/ Contamination	%R must be within DoD QSM limits, allowing for the marginal exceedances presented in **Worksheet #15A**.
MS (Matrix Spike)	One per digestion batch or sample delivery group (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.”		Accuracy/Bias	%R should be within the DoD QSM limits for LCS, if sample < 4x spike added.
Post-digestion Spike	When dilution test fails or analyte concentration in all samples < 50x LOD.	%R should be within 75-125%.	Run associated samples by method of standard addition, or flag results.		Accuracy/Bias	%R should be within 75-125%.
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.		Precision	Project-specific criteria: if values are ≥ 5x LOQ, RPD should be ≤ 20%. If values are < 5x LOQ, Absolute Difference should be ≤ LOQ.

SAP Worksheet #28-1—Laboratory QC Samples Table (continued)

Matrix: Soil

Analytical Group: Metals (excluding Mercury)

Analytical Method/SOP Reference: SW846 6020/CA-608

QC Sample:	Frequency/Number	Method/SOP QC Acceptance Limits	CA	Person(s) Responsible for CA	Data Quality Indicator (DQI)	Measurement Performance Criteria
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 ± 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	If original sample result is at least 50x LOQ, 5-fold dilution must agree within ± 10% of the original result.
Results between DL and LOQ	NA	Apply "J" qualifier to results between DL and LOQ.	NA		Accuracy	Apply "J" qualifier to results between DL and LOQ.

DoD QSM v. 4.2 is the basis for specifications on this table.

SAP Worksheet #28-2—Laboratory QC Samples Table

Matrix: Soil

Analytical Group: Mercury

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

QC Sample:	Frequency/Number	Method/SOP QC Acceptance Limits	CA	Person(s) Responsible for CA	DQI	Measurement Performance Criteria
Method Blank	One per digestion batch of 20 or fewer samples of similar matrix.	No mercury > ½ 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.	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	No mercury > ½ 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.
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	Water and Sediment: %R must be within 80-120%.
MS (Matrix Spike)	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	%R should be within 80-120% if sample < 4x spike added.
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	Project-specific criteria: If values are ≥ 5x LOQ, RPD should be ≤ 20%. If values are < 5x LOQ, Absolute Difference should be ≤ LOQ.
Results between DL and LOQ	NA	Apply "J" qualifier to results between DL and LOQ.	NA	Analyst, Supervisor	Accuracy	Apply "J" qualifier to results between DL and LOQ.

DQI = data quality indicator
DoD QSM v. 4.2 is the basis for specifications on this table.

SAP Worksheet #28-3—Laboratory QC Samples Table

Matrix: Soil

Analytical Group: Hexavalent Chromium

Analytical Method/SOP Reference: SW846 7199/GEN-7199

QC Sample:	Frequency/Number	Method/SOP QC Acceptance Limits	CA	Person(s) Responsible for CA	DQI	Measurement Performance Criteria
Method Blank	1 per batch of 20 or fewer samples	No target compounds should be >1/2 quantitation level (QL)	Re-clean, reanalyze and/or qualify the data.	Analyst/ Supervisor	Bias/ Contamination	No target compounds should be >1/2 QL
MS (Matrix Spike) - soluble	1 per batch of 20 or fewer samples	75-125% of True Value	Redigest entire batch unless spike is diluted out (sample result > 4x spike concentration). If redigest fails, contact client about possible matrix investigations. If samples are out of holding time, redigest and report both sets of data. If insufficient sample is available to redigest, flag. Flag results associated with out of control MS.	Analyst/ Supervisor	Accuracy/Bias	75-125% of True Value
MS - insoluble	1 per batch of 20 or fewer samples	75-125% of True Value	Redigest entire batch unless spike is diluted out (sample result > 4x spike concentration). If redigest fails, contact client about possible matrix investigations. If samples are out of holding time, redigest and report both sets of data. If insufficient sample is available to redigest, flag. Flag results associated with out of control MS.	Analyst/ Supervisor	Accuracy/Bias	75-125% of True Value
LCS -insoluble	1 per batch of 20 or fewer samples	82-120% of True Value	Redigest if possible. If samples are out of holding time, redigest and report both sets of data. If insufficient sample is available to redigest, flag. If the LCS recoveries are high and the sample results are <QL, narrate.	Analyst/ Supervisor	Accuracy/Bias	82-120% of True Value
MS/MSD	1 per batch of 20 or fewer samples	RPD <20%; +/- reporting limit if <4xLOQ	Repeat sample and duplicate unless obvious or historical interferences or lack of volume.	Analyst/ Supervisor	Precision	RPD<20%; +/- RL if <4xLOQ
Post-Digestion MS	1 per batch of 20 or fewer samples	85-115% of True Value	If MS also failed, no action beyond CA for MS.	Analyst/ Supervisor	Bias	85-115% of True Value

DoD QSM v. 4.2 is the basis for specifications on this table.

SAP Worksheet #29—Project Documents and Records Table

Document/Report/Form	Generator	DFOW	Frequency of Completion	Location/Where Maintained
Field Notebook	CH2M HILL FTL	All Fieldwork	Daily	Hard copy onsite, then in project file, copies saved on CH2M HILL's local server
Fieldwork Plans	CH2M HILL	Pre-mobilization activities	Once before beginning fieldwork	Hard copy onsite, then in project file, copies saved on CH2M HILL's local server
CA Forms	CH2M HILL	All Fieldwork	As necessary	CH2M HILL's local server and project file
Electronic Data Deliverables	CH2M HILL and Geophysical Survey Subcontractor	Geophysical Survey/Data Transfer	As necessary based on data collection	CH2M HILL's local server
Equipment/Instrument check logs	CH2M HILL and Geophysical Survey Subcontractor	Geophysical Survey	As required by this UFP-SAP	Hard copy onsite, then in project file, copies saved on CH2M HILL's local server
Test Pit Logs	CH2M HILL	Excavate test pits	Daily, as necessary	CH2M HILL local server
Geophysical Survey Subcontractor Notes and Field Logs	Geophysical Survey Subcontractor	Geophysical Survey	Daily	Onsite, then transfer copy to CH2M HILL to store on local server
Pre-Processed Data	CH2M HILL and Geophysical Survey Subcontractor	Geophysical Survey and Data Evaluation	As necessary	Subcontractor database and CH2M HILL local server
Final Geophysical Survey Data	CH2M HILL and Geophysical Survey Subcontractor	Geophysical Survey and Data Evaluation	As necessary	Subcontractor database and CH2M HILL local server
Field Photo Log	CH2M HILL	All Fieldwork	Daily/As necessary	CH2M HILL local server
Daily Project Reports	CH2M HILL	All Fieldwork	Daily	CH2M HILL's local server, hard copy onsite, then in project file
Daily H&S Documents	CH2M HILL	All Fieldwork	Daily	CH2M HILL's local server, hard copy onsite, then in project file
Training Records	CH2M HILL and Geophysical Survey Subcontractor	All Fieldwork	Before mobilization to the site	Hard copy onsite and with Human Resources

SAP Worksheet #29—Project Documents and Records Table (continued)

Document/Report/Form	Generator	DFOW	Frequency of Completion	Location/Where Maintained
Meeting Agendas, Minutes, Presentations and so forth	CH2M HILL	All DFOWs	As necessary	CH2M HILL local server
Technical Memorandum Summary Report	CH2M HILL	Final Reports and Closeout	Once upon completion of site activities	CH2M HILL local server
DD Form 1348-1	CH2M HILL	Demilitarization of MDAS	For each MDAS item demilitarized	Hard copy onsite, then in project file, copies saved on CH2M HILL's local server

SAP Worksheet #30—Analytical Services Table

Matrix	Analytical Group	Analytical Method	Data Package Turnaround Time	Laboratory/Organization	Backup Laboratory/Organization
Soil	Metals	SW846 6020/7471B	28 calendar days	Katahdin Analytical Services Technology Way Scarborough, ME 04074 Contact: Jennifer Obrin (207) 874-2400	TBD
	Hexavalent Chromium	SW846 7199		ALS Rochester 1565 Jefferson Road Building 300, Suite 360 Rochester, NY 14623 Contact: Deb Patton (585) 288 5380	

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SAP Worksheet #31—Planned Project Assessments Table

Assessment Type	Frequency	Internal or External	Organization Performing Assessment	Person(s) Responsible for Performing Assessment	Person(s) Responsible for Responding to Assessment Findings	Person(s) Responsible for Identifying and Implementing CA	Person(s) Responsible for Monitoring Effectiveness of CA
Field Performance Audit	Once during field event	Internal	CH2M HILL	FTL and or Project Geophysicist	FTL, Geophysical Subcontractor	FTL, Geophysical Subcontractor	CH2M HILL
Data storage and transfer system check	Before initial data collection and once weekly	Internal	CH2M HILL	CH2M HILL Geophysicist	Geophysical Subcontractor	Geophysical Subcontractor	CH2M HILL
Offsite Laboratory Technical Systems Audit	Laboratory must have current DoD ELAP evaluation letter that will identify the period of performance. The laboratory must be re-evaluated before expiration of the period of performance.	External	Third Party Accrediting Body	TBD, Third-Party Accrediting Body	Jennifer Obrin/ Katahdin; Deb Patton/ALS Rochester	Katahdin ALS Rochester Lab PMs	Anita Dodson, Program Chemist, CH2M HILL
Safe Behavior Observation	Once/week during field activities	Internal	CH2M HILL	SSC CH2M HILL	Field Team Member observed CH2M HILL	Carl Woods H&S Manager CH2M HILL	SSC CH2M HILL

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SAP Worksheet #32—Assessment Findings and Corrective Action Responses

Assessment Type	Nature of Deficiencies Documentation	Individual(s) Notified of Findings	Timeframe of Notification	Nature of CA Response Documentation	Individual(s) Receiving CA Response	Timeframe for Response
Field Performance Audit	Checklist and Written Audit Report	Dan Hockett PM, CH2M HILL	Within 1 week of audit	Memorandum	CH2M HILL FTL CH2M HILL Geophysicist	Within 1 week of receipt of CA Form

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SAP Worksheet #32-1—Laboratory Corrective Action Form

Person initiating CA _____ Date _____

Description of problem and when identified (submit a drawing or sketch if necessary): _____

_____

_____

_____

_____

_____

Cause of problem, if known or suspected: _____

_____

_____

_____

_____

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

_____

_____

_____

_____

_____

CA implemented by: _____ Date: _____

CA initially approved by: _____ Date: _____

Follow-up date: _____

Final CA approved by: _____ Date: _____

Information copies to:

_____

_____

_____

_____

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SAP Worksheet #32-2—Field Performance Audit Checklist

Project Responsibilities

Project No.: _____ Date: _____

Project Location: _____ Signature: _____

Team Members:

Yes _ No _ 1) Is the approved work plan being followed?

Comments _____

_____

Yes _ No _ 2) Was a briefing held for project participants?

Comments _____

_____

Yes _ No _ 3) Were additional instructions given to project participants?

Comments _____

_____

DGM Operations

Yes _ No _ 1) Are routine inspections and QC checks of the equipment being performed as outlined in this SAP?

Comments _____

_____

Yes _ No _ 2) Is the proposed location of grid lines clearly communicated with the DGM Survey Team?

Comments _____

_____

Yes _ No _ 3) Are data collection being performed as required by the SAP?

Comments _____

_____

Yes _ No _ 4) Are data stored properly and uploaded for transfer in a timely manner?

Comments _____

_____

Yes _ No _ 5) Are photographs taken and documented?

Comments _____

_____

SAP Worksheet #32-2—Field Performance Audit Checklist (continued)

Document/Data Control

Yes _ No _ 1) Are all work plan documents available onsite for review?

Comments _____

_____

Yes _ No _ 2) Are daily reports and other documentation completed as required by the SAP?
Comments _____

_____

Yes _ No _ 3) Are equipment QC data and collected field data properly transferred? Review?

Comments _____

_____

SAP Worksheet #33—QA Management Reports Table

Type of Report	Frequency	Projected Delivery Date	Person Responsible for Report Preparation	Report Recipient(s)
Daily QC Report	Daily	Following day	Site QC Manager	Dan Hockett/ CH2M HILL
QC Meeting Minutes	Post-meeting	Within 7 days	Site QC Manager	Dan Hockett/ CH2M HILL
Preparatory Inspection Forms	Once for each applicable DFOW (before start of task)	With daily reports the following day after meeting	Site QC Manager	Dan Hockett/ CH2M HILL
Initial Inspection Forms	Once for each applicable DFOW (before start of task)	With daily reports the following day after meeting	Site QC Manager	Dan Hockett/ CH2M HILL
Follow-up Inspection Forms	Once for each applicable DFOW (document in daily reports)	Document in daily Reporting	Site QC Manager	Dan Hockett/ CH2M HILL
Technical Memorandum Report	Post-field Event	June 2014	Dan Hockett/CH2M HILL	Stakeholders, see **Worksheet #4**

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SAP Worksheet #34-35—Data Verification and Validation (Step I and IIa/IIb) Process Table

Data Review Input	Description	Responsible for Verification	Step I / IIa / IIb[1]	Internal / External[2]
Onsite Screening	Make sure that all field data meet Work Plan requirements for completeness and accuracy based on the field calibration records.	FTL, CH2M HILL	IIb	Internal
Evidence of Required Approval of plan (UFP-SAP)	Evidence of approval and completeness of UFP-SAP. Includes establishment of PQOs, QC criteria, SOPs, PALs, figures, and so forth.	Dan Hockett (Project Manager)/CH2M HILL	IIa	Internal
Site-specific Training Records	Make sure project personnel have proper training and certification to perform site activities and achieve project DQOs.	Dan Hockett/CH2M HILL	IIa	Internal
Geophysical Survey Data Methods	Geophysical survey data methods will be reviewed to be sure data collection is performed as defined in the UFP-SAP.	FTL and Project Geophysicist CH2M HILL	IIb	Internal
Data Collection and Transfer	Be sure data collection is complete and recorded accurately and that data transfer protocol is adequate.	Dan Hockett/CH2M HILL	IIa	Internal
Performance Requirements (including QC criteria)	Be sure performance requirements are fully established (see **Worksheet #12** and **Worksheet #15**).	Dan Hockett/CH2M HILL	IIb	Internal
Field Log Notebooks	Field notes will be reviewed to ensure completeness of field data collection, data collection times, site operations, site conditions, and so forth. The logbook will also be used to document, explain, and justify all deviations from the approved UFP-SAP and other work planning documents.	Dan Hockett/CH2M HILL	I	Internal
Chains of Custody and Shipping Forms	Chain-of-custody forms and shipping documentation will be reviewed internally upon their completion and verified against the packed sample coolers they represent. The shipper's signature on the chain-of-custody will be initialed by the reviewer, a copy of the chain-of custody retained in the site file, and the original and remaining copies taped inside the cooler for shipment.	FTL/CH2M HILL Bianca Kleist (Project Chemist) /CH2M HILL	I	Internal / External
Sample Condition Upon Receipt	Any discrepancies, missing, or broken containers will be communicated to the project data manager in the form of laboratory logins.	Bianca Kleist/CH2M HILL	I	External
Electronic Data Deliverables	Electronic Data Deliverables will be compared against hardcopy laboratory results (10% check).	Bianca Kleist/CH2M HILL	I	External
Audit reports	Upon report completion, a copy of all audit reports will be placed in the site file. If CAs are required, a copy of the documented CA taken will be attached to the appropriate audit report in the QA site file. Periodically, and at the completion of site work, site file audit reports and CA forms will be reviewed internally to ensure that all appropriate CAs have been taken and that CA reports are attached. If CAs have not been taken, the site manager will be notified to ensure action is taken.	Dan Hockett/CH2M HILL	I	Internal

SAP Worksheet #34-35—Data Verification and Validation (Step I and IIa/IIb) Process Table (continued)

Data Review Input	Description	Responsible for Verification	Step I / IIa / IIb[1]	Internal / External[2]
Corrective Action Reports	CA reports will be reviewed by the project chemist or PM and placed into the project file for archival at project closeout.	Dan Hockett/CH2M HILL	I	Internal
Target Compound List and TAL	Be sure the laboratory reported all analytes from each analysis group.	Bianca Kleist/CH2M HILL	IIa	External
Reporting Limits	Be sure the laboratory met the PQLs. If they were not met, the reason will be identified and documented.	Bianca Kleist/CH2M HILL	IIb	External
Raw Data	Ten percent review of raw data to confirm laboratory calculations.	Respective Laboratory QAO	IIa	External
Documentation of Method QC Results	Establish that all required QC samples were run.	FTL/CH2M HILL	IIa	External
Documentation of Field QC Sample Results	Establish that all required QC samples were run.	Bianca Kleist/CH2M HILL Doug Weaver (Validator) / Environmental Data Services	IIb	Internal
DoD ELAP Evaluation	Be sure that each laboratory is DoD ELAP-certified for the analyses it is to perform. Make sure evaluation timeframe does not expire.	Bianca Kleist/CH2M HILL	IIa	External
Analytical data for TAL Metals and Hexavalent Chromium in soil	Analytical methods and laboratory SOPs as presented in this UFP-SAP will be used to evaluate compliance against QA/QC criteria. Should adherence to QA/QC criteria yield deficiencies, data may be qualified. The data qualifiers used are those presented in *Region 4 Modifications to the Laboratory Data Validation Guidelines for Inorganic Data Review* (USEPA, 1993). National Functional Guidelines will not be used for data validation; however, the specific qualifiers listed therein may be applied to data should non-conformances against the QA/QC criteria as presented in this UFP-SAP be identified.	Doug Weaver /Environmental Data Services	Step IIa and IIb	External

Notes:

[1] I = verification
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]
Should CH2M HILL find discrepancies during the verification or validation procedures identified in the table above, an email documenting the issue will be circulated to the project team, and a Corrections to File Memo will be prepared identifying the issues and the corrective action needed. This Memo will be sent to the laboratory, or applicable party, and maintained in the project file.
[2] Internal or external is in relation to the data generator.

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

Data Review Input	Description	Responsible for Verification[1] and Validation2 (name, organization)	Internal/ External[2]
Target Compound List and TAL	Be sure the laboratory reported all analytes from each analysis group.	PC/CH2M HILL	External
Reporting Limits	Be sure the laboratory met the PQLs. If they were not met, the reason will be identified and documented.	PC/CH2M HILL	External
Field SOPs	Be sure that all field SOPs were followed.	PC/CH2M HILL	Internal
Laboratory SOPs	Be sure that approved analytical laboratory SOPs were followed.	FTL/CH2M HILL	Internal
Raw Data	Ten percent review of raw data to confirm laboratory calculations.	Respective Laboratory QAO	External
Onsite Screening	All non-analytical field data will be reviewed against UFP-SAP requirements for completeness and accuracy based on the field calibration records.	Data Validator /CH2M HILL	Internal
Documentation of Method QC Results	Establish that all required QC samples were run.	FTL/CH2M HILL	External
Documentation of Field QC Sample Results	Establish that all required QC samples were run.	PC/CH2M HILL	Internal
DoD ELAP Evaluation	Be sure that each laboratory is DoD ELAP-certified for the analyses it is to perform. Make sure evaluation timeframe does not expire.	PC/CH2M HILL	External
Analytical data for TAL Metals and Hexavalent Chromium in soil	Analytical methods and laboratory SOPs as presented in this UFP-SAP will be used to evaluate compliance against QA/QC criteria. Should adherence to QA/QC criteria yield deficiencies, data may be qualified. The data qualifiers used are those presented in *Region 4 Modifications to the Laboratory Data Validation Guidelines for Inorganic Data Review* (USEPA, 1993). National Functional Guidelines will not be used for data validation; however, the specific qualifiers listed therein may be applied to data should non-conformances against the QA/QC criteria as presented in this UFP-SAP be identified.	Doug Weaver /Environmental Data Services	External

[1] Verification (Step I) is a completeness check that is performed before the data review process continues in order to assess whether the required information (complete data package) is available for further review. Validation (Step IIa) is a check that the data generated are in compliance with analytical methods, procedures, and contracts. Validation (Step IIb) is a comparison of generated data against measurement performance criteria in the UFP-SAP (both sampling and analytical).

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SAP Worksheet #37—Usability Assessment

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

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

- Non-detected site contaminants will be evaluated to ensure that project required quantitation limits in **Worksheet #15** were achieved. If project quantitation limits were achieved and the verification and validation steps yielded acceptable data, then the data is considered usable.
- The third-party data validator is the only party that may apply qualifiers to the data. Minor QC exceedances will result in "estimated" data, represented by J, NJ, and UJ qualifiers. Major QC exceedances will result in "rejected" data, represented by R-qualifiers. The effect on availability and usability of rejected results will be evaluated.
- For statistical comparisons non-detect values will be represented by a concentration equal to one-half the sample reporting limit. For duplicate sample results, the most conservative value will be used for project decisions.
- Analytical data will be checked to ensure the values and any qualifiers are appropriately transferred to the electronic database. These checks include comparison of hardcopy data and qualifiers to the electronic data deliverable. Once the data has been uploaded into the electronic database, another check will be performed to ensure all results were loaded accurately.
- Field and laboratory precision will be compared as relative percent difference (RPD) between the two results.
- Deviations from the SAP will be reviewed to assess whether corrective action is warranted and to assess impacts to achievement of project objectives.

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

- To assess whether a sufficient quantity of acceptable data are available for decision-making, the data will be reconciled with measurement performance criteria following validation and review of data quality indicator.
- If significant biases are detected with laboratory QA/QC samples, it will be evaluated to assess impact on decision-making. Low biases will be described in greater detail as they represent a possible inability to detect compounds that may be present at the site.
- If significant deviations are noted between lab and field precision, the cause will be further evaluated to assess impact on decision-making.

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

- Data tables will be produced to reflect detected and non-detected site COC's and geochemical parameters. Data qualifiers will be reflected in the tables and discussed in the data quality evaluation.
- Figures will be produced to reflect areas of investigation including environmental sampling locations and results.
- A data quality evaluation will be provided as part of the technical memorandum prepared to assess remedy effectiveness.
- If needed a technical memorandum will be produced that will identify any data usability limitations and make recommendations for corrective action.

SAP Worksheet #37—Usability Assessment (continued)

Identify the personnel responsible for performing the usability assessment.

The CH2M HILL team, including the Project Manager, Project Geophysicist, and Project Chemist, will review the data and compile a presentation for the Tier I Project Team. The Tier I Project Team as a whole will assess the usability of the data.

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Figures

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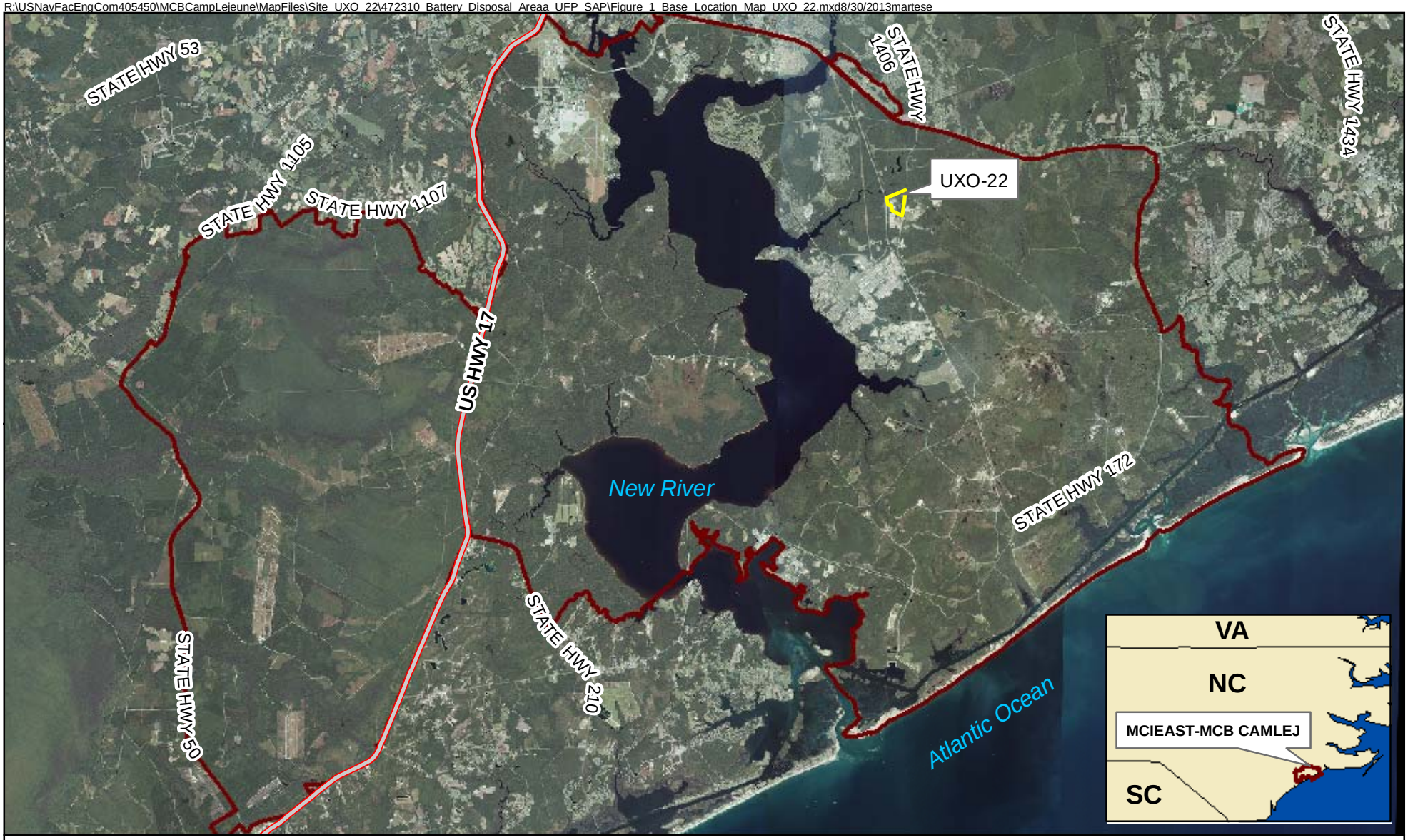


Legend
- Highways
- UXO-22 Boundary
- Installation Boundary

N

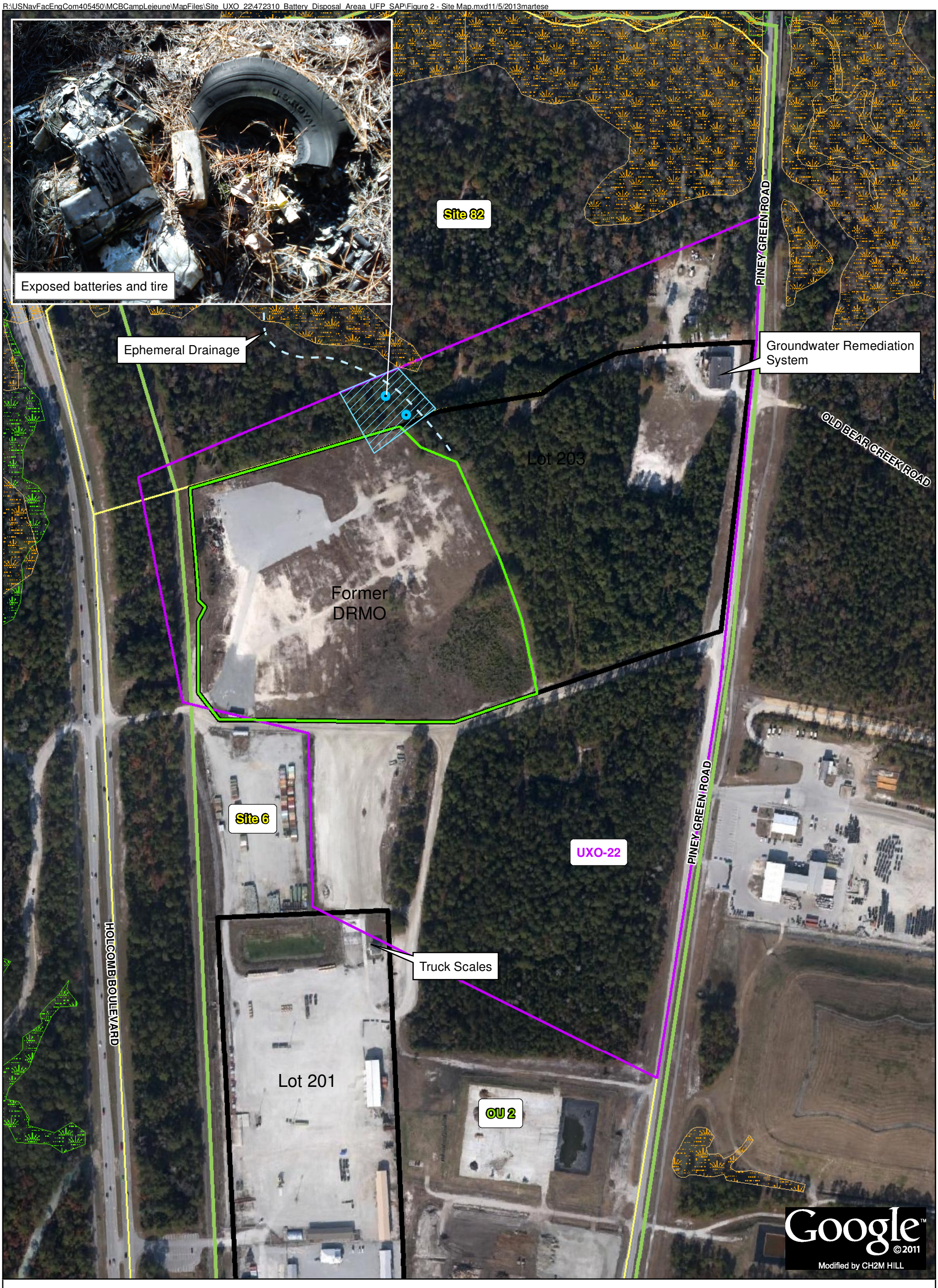
0 7,500 15,000 30,000 Feet

1 inch = 15,000 feet

Figure 1
Base Location Map
Site UXO-22 - Battery Disposal Area Investigation UFP-SAP
MCIEAST-MCB CAMLEJ
North Carolina

CH2MHILL

R:\USNavFacEngCom405450\MCBCampLejeune\MapFiles\Site_UXO_22\472310_Battery_Disposal_Areaa_UFP_SAP\Figure 2 - Site Map.mxd11/5/2013martese



Legend

- Location of Exposed Batteries
- Ephemeral Drainage Feature
- Battery Disposal Investigation Area (Approximately 1 acre)
- UXO-22 Boundary
- Planning Wetland Area
- Jurisdictional Wetland Area
- Former DRMO-Defense Reutilization and Marketing Office
- Lots 201 and 203
- Site 6 and 82 Boundaries
- Operable Unit 2

N

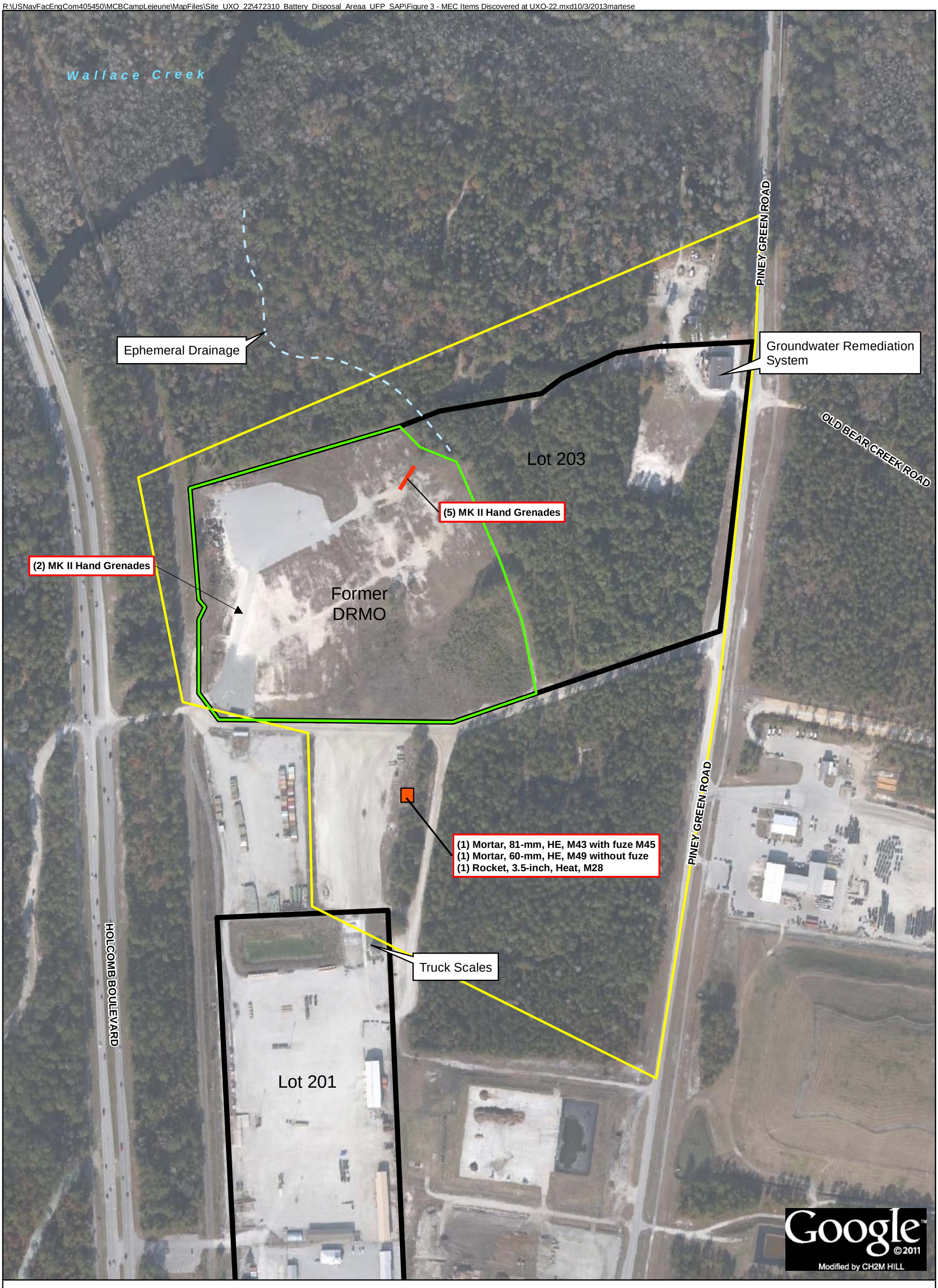
0 150 300 600 Feet

1 inch = 300 feet

Figure 2
Site Map
Site UXO-22 - Battery Disposal Area Investigation UFP-SAP
MCIEAST-MCB CAMLEJ
North Carolina

CH2MHILL

R:\USNavFacEngCom405450\MCBCampLejeune\MapFiles\Site_UXO_22\472310_Battery_Disposal_Areaa_UFP_SAP\Figure 3 - MEC Items Discovered at UXO-22.mxd10/3/2013martese



Legend

- Ephemeral Drainage Feature
- Trench (Baker, 1993)
- MPPEH Disposal Pit (CH2M Hill, 2009)
- UXO-22 Boundary
- Former DRMO-Defense Reutilization and Marketing Office
- Lots 201 and 203

N

0 150 300 600 Feet

1 inch = 300 feet

Figure 3
MEC Items Discovered at UXO-22
Site UXO-22 - Battery Disposal Area Investigation UFP-SAP
MCIEAST-MCB CAMLEJ
North Carolina

CH2MHILL

Attachment 1
Field Standard Operating Procedures-CH2M HILL

STANDARD OPERATING PROCEDURE

Equipment Blank and Field Blank Preparation

I. Purpose

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

II. Scope

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

III. Equipment and Materials

- Blank liquid (use ASTM Type II or lab grade water)
- Millipore™ deionized water
- Sample bottles as appropriate
- Gloves
- Preservatives as appropriate

IV. Procedures and Guidelines

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

B. To collect an equipment blank for volatile analysis from the surfaces of sampling equipment other than pumps, pour blank water over one piece of equipment and into two 40-ml vials until there is a positive meniscus, then seal the vials. Note the sample number and associated piece of equipment in the field notebook as well as the type and lot number of the water used.

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

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

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

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

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

F. Collect next field sample.

V. Attachments

None.

VI. Key Checks and Items

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

STANDARD OPERATING PROCEDURE

Chain-of-Custody

I Purpose

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

II Scope

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

III Definitions

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

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

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

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

IV. Procedures

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

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

Sample Identification

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

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

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

Measurements and observations shall be recorded using waterproof ink.

Sample Label

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

- Project - CTO Number.
- Station Location - The unique sample number identifying this sample.
- Date - A six-digit number indicating the day, month, and year of sample collection (e.g., 08/21/12).

- Time - A four-digit number indicating the 24-hour time of collection (for example: 0954 is 9:54 a.m., and 1629 is 4:29 p.m.).
- Medium - Water, soil, sediment, sludge, waste, etc.
- Sample Type - Grab or composite.
- Preservation - Type and quantity of preservation added.
- Analysis - VOA, BNAs, PCBs, pesticides, metals, cyanide, other.
- Sampled By - Printed name of the sampler.
- Remarks - Any pertinent additional information.

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

Chain-of-Custody Procedures

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

Field Custody Procedures

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

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

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

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

sample locations in photographs, an easily read sign with the appropriate sample location number should be included.

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

Transfer of Custody and Shipment

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

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

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

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

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

V Quality Assurance Records

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

VI Attachments

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

VII References

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STANDARD OPERATING PROCEDURE

Decontamination of Personnel and Equipment

I. Purpose

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

II. Scope

This is a general description of decontamination procedures.

III. Equipment and Materials

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

IV. Procedures and Guidelines

A. PERSONNEL DECONTAMINATION

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

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

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

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

4. Remove respirator (if worn).

5. Remove inner gloves and discard.

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

7. Sanitize respirator if worn.

B. SAMPLING EQUIPMENT DECONTAMINATION—GROUNDWATER SAMPLING PUMPS

Sampling pumps are decontaminated after each use as follows.

1. Don phthalate-free gloves.

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

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

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

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

6. Rinse with 1 gallon of tap water.

7. Rinse with 1 gallon of deionized water.

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

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

10. Decontamination materials (e.g., plastic sheeting, tubing, etc.) that have come in contact with used decontamination fluids or sampling equipment will be disposed of in either DOT-approved 55-gallon drums or with solid waste in garbage bags, dependent on Facility/project requirements.

C. SAMPLING EQUIPMENT DECONTAMINATION—OTHER EQUIPMENT

Reusable sampling equipment is decontaminated after each use as follows.

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

D. HEALTH AND SAFETY MONITORING EQUIPMENT DECONTAMINATION

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

E. SAMPLE CONTAINER DECONTAMINATION

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

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

2. Dispose of all used paper towels in a DOT-approved 55-gallon drum or with solid waste in garbage bags, dependent on Facility/project requirements.

F. HEAVY EQUIPMENT AND TOOLS

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

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

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

V. Attachments

None.

VI. Key Checks and Items

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

STANDARD OPERATING PROCEDURE

Electromagnetic Induction

I. Purpose

The purpose of this SOP is to provide general reference information for using electromagnetic induction (EM) methods.

II. Scope

This SOP provides a description of field procedures, equipment, and interpretation methods necessary to fully utilize this procedure.

III. Definitions

Conductivity - Ability of a material to transmit an electrical current. Inverse of resistivity.

Horizontal dipole mode - Transmitter and receiver coils oriented vertically.

Vertical dipole mode - Transmitter and receiver coils oriented horizontally.

Vertical sounding - Multiple EM measurements centered at a point with varying coil spacings.

Vertical profiling - EM measurements along a traverse with a fixed coil spacing and coil orientation.

IV. Procedures

A. Overview

Electromagnetic Induction (EM) methods are non-intrusive geophysical techniques of measuring the apparent conductivity of the subsurface materials. Electrical conductivity values of subsurface materials are determined by transmitting a high frequency electromagnetic (primary) field into the earth and measuring the secondary electromagnetic field produced by the eddy current. The transmitter and receiver coils do not require direct ground contact thus permitting continuous profiling and rapid data acquisition.

The strength of the secondary field is a function of the inter coil spacing, operating frequency and ground conductivity. The ratio of the secondary to the primary magnetic field is directly proportional to the terrain conductivity which enables direct instrument readout of apparent conductivity values (measured conductivity values are the bulk average conductivity for the area or volume of earth sampled).

EM conductivity values are usually expressed in units of milliohms per meter. Conductivity values are converted to resistivity values in ohm-meters by use of the following relationship:

$$\text{resistivity (ohm - meters)} \quad \frac{1{,}000}{\text{EM instrument readout (milliohms per meter)}}$$

The apparent conductivity of the subsurface materials is dependent upon subsurface conditions such as:

- Lithology
- Porosity
- Permeability
- Conductivity of subsurface pore fluids

Changes in these parameters causing measurable variations in electromagnetic conductivity can result from:

- Conductive contaminant plumes
- Abandoned trenches and lagoons
- Lateral changes such as backfill or landfill materials
- Bedrock fracture zones
- Lithological variations
- Buried metallic objects

The sampling depth or depth of investigation is related to the coil spacing and coil mode. The two coil modes used are the vertical dipole mode (coils horizontal) and the horizontal dipole mode (coils vertical).

Two common terrain conductivity meters are EM-31 and the EM-34-3. The EM-31 has a fixed intercoil spacing of 3.7 meters and an effective depth of penetration of approximately 6 meters. The EM-34-3 has two coils which can be separated by 10, 20, or 40 meters and can be oriented in either the horizontal or vertical dipole modes; Intercoil separations increase the effective depth-of investigation as shown below.

Intercoil Spacing (meters)	Depth of Investigation (meters) Horizontal Dipoles	Vertical Dipoles
10	7.5	15
20	15	30
40	30	60

The coil orientation (horizontal or vertical) allows the EM-34-3 to respond to materials of different depths.

Vertical sounding and horizontal profiling are the two EM survey techniques. Vertical profiling is accomplished by multiple measurements about a point with varying coil spacing. Horizontal profiling is performed by making measurements along traverses with fixed coil spacing. General discussions of electromagnetic induction methods are presented in texts by Grant and West (1965), Telford and others (1976), and Griffiths and King (1981).

B. Applications and Uses

The measurement of subsurface conductivity at a hazardous waste site provides a valuable contribution to site characterization. The conductivity (resistivity) of the hydrogeologic section is predominantly influenced by the pore fluids. Consequently, conductivity measurements provide indirect information on the porosity and permeability of subsurface materials, the degree of saturation, and the conductivity of the pore fluids. The conductivity of the pore fluid is influenced by the presence of dissolved electrolytes. Contaminant plumes in the unsaturated and saturated zones can be mapped provided there is a sufficient change in the conductivity to be detected by the EM instrument. Generally, contaminant plumes of inorganic waste are easily detected because the pore fluids often have conductivity values as much as three orders of magnitude above background values. EM conductivity measurements can also be used to detect the presence of buried waste; filled disposal trenches, and buried metal objects such as drums, tanks or metal debris. Electromagnetic surveys can be used to locate conductive as well as and non-conductive bodies. The many applications include:

- Contaminant plume mapping
- Locating abandoned trenches and lagoons
- Delineating bedrock fracture zones
- Determining thickness of weathered layers
- Lithology mapping
- Locating buried metallic objects
- Lateral anomalies such as pockets or pits of different materials

Examples of EM applications at sites where groundwater is contaminated are presented by Duran (1982), Greenhouse (1983), and Greenhouse and Slaine (1983).

C. Equipment

The two-coil EM instrument and the VLF (very low frequency) instrument are basically the two different types of electromagnetic surveying instruments in use; each is capable of sensing to different depths. There are several models and manufacturers of this equipment.

The two-coil system consists of a transmitter coil and a receiver coil. The transmitter coil induces an electromagnetic field of known strength and the receiver coil measures the resulting quadrature, or ratio of primary to secondary fields resulting from subsurface features. Each instrument is read directly in units of milliohms per meter (conductivity). EM readings represent the average bulk conductivity at a point halfway between the two coils.

The VLF instrument is a receiver which relies on specialized, very low frequency communication antennas for induction of an electromagnetic field. Surveying with the VLF or equivalent instrumentation is commonly referred to as VLF surveying.

The VLF Instrumentation is a small, lightweight hand-held instrument which can be operated by one person. Principal components of the instrument are a pair of mutually perpendicular coils and a receiving crystal with a frequency specific to a

transmitting antenna. The two receiving coils are used to measure local characteristics of the primary induced field and any secondary fields emanating from bodies of variable conductivity. Typical sources of induced electromagnetic fields for VLF surveying are the very low frequency antennas used for submarine communications.

D. Data Acquisition

The advantage of the EM survey method is the speed and accuracy with which lateral changes of terrain conductivity can be measured. The EM conductivity data can be acquired using sounding and profiling techniques similar to those used in electrical resistivity. EM profiling is accomplished by traversing an area with a fixed coil spacing and orientation; EM sounding is accomplished by expanding the inter-coil spacings in a manner similar to that used by electrical resistivity soundings. Some commonly used EM equipment is limited in the number of available inter-coil spacings that can be used; however, there are other EM instruments available that can operate at many coil spacings and frequency ranges to provide numerous sounding data points necessary for accurate computer modeling and profiling.

The factors determining which instrument is used and what the grid spacing should be at particular sites are:

- Depth to target and size of target
- Accessibility of the site
- Effects of manmade structures and utilities, such as electric power lines
- Conductivity of the earth materials

EM induction instruments may have a depth of investigation of up to 200 feet depending upon coil spacing and orientations used. The very low frequency VLF device has the greatest depth of investigation and is generally used to evaluate large geologic structures.

In conducting a VLF survey, VLF readings should be acquired with the instrument oriented perpendicular to a straight line from the site to the transmitter antennas. This orientation is necessary to ensure optimum data quality. All readings from a particular VLF station must be obtained with the instrument oriented in the same direction.

For an EM induction survey, a regular pattern of survey stations will provide coverage of the area in question. Typically, use of a grid spacing which is approximately equal to the size of the target sought by the survey, and coil spacing with a maximum response for the depth of interest will produce satisfactory results. Specific needs for local detail, however, may require a refined coverage. The chosen spacing should always be site and target specific.

In conducting an EM survey, the field operator must avoid or note any potential sources of anomalous (noise) conductivity values such as power lines, buildings, fences, buried pipelines or any other large metal objects. Noise sources should be noted on the profiles or contour maps accounting for anomalies due to these known sources.

Important information that should be known for planning and before conducting an EM conductivity survey are: assumed hydrogeologic characteristics of the site, potential source locations and migration paths, characteristics of the hazardous substance of interest, and depths of interest. The level of detail necessary (size of object of interest and detail of resolution) determines the number of lines and station spacings of readings required.

EM data, if not recorded on a strip chart or digital recording instrument, should be recorded on standardized data sheets. At a minimum all data (strip chart, digital disks, or standard forms) should have the following information listed:

- Project/site location identification
- Company
- Date and time
- Operators name
- Instrument make, model
- Coil spacings and configuration
- Line and station numbers
- Instrument reading scales
- Weather conditions/temperature

E. Interpretation

1. Data Analysis

In general, electromagnetic survey data require relatively little processing before they can be interpreted. This is especially true for fixed coil spacing surveys because the data are recorded in units of conductivity; preliminary interpretations are made by comparison of conductivity values. A contour map can be prepared from the data and compared with results of other surveys. EM instruments also can be used for vertical soundings similar to resistivity sounding. Vertical sounding with EM equipment, however, has lower resolution than that performed with the resistivity technique. As a result, EM data are generally more useful for continuous profiling surveys.

VLF instruments do not read directly in units of conductivity. The in-phase measurement (the tilt of primary induced field) is read in terms of the tangent to the angle of tilt and is given as a percentage. Quadrature measurements, which are the ratios of voltage required to equalize the primary to secondary signal strengths, are also given as percentages. For field interpretation these two sets of data can be plotted in profile form, percentage versus distance. Greenhouse and Slaine (1983) describe a simple mathematical conversion so that VLF data can be presented in contour format and compared to other available data such as resistivity and magnetics. Digital data acquisition systems are now available that allow calculation of conductivity.

2. Presentation of Results

Results of an EM conductivity survey can be presented in profile and/or contour map form. The orientation of the traverses should be indicated on profiles in lines of

coverage on contour maps. Locations of observed surface metal and other cultural features such as topography, buildings, fences, power lines etc. should be noted on both the profiles and the contour maps.

3. Interpretation

EM conductivity data can be analyzed qualitatively and quantitatively. Generally, profiling data are presented as a contour map or profiles. Profile lines should be stacked and aligned. A qualitative analysis of the contour map or aligned profiles usually can allow an interpreter to identify any conductivity trends that may be indicative of buried metal, groundwater flow and contaminant transport. A comparison of available geologic data, cultural ferrous metal and debris maps prepared during data acquisitions should be made to evaluate the causes of any conductivity trends observed.

Computer or chart comparisons of EM sounding data with available theoretical models can be made. This type of interpretation is similar to that used in electrical resistivity, but in EM sounding it is limited to relatively simple hydrogeologic conditions.

F. Advantages and Limitations

Advantages of the electromagnetic induction method include:

- No ground contact required
- Rapid data acquisition (faster than resistivity)
- Lightweight, one or two man operation
- Wide range of applications
- High lateral resolution
- Field interpretation possible

Limitations of the electromagnetic induction method include:

- Limited dynamic range l-1,000 milliohm/meter
- Susceptible to effects of man-made structures, utilities, etc.
- Less vertical resolution than resistivity
- Limited penetration
- Does not distinguish even simple layering without more complex application and interpretation
- Setting and maintaining instrument at zero

V. Quality Assurance Records

Field data will be recorded in log books and/or data recording sheets accompanying the monitoring equipment. Data recorded in a field log book will be entered with the following data: date, site location, Contract Task Order number, personnel

conducting the investigation, time (military time), start time and end time, and weather.

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STANDARD OPERATING PROCEDURE

Preparing Field Log Books

I. Purpose

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

II. Scope

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

III. Equipment and Materials

- Log book
- Indelible pen

IV. Procedures and Guidelines

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

A. PROCEDURES FOR COMPLETING FIELD LOG BOOKS

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

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

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

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

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

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

5. Daily entries will be made chronologically.

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

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

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

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

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

B. INFORMATION TO BE INCLUDED IN FIELD LOG BOOKS

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

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

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

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

5. Tail Gate Safety Meetings: Record time and location of meeting, who was present, topics discussed, issues/problems/concerns identified,

and corrective actions or adjustments made to address concerns/ problems, and other pertinent information.

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

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

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

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

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

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

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

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

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

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

16. Any conditions that might adversely affect the work or any data obtained (e.g., nearby construction that might have introduced excessive amounts of dust into the air).

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

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

C. SUGGESTED FORMAT FOR RECORDING FIELD DATA

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

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

3. Sketch sampling locations and other pertinent information.

4. Sketch well construction diagrams.

V. Attachments

Example field notes.

STANDARD OPERATING PROCEDURE

Low-Flow Groundwater Sampling from Monitoring Wells – EPA Region IV

I. Purpose and Scope

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

II. Equipment and Materials

- Adjustable-rate positive-displacement pump, submersible pump, or peristaltic pump
- Horiba® U-22 or equivalent water quality meters to monitor pH, specific conductance, turbidity, dissolved oxygen, oxidation-reduction potential (ORP), and temperature
- Flow-through cell with inlet/outlet ports for purged groundwater and watertight ports for each probe
- Generator or alternate power source depending on pump type
- Water-level indicator
- Disposable Teflon, Teflon-lined polyethylene tubing or polyethylene tubing for metals and other inorganics
- Plastic sheeting
- Well-construction information
- Calibrated container and stopwatch to determine flow rate
- Sample containers
- In-line disposable 0.45µm filters (QED® FF8100 or equivalent)
- Shipping supplies (labels, coolers, and ice)
- Field book

III. Procedures and Guidelines

A. Setup and Purging

1. Obtain information on well location, diameter(s), depth, and screen interval(s), and the method for disposal of purged water.
2. Calibrate instruments according to manufacturer's instructions.
3. The well number, site, date, and condition are recorded in the field logbook.

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

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

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

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

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

9. If using a generator, locate it 30 feet downwind from the well to avoid exhaust fumes contaminating the samples.

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

11. The water level should be monitored during purging, and, ideally, the purge rate should equal the well recharge rate so that there is little or no drawdown in the well (i.e., less than 0.3-foot). The water level should stabilize for the specific purge rate. Record adjustments in the purge rate and changes in depth to water in the logbook. Purge rates should, if needed, be decreased to the minimum capabilities of the pump (0.1- to 0.2-liter per minute) to avoid affecting well drawdown. <u>If the water level is drawn down by more than 0.3 feet, purging should be conducted in accordance with SOP *Groundwater Sampling from Monitoring Wells*</u>.

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

    - pH: within 0.1 pH units

- Specific conductance: within 10 percent
- Turbidity: <10 NTU or within 10 percent
- Temperature: constant

B. Sample Collection

Once purging is complete the well is ready to sample. The elapsed time between completion of purging and collection of the groundwater sample should be minimized. Typically, the sample is collected immediately after the well has been purged, but this is also dependent on well recovery.

Samples will be placed in sample containers that have been cleaned to laboratory standards and are preserved in accordance with the analytical method. The containers are typically pre-preserved, if required.

VOC samples are normally collected first and directly into pre-preserved sample containers (see Special Conditions for Sampling with Peristaltic Pumps).

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

1. The cap is removed from the sample bottle, and the bottle is tilted slightly.
2. The sample is slowly poured from the bailer or discharged from the pump so that it runs down the inside of the sample bottle with a minimum of splashing. The pumping rate should be reduced to approximately 100 ml per minute when sampling VOCs.
3. Inorganics, including metals, may be collected and preserved in the filtered form as well as the unfiltered form. Disposable in-line filters (0.45 micron filter), connected to the end of the sample tubing,, are typically used for field filtration. Samples are field filtered as the water is being placed into the sample container. If a bailer is used, filtration may be driven by a peristaltic pump.
4. Adequate space is left in the bottle to allow for expansion, except for VOC vials, which are filled to the top with a positive meniscus.
5. The bottle is capped and clearly labeled.
6. Immediately upon collection, all samples for chemical analysis are to be placed in a closed container on ice unless it is not possible to do so. Although unusual and uncommon, there may be instances where it is not possible to have containers with ice at the sample location. In these instances, the samples should be placed on ice as soon as practical and during the time between collection and placing the samples on ice, the samples should be kept as cool as possible.

7. Nondedicated equipment is cleaned and decontaminated in accordance with the *Decontamination of Personnel and Equipment* SOP.

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

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

Special Conditions for Sampling with Peristaltic Pumps
It is not acceptable to collect samples for organic compounds analyses through the flexible tubing used in the pump head. When collecting samples for organic compound analyses it is necessary to use a vacuum container, placed between the pump and the well for sample collection.

The following step-by-step procedures describe the process of sampling with a peristaltic pump and vacuum jug (see note following these procedures for collection of VOC samples):

1. Disconnect the purge tubing from the pump. Make sure the tubing is securely attached to the protective casing or other secure object.
2. Insert the tubing into one of the ferrule nut fittings of a Teflon® vacuum container transfer cap assembly.
3. Place a suitable length of Teflon® tubing between the remaining transfer cap assembly ferrule nut fitting and the vacuum side of the flexible tubing in the peristaltic pump head. Securely hand-tighten both fittings.
4. Turn the pump on. Water should begin to collect in the transfer container (typically a 1-liter "Boston round" glass sample container) within a few minutes. If water does not begin to flow into the container within several minutes, check the transfer cap fittings and make sure the assembly is tightly attached to the container. It may be necessary to tighten the ferrule nuts with a wrench or pliers to achieve a vacuum in the system, particularly when approaching the maximum head difference between the pump and water table (limit of suction).

5. When the transfer container is nearly full, turn off the pump, remove the transfer cap assembly, and pour the sample into the appropriate containers.
6. If additional sample volume is needed, replace the transfer cap assembly, turn the pump on, and collect additional volume.

NOTE: Samples for volatile organic compound analyses cannot be collected using the vacuum jug method. If samples for VOC analyses are required, they must be collected with a bailer or by other approved methods, such as the "soda straw" method. The "soda straw" method involves allowing the tubing to fill, by either lowering it into the water column (A) or by filling it via suction applied by the pump head (B). If method (A) is used, the tubing is removed from the well after filling and the captured sample is allowed to drain into the sample vial. If method (B) is used, after running the pump and filling the tubing with sample, the pump speed is reduced and the direction reversed to push the sample out of the tubing into the vials. Avoid completely emptying the tubing when filling the sample vials when using method (B) to prevent introducing water that was in contact with the flexible pump head tubing. Either method is repeated, as necessary, until all vials are filled.

Samples for some constituents, primarily inorganic analytes such as metals and cyanide, may be collected directly from the peristaltic pump head tubing. This method is acceptable under the following conditions:

- The pump head tubing must be changed between sampling locations;
- An equipment rinsate blank must be collected by pumping de-ionized water through a piece of the tubing.

C. Additional remarks

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

IV. Attachments

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

V. Key Checks and Preventative Maintenance

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

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

White Paper on Low-Flow Sampling

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

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

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

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

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

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

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

STANDARD OPERATING PROCEDURE

Magnetometry

I. Purpose

This SOP provides general reference information and standard techniques for using magnetometry.

II. Scope

This SOP provides a description of the field procedures, equipment, and interpretation methods necessary to fully utilize this procedure.

III. Definitions

Diurnal variations - daily changes in the total magnetic field strength due to solar activity and which (may be as large as 100 gammas or more).

Gradient - change in magnetic field strength in a given vertical or horizontal distance.

Magnetic storm - sudden and simultaneous variations of up to several hundred gammas throughout the world. Magnetic storms can occur as often as several times a month and can last one to several days.

Total magnetic field intensity - a scaler measurement of the magnitude of the earth's magnetic field vector independent of its direction.

IV. PROCEDURES

A. Overview

Magnetic surveying is a passive geophysical technique which measures the strength of the earth's magnetic field. The earth's field is a vector quantity having a unique magnitude and direction at every point on the earth's surface. A magnetometer is the instrument which measures the magnetic field strength in units of gammas or nanoteslas. In order to recognize a magnetic anomaly, it must be several times larger than the background noise level along that profile. Buried ferrous metal objects such as steel drums or tanks cause local variations or anomalies in the earth's magnetic field that can be detected by a magnetometer. Geologic features such as igneous intrusion or iron rich sands can also be mapped using magnetic surveying.

The earth's magnetic field is not completely stable. It undergoes long-term (secular) variations over centuries; small, daily (diurnal) variations (less than 1% of the total field magnitude); and transient fluctuations called magnetic storms resulting from

solar flare phenomena. Both naturally-occurring and manmade magnetic materials can modify the earth's magnetic field locally.

Analysis of magnetic data by an experienced geophysicist can provide an estimate of the areal extent and quantity of buried ferrous objects. Depth of burial approximations can be made using graphical methods of interpretation such as slope techniques and half-width rules as described in Nettleton (1976).

B. Application and Uses

Buried ferrous metal objects such as pipelines, barrels, tanks, etc., generally produce a perturbation in the earth's naturally occurring magnetic field. The size (amplitude) of this perturbation is related to the size of, distance to, susceptibility and remnant magnetization of the buried object. The magnetic survey method, therefore, is a useful tool for site studies to locate and identify buried ferrous metal. Non-anomalous magnetic data acquired over EM conductivity anomalies is an indication of the existence of buried conductive, non-ferrous metal (copper, aluminum, brass) objects.

Magnetic data also can be helpful in determining the size and geometry of geologic features such as fault zones, mineralized zones, and bedrock valleys and depressions. These features are characterized generally by longer wavelength anomalies and are readily distinguishable from anomalies associated with buried metal. In many areas, such geologic features may control or affect the direction and magnitude of groundwater flow.

The total field proton precession magnetometer, the fluxgate magnetometer, and the magnetic gradiometer are commonly used magnetometers in environmental site investigations. The total field proton precession magnetometer is the most commonly used magnetometer because they are easy to operate, have no instrumental drift, and can acquire data rapidly. The fluxgate magnetometer can better define the boundaries of buried ferrous objects than the proton precession magnetometer but is subject to instrument drift, and needs to be exactly oriented. Magnetic gradiometer measurements enhance anomalies resulting from shallow magnetic sources.

C. Equipment

Magnetometers commonly used in hazardous waste site investigations include the total field proton procession magnetometer, the flux gate magnetometer, and the magnetic gradiometer. Text books such as Telford (1976) and Nettleton (1976) discuss in detail the operation and construction of these and other magnetometers.

The total field proton procession magnetometer is the most commonly used magnetometer in hazardous waste investigations. This instrument utilizes the precession of spinning protons of hydrogen atoms in a sample fluid (kerosene, alcohol or water) to measure the total magnetic field intensity. Total field proton precession magnetometers are portable and do not require precise orientation and leveling; the sensor must be oriented with one side facing approximately north and the sensor held stationary during the cycling period. Proton precession magnetometers have no instrument drift, do not require calibrations, are easy to

operate, and have an accuracy of 0.1 gamma. Most modern proton precession magnetometers have digital readouts and electronic storage of data.

Vertical magnetic gradiometers are magnetometers that measure vertical differences of the earth's total magnetic field. Gradient measurements enhance magnetic anomalies resulting from near surface magnetic source and discrimination between neighboring magnetic anomalies is also enhanced. These measurements are generally made using an instrument similar to a total field magnetometer that has two or more sensors mounted on a staff. The sensors are vertically separated by a constant distance, usually one to three feet. Gradient readings are adversely affected by ferrous metal surface debris since signals from this surface debris are also amplified. Consequently, removal of surface metal should be considered before conducting a gradiometer survey.

The flux gate magnetometer was developed during World War II as a submarine detector. Text books such as Telford (1976), RAO and Murthy (1978) explain in detail the principals of operation of the flux gate magnetometer. A fluxgate magnetometer can define the boundaries of regions of buried ferrous metal objects more precisely than the proton precession magnetometer. There are several sources of errors in flux gate magnetometers including unbalance in the two coils, thermal and shock noise, circuit drift and temperature sensitivity. The advantages are direct readout, no azimuth orientation, coarse leveling required, light weight and portability (Telford, 1976).

D. Field Procedures

Magnetic data are generally acquired at relatively close station spacings (5 to 50 foot intervals) along closely spaced (10 to 50 feet) parallel survey lines.

Magnetic data can be acquired in a rectangular grid pattern or along traverses. Grid data are readings acquired at the nodes of a rectangular grid; traverse data is acquired at fixed intervals along a line. Traverse data is often preferable to grid data because it generally is less expensive to acquire (heavily vegetated sites require time consuming brush cutting to establish a complete grid) and more useful for interpretation than an equal number of grid readings. Traverse lines generally ought to be oriented in a north-south direction so that the maximum amplitude of an anomaly can be detected. However, line orientations are often more dependent on site obstacles and sources of magnetic noise.

Station and line spacing intervals are determined on the basis of the desired resolution of the survey. If individual drums or clusters of deeply (greater than 25 feet) buried drums are the objective of the survey, then a detailed magnetic survey with relatively close station spacings (approximately 5 to 10 feet) and line spacings (approximately 10 to 25 feet) should be used. If large metal objects such as 10,000 gallon tanks or trenches filled with barrels are the objective of the magnetic survey, then a reconnaissance or screening survey with longer station spacings (25, 50, or 100 feet) and line spacings of (25, 50, or 100 feet) may be appropriate.

In conducting a survey, the field operator must avoid or note any sources of high magnetic gradients and alternating currents, such as power lines, buildings, and any

large iron or steel objects. It is also important that the operator be relatively free of magnetic materials on his/her person and the magnetometer sensor be kept clean to avoid possible magnetic-bearing soil. Periodically during a survey, and particularly when an anomaly is detected, it is important to establish that the magnetometer is providing valid readings and not random, meaningless instrument noise. The simplest means of verifying magnetometer field readings is to take several successive readings at one location. These readings should repeat to within ± 1 gamma. Readings are taken at predetermined intervals which depend on the nature of the survey and which may have to be modified depending on the gradients encountered. For detailed surveys, a base station or the reoccupation of a set of stations several times a day or a continuous monitoring station (within 100 miles) is established to check for diurnal variations and magnetic storms. At the height of a magnetic storm, magnetic surveying may be impractical due to the large instantaneous changes in the total magnetic field.

E. Interpretation

1. Data Analysis

Magnetic data can be corrected for diurnal variations; however, diurnal changes are generally very gradual and linear and should not have the extreme fluctuations associated with buried ferrous metal objects. Magnetic data can be plotted in profile form or contoured depending upon the survey coverage. Noise sources (surface ferrous metal objects, fences, power lines, etc.) should be noted on the profiles or contour map so that anomalies due to these known sources can be accounted for. The amplitudes of similar sized surface metal objects should be compared. If similar sized ferrous metal surface objects have extremely different anomaly amplitudes, it may be an indication that buried ferrous metal objects exist in the vicinity of the higher amplitude anomalies.

2. Presentation of Results

The results of a magnetic survey should be presented in profile and/or contour map form. The orientation of the traverses should be indicated on profiles and lines of coverage on contour maps. Locations of observed ferrous metal and other cultural features (hills, valleys, streams, etc.) should be noted on both the profile and the contour maps.

3. Interpretation

Magnetic anomalies can be analyzed both qualitatively and quantitatively. The shape and gradient of an anomaly (slope, wave-length, amplitude, etc.) contains enough information to draw qualitative conclusions regarding the location and depth of the causative source.

Quantitative computer modeling interpretations of magnetic data are complicated both by the inherent complexity of dipole magnetic behavior and by the fact that a number of different types and configurations of sources can cause the same anomaly. Where the properties of the earth's field and the local geologic materials (inclination, declination, susceptibility, and remnant magnetization) are well known,

reasonable assumptions regarding the nature of the source- can be made, and a fairly accurate model of the source generally can be derived.

F. Advantages and Limitations

Advantages of the magnetic survey method include:

- Rapid operation
- Low expense
- Identification of buried metal (ferrous)
- Sensitivity to small ferrous objects

Limitations of the magnetic survey method include:

- Susceptible to effects of manmade structures, utilities, buildings, fences, etc.
- Detection is limited to the distance to and quantity of ferrous metal present

V. Quality Assurance Records

All data will be recorded in log books and/or data logging sheets designed for this procedure. All data will be entered with the following basic information: date, start and end times (military time), location, personnel on site, Contract Task Order number, and weather.

VI. References

Dobrin, M.B., 1976, "Introduction to Geophysical Prospecting," McGraw-Hill Inc., New York, 630 p.

Grant, F.S. and West, G.F., 1965, Interpretation Theory in Applied Geophysics: New York, McGraw-Hill.

Nettleton, L.L., 1976, "Gravity and Magnetics in Oil Prospecting," McGraw-Hill Book Company, New York, 453 p.

Nettleton, L.L., 1973, "Elementary Gravity and Magnetics For Geologists and Seismologists, "Society of Exploration Geophysicists, Monograph no.I, Tulsa, Oklahoma, 121 p.

Telford, W.M., Geldart, L.P., Sheriff, R.E., Keys, D.A., 1976, "Applied Geophysics," Cambridge University Press, New York, 860 p.

RAO and Murthy, "Gravity and Magnetic Methods of Prospecting," Safdarjang Enclave, New Delhi-1100166 390 p.

STANDARD OPERATING PROCEDURE

Logging of Soil Borings

I. Purpose and Scope

This SOP provides guidance to obtain accurate and consistent descriptions of soil characteristics during soil-sampling operations. The characterization is based on visual examination and manual tests, not on laboratory determinations.

II. Equipment and Materials

- Indelible pens
- Tape measure or ruler
- Field logbook
- Spatula
- HCL, 10 percent solution
- Squirt bottle with water
- Rock- or soil-color chart (e.g., Munsell)
- Grain-size chart
- Hand lens
- Unified Soil Classification System (USCS) index charts and tables to help with soil classification (attached)

III. Procedures and Guidelines

This section covers several aspects of soil characterization: instructions for completing the CH2M HILL soil boring log Form D1586 (attached), field classification of soil, and standard penetration test procedures.

A. Instructions for Completing Soil Boring Logs

Soil boring logs will be completed in the field log books or on separate soil boring log sheets. Information collected will be consistent with that required for Form D1586 (attached), a standard CH2M HILL form (attached), or an equivalent form that supplies the same information.

The information collected in the field to perform the soil characterization is described below.

Field personnel should review completed logs for accuracy, clarity, and thoroughness of detail. Samples also should be checked to see that information is correctly recorded on both jar lids and labels and on the log sheets.

B. Heading Information

Boring/Well Number. Enter the boring/well number. A numbering system should be chosen that does not conflict with information recorded for previous exploratory work done at the site. Number the sheets consecutively for each boring.

Location. If station, coordinates, mileposts, or similar project layout information is available, indicate the position of the boring to that system using modifiers such as "approximate" or "estimated" as appropriate.

Elevation. Elevation will be determined at the conclusion of field activities through a survey.

Drilling Contractor. Enter the name of the drilling company and the city and state where the company is based.

Drilling Method and Equipment. Identify the bit size and type, drilling fluid (if used), and method of drilling (e.g., rotary, hollow-stem auger). Information on the drilling equipment (e.g., CME 55, Mobile B61) also is noted.

Water Level and Date. Enter the depth below ground surface to the apparent water level in the borehole. The information should be recorded as a comment. If free water is not encountered during drilling or cannot be detected because of the drilling method, this information should be noted. Record date and time of day (for tides, river stage) of each water level measurement.

Date of Start and Finish. Enter the dates the boring was begun and completed. Time of day should be added if several borings are performed on the same day.

Logger. Enter the first and last name.

C. Technical Data

Depth Below Surface. Use a depth scale that is appropriate for the sample spacing and for the complexity of subsurface conditions.

Sample Interval. Note the depth at the top and bottom of the sample interval.

Sample Type and Number. Enter the sample type and number. SS-1 = split spoon, first sample. Number samples consecutively regardless of type. Enter a sample number even if no material was recovered in the sampler.

Sample Recovery. Enter the length to the nearest 0.1-foot of soil sample recovered from the sampler. Often, there will be some wash or caved material above the sample; do not include the wash material in the measurement. Record soil recovery in feet.

Standard Penetration Test Results. In this column, enter the number of blows required for each 6 inches of sampler penetration and the "N" value, which is the sum of the blows in the middle two 6-inch penetration intervals. A typical standard penetration test involving successive blow counts of 2, 3, 4, and 5 is recorded as 2-3-4-5 and (7). The standard penetration test is terminated if the sampler encounters refusal. Refusal is a penetration of less than 6 inches with a blow count of 50. A

partial penetration of 50 blows for 4 inches is recorded as 50/4 inches. Penetration by the weight of the slide hammer only is recorded as "WOH."

Samples should be collected using a 140-pound hammer and 2-inch diameter split spoons. Samples may be collected using direct push sampling equipment. However, blow counts will not be available. A pocket penetrometer may be used instead to determine relative soil density of fine grained materials (silts and clays).

Sample also may be collected using a 300-pound hammer or 3-inch-diameter split-spoon samples at the site. However, use of either of these sample collection devices invalidates standard penetration test results and should be noted in the comments section of the log. The 300-pound hammer should only be used for collection of 3-inch-diameter split-spoon samples. Blow counts should be recorded for collection of samples using either a 3-inch split-spoon, or a 300-pound hammer. An "N" value need not be calculated.

Soil Description. The soil classification should follow the format described in the "Field Classification of Soil" subsection below.

Comments. Include all pertinent observations (changes in drilling fluid color, rod drops, drilling chatter, rod bounce as in driving on a cobble, damaged Shelby tubes, and equipment malfunctions). In addition, note if casing was used, the sizes and depths installed, and if drilling fluid was added or changed. You should instruct the driller to alert you to any significant changes in drilling (changes in material, occurrence of boulders, and loss of drilling fluid). Such information should be attributed to the driller and recorded in this column.

Specific information might include the following:

- The date and the time drilling began and ended each day
- The depth and size of casing and the method of installation
- The date, time, and depth of water level measurements
- Depth of rod chatter
- Depth and percentage of drilling fluid loss
- Depth of hole caving or heaving
- Depth of change in material
- Health and safety monitoring data
- Drilling interval through a boulder

D. Field Classification of Soil

This section presents the format for the field classification of soil. In general, the approach and format for classifying soils should conform to ASTM D 2488, Visual-Manual Procedure for Description and Identification of Soils (attached).

The Unified Soil Classification System is based on numerical values of certain soil properties that are measured by laboratory tests. It is possible, however, to estimate these values in the field with reasonable accuracy using visual-manual procedures (ASTM D 2488). In addition, some elements of a complete soil

description, such as the presence of cobbles or boulders, changes in strata, and the relative proportions of soil types in a bedded deposit, can be obtained only in the field.

Soil descriptions should be precise and comprehensive without being verbose. The correct overall impression of the soil should not be distorted by excessive emphasis on insignificant details. In general, similarities rather than differences between consecutive samples should be stressed.

Soil descriptions must be recorded for every soil sample collected. The format and order for soil descriptions should be as follows:

1. Soil name (synonymous with ASTM D 2488 Group Name) with appropriate modifiers. Soil name should be in all capitals in the log, for example "POORLY-GRADED SAND."

2. Group symbol, in parentheses, for example, "(SP)."

3. Color, using Munsell color designation

4. Moisture content

5. Relative density or consistency

6. Soil structure, mineralogy, or other descriptors

This order follows, in general, the format described in ASTM D 2488.

E. Soil Name

The basic name of a soil should be the ASTM D 2488 Group Name on the basis of visual estimates of gradation and plasticity. The soil name should be capitalized.

Examples of acceptable soil names are illustrated by the following descriptions:

- A soil sample is visually estimated to contain 15 percent gravel, 55 percent sand, and 30 percent fines (passing No. 200 sieve). The fines are estimated as either low or highly plastic silt. This visual classification is SILTY SAND WITH GRAVEL, with a Group Symbol of (SM).

- Another soil sample has the following visual estimate: 10 percent gravel, 30 percent sand, and 60 percent fines (passing the No. 200 sieve). The fines are estimated as low plastic silt. This visual classification is SANDY SILT. The gravel portion is not included in the soil name because the gravel portion was estimated as less than 15 percent. The Group Symbol is (ML).

The gradation of coarse-grained soil (more than 50 percent retained on No. 200 sieve) is included in the specific soil name in accordance with ASTM D 2488. There is no need to further document the gradation. However, the maximum size and angularity or roundness of gravel and sand-sized particles should be recorded. For fine-grained soil (50 percent or more passing the No. 200 sieve), the name is modified by the appropriate plasticity/elasticity term in accordance with ASTM D 2488.

Interlayered soil should each be described starting with the predominant type. An introductory name, such as "Interlayered Sand and Silt," should be used. In addition, the relative proportion of each soil type should be indicated (see Table 1 for example).

Where helpful, the evaluation of plasticity/elasticity can be justified by describing results from any of the visual-manual procedures for identifying fine-grained soils, such as reaction to shaking, toughness of a soil thread, or dry strength as described in ASTM D 2488.

F. Group Symbol

The appropriate group symbol from ASTM D 2488 must be given after each soil name. The group symbol should be placed in parentheses to indicate that the classification has been estimated.

In accordance with ASTM D 2488, dual symbols (e.g., GP-GM or SW-SC) can be used to indicate that a soil is estimated to have about 10 percent fines. Borderline symbols (e.g., GM/SM or SW/SP) can be used to indicate that a soil sample has been identified as having properties that do not distinctly place the soil into a specific group. Generally, the group name assigned to a soil with a borderline symbol should be the group name for the first symbol. The use of a borderline symbol should not be used indiscriminately. Every effort should be made to first place the soil into a single group.

G. Color

The color of a soil must be given. The color description should be based on the Munsell system. The color name and the hue, value, and chroma should be given.

H. Moisture Content

The degree of moisture present in a soil sample should be defined as dry, moist, or wet. Moisture content can be estimated from the criteria listed on Table 2.

I. Relative Density or Consistency

Relative density of a coarse-grained (cohesionless) soil is based on N-values (ASTM D 1586 [attached]). If the presence of large gravel, disturbance of the sample, or non-standard sample collection makes determination of the in situ relative density or consistency difficult, then this item should be left out of the description and explained in the Comments column of the soil boring log.

Consistency of fine-grained (cohesive) soil is properly based on results of pocket penetrometer or torvane results. In the absence of this information, consistency can be estimated from N-values. Relationships for determining relative density or consistency of soil samples are given in Tables 3 and 4.

J. Soil Structure, Mineralogy, and Other Descriptors

Discontinuities and inclusions are important and should be described. Such features include joints or fissures, slickensides, bedding or laminations, veins, root holes, and wood debris.

Significant mineralogical information such as cementation, abundant mica, or unusual mineralogy should be described.

Other descriptors may include particle size range or percentages, particle angularity or shape, maximum particle size, hardness of large particles, plasticity of fines, dry strength, dilatancy, toughness, reaction to HCl, and staining, as well as other information such as organic debris, odor, or presence of free product.

K. Equipment and Calibration

Before starting the testing, the equipment should be inspected for compliance with the requirements of ASTM D 1586. The split-barrel sampler should measure 2-inch or 3-inch O.D., and should have a split tube at least 18 inches long. The minimum size sampler rod allowed is "A" rod (1-5/8-inch O.D.). A stiffer rod, such as an "N" rod (2-5/8-inch O.D.), is required for depths greater than 50 feet. The drive weight assembly should consist of a 140-pound or 300-pound hammer weight, a drive head, and a hammer guide that permits a free fall of 30 inches.

IV. Attachments

Soil Boring Log (Sample Soil Boring Log.xls)

CH2M HILL Form D1586 and a completed example (Soil_Log_Examp.pdf)

ASTM D 2488 *Standard Practice for Description and Identification of Soils (Visual-Manual Procedures)* (ASTM D2488.pdf)

ASTM 1586 *Standard Test Method for Penetration Test and Split-Barrel Sampling of Soils* (ASTM D1586.pdf)

Tables 1 through 4 (Tables 1-4.pdf)

V. Key Checks and Preventive Maintenance

- Check entries to the soil-boring log and field logbook in the field; because the samples will be disposed of at the end of fieldwork, confirmation and corrections cannot be made later.
- Check that sample numbers and intervals are properly specified.
- Check that drilling and sampling equipment is decontaminated using the procedures defined in SOP *Decontamination of Drilling Rigs and Equipment*.

STANDARD OPERATING PROCEDURE

Shallow Soil Sampling

I. Purpose

To provide general guidelines for the collection and handling of surface soil samples during field operations.

II. Scope

The method described for surface soil sampling is applicable for loosely packed earth and is used to collect disturbed-soil samples.

III. Equipment and Materials

- Sample jars.
- A hand auger or other device that can be used to remove the soil from the ground. Only stainless steel, Teflon, or glass materials should be used. The only exception is split spoons, which are most commonly available in carbon steel; these are acceptable for use only if they are not rusty.
- A stainless steel spatula or disposable plastic scoop should be used to remove material from the sampling device.
- Unpainted wooden stakes or pin flags
- Fiberglass measuring tape (at least 200 feet in length)
- GPS Unit (if available)

IV. Procedures and Guidelines

A. Wear protective gear, as specified in the Health and Safety Plan.

B. To locate samples, identify the correct location using the pin flags or stakes. Proceed to collect a sample from the undisturbed soil adjacent to the marker following steps C and D. If markers are not present, the following procedures will be used.

1. For samples on a grid:

a. Use measuring tape to locate each sampling point on the first grid line as prescribed in the sampling plan. As each point is located, drive a numbered stake in the ground and record its location on the site map and in the logbook.

b. Proceed to sample the points on the grid line.

c. Measure to location where next grid line is to start and stake first sample. For subsequent samples on the line take two orthogonal measurements: one to the previous grid line, and one to the previous sample on the same grid line.

d. Proceed to sample the points on the grid line as described in Section C below.

e. Repeat 1c and 1d above until all samples are collected from the area.

f. Or, a GPS unit can be used to identify each location based on map coordinated, if available.

2. For non-grid samples:

a. Use steel measuring tape to position sampling point at location described in the sampling plan by taking two measurements from fixed landmarks (e.g., corner of house and fence post).

b. Note measurements, landmarks, and sampling point on a sketch in the field notebook, and on a site location map.

c. Proceed to sample as described in Section C below.

d. Repeat 2a through 2c above until all samples are collected from the area.

e. Or, a GPS unit can be used to identify each location based on map coordinated, if available.

C. To the extent possible, differentiate between fill and natural soil. If both are encountered at a boring location, sample both as prescribed in the field sampling plan. Do not locate samples in debris, tree roots, or standing water. In residential areas, do not sample in areas where residents' activities may impact the sample (e.g., barbecue areas, beneath eaves of roofs, driveways, garbage areas). If an obstacle prevents sampling at a measured grid point, move as close as possible, but up to a distance of one half the grid spacing in any direction to locate an appropriate sample. If an appropriate location cannot be found, consult with the Field Team Leader (FTL). If the FTL concurs, the sampling point will be deleted from the program. The FTL will contact the CH2M HILL project manager (PM) immediately. The PM and Navy Technical Representative (NTR) will discuss whether the point should be deleted from the program. If it is deleted, the PM will follow-up with the NTR in writing.

D. To collect samples:

1. Use a decontaminated stainless steel scoop/trowel or disposable plastic scoop to scrape away surficial organic material (grass, leaves, etc.) adjacent to

the stake. New disposable scoops or trowels may also be used to reduce the need for equipment blanks.

2. If sampling:

   a. Surface soil: Obtain soil sample by scooping soil using the augering scoop/trowel, starting from the surface and digging down to a depth of about 6 inches, or the depth specified in the workplan.

   b. Subsurface soil: Obtain the subsurface soil sample using an auger down to the depths prescribed in the field sampling plan.

3. Take a photo ionization detector (PID) reading of the sampled soil if organics are anticipated to be present and record the response in the field notebook. Also record lithologic description and any pertinent observations (such as discoloration) in the logbook.

4. Empty the contents of the scoop/trowel into a decontaminated stainless steel pan or dedicated sealable bag.

5. Repeat this procedure until sufficient soil is collected to meet volume requirements.

6. For TCL VOC and field GC aliquots, fill sample jars directly with the trowel or scoop or specialized sampling equipment (i.e. Encore® or Terra Core® sampler) and cap immediately upon filling. DO NOT HOMOGENIZE.

7. For TCL pesticides/PCBs and SVOCs, TAL metals, and field XRF aliquots, homogenize cuttings in the pan using a decontaminated stainless steel utensil in accordance with SOP *Decontamination of Drilling Rigs and Equipment*.

8. Transfer sample for analysis into appropriate containers with a decontaminated utensil.

9. Immediately upon collection, all samples for chemical analysis are to be placed in a closed container on ice unless it is not possible to do so. Although unusual and uncommon, there may be instances where it is not possible to have containers with ice at the sample location. In these instances, the samples should be placed on ice as soon as practical and during the time between collection and placing the samples on ice, the samples should be kept as cool as possible

10. Backfill the hole with soil removed from the borehole. To the extent possible, replace topsoil and grass and attempt to return appearance of sampling area to its pre-sampled condition. For samples in non-residential, unmowed areas, mark the sample number on the stake and leave stake in place. In mowed areas, remove stake.

V. Attachments

None.

VI. Key Checks and Items

- Use phthalate-free latex or surgical gloves and other personal protective equipment.
- Transfer volatiles first, avoid mixing.
- Decontaminate utensils before reuse, or use dedicated, disposable utensils.

I. Purpose and Scope

Test pits or trenches may be completed in areas where characterization of fill or other waste materials is required or the extent of contamination needs to be determined. In general, test pits/trenches may be excavated up to 15 feet in length and to a maximum depth of 10 feet. Samples of materials excavated from the trench will be collected from the bucket of the backhoe, the pile of excavated material using a stainless steel trowel or spoon, or the bottomwall of the test pit if it is less than 4 feet below ground surface (bgs). Test pits/trenches will not be entered by any member of the sampling team if they are deeper than 4 feet bgs. OSHA trenching guidelines will be followed. Depending on the subsurface material and depth to groundwater, people and surface loads such as soil stockpiles will be kept away from the edge of the trench.

The position of the test pit/trench will be determined in the field by the Project Geologist/Scientist. Utility clearance will be conducted by a professional utilities locating service prior to excavation. If excavation equipment is used, it will be decontaminated prior to and after each test pit/trench excavation. Excavation will proceed by removing lifts of no more than about six to 12 inches, until an assessment of the material can be made. The material removed from the trench will be placed on plastic sheeting. A geologist will log the test pit materials. The cross section will be sketched or described and notable features will be identified in the field logbook. Depths will be measured from the ground surface. The length and width of the test pit will also be measured. The test pits/trenches will be backfilled with the material removed from the excavation immediately after completed to reduce site hazards and minimize the potential for rainwater accumulation and subsequent contaminant migration.

Attachment 2
DOD ELAP Letter – Analytical Laboratory

PERRY JOHNSON LABORATORY ACCREDITATION, INC.

Certificate of Accreditation

Perry Johnson Laboratory Accreditation, Inc. has assessed the Laboratory of:

ALS Environmental-Rochester

1565 Jefferson Road, Building 300, Suite 360, Rochester, NY 14623

(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 4.2 10/26/10 and is accredited is 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:

Initial Accreditation Date:	*Issue Date:*
January 22, 2010	April 7, 2012

Accreditation No.:	Certificate No.:	Revision Date:
65817	L12-48 R1	May 8, 2013

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.pjlabs.com

Certificate of Accreditation: Supplement

ISO/IEC 17025:2005 and DoD-ELAP

ALS Environmental-Rochester

1565 Jefferson Road, Building 300, Suite 360, Rochester, NY 14623
Lisa Reyes Phone: 585-288-5380

Accreditation is granted to the facility to perform the following testing:

Matrix	Standard/Method	Technology	Analyte
Aqueous	(CAS SOP) GEN-TICW	UV-VIS	Total inorganic carbon
Aqueous	EPA 1631	CVAFS	Mercury
Aqueous	EPA 1664A	Gravimetric	Oil and grease
Aqueous	EPA 1664A	Gravimetric	Total petroleum hydrocarbons
Aqueous	EPA 218.6	IC-UV	Chromium, Hexavalent
Aqueous	EPA 218.7	IC-UV	Chromium, Hexavalent
Aqueous	EPA 245.1	CVAA	Mercury
Aqueous	EPA 300.0	IC	Chloride
Aqueous	EPA 300.0	IC	Fluoride
Aqueous	EPA 300.0	IC	Nitrate
Aqueous	EPA 300.0	IC	Sulfate
Aqueous	EPA 350.1	Colorimetric	Ammonia
Aqueous	EPA 351.2	UV-VIS	Nitrogen, total Kjeldahl
Aqueous	EPA 353.2	UV-VIS	Nitrite as N
Aqueous	EPA 410.4	UV-VIS	Chemical oxygen demand
Aqueous	EPA 522	GC-MS-SIM	1,4-Dioxane
Aqueous	EPA 7470A	CVAA	Mercury
Aqueous	EPA 8151A	GC-ECD	Dinoseb
Aqueous	EPA 8260C	GC-MS-SIM	1,1-Dichloroethene
Aqueous	EPA 8260C	GC-MS-SIM	1,2-Dichlorobenzene
Aqueous	EPA 8260C	GC-MS-SIM	1,2-Dichloroethane
Aqueous	EPA 8260C	GC-MS-SIM	1,4-Dioxane
Aqueous	EPA 8260C	GC-MS-SIM	Carbon tetrachloride
Aqueous	EPA 8260C	GC-MS-SIM	Dichloromethane
Aqueous	EPA 8260C	GC-MS-SIM	Ethylbenzene
Aqueous	EPA 8260C	GC-MS-SIM	m- + p-Xylene
Aqueous	EPA 8260C	GC-MS-SIM	o-Xylene
Aqueous	EPA 8260C	GC-MS-SIM	Tetrachloroethene
Aqueous	EPA 8260C	GC-MS-SIM	Trichloroethene
Aqueous	EPA 8260C	GC-MS-SIM	Vinyl chloride
Aqueous	EPA 8260C	GC-MS-SIM	Xylenes, total
Aqueous	EPA 8270D	GC-MS-SIM	1,4-Dioxane
Aqueous	EPA 8310	HPLC-UV/FLUOR	Acenaphthene
Aqueous	EPA 8310	HPLC-UV/FLUOR	Acenaphthylene
Aqueous	EPA 8310	HPLC-UV/FLUOR	Anthracene

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ALS Environmental-Rochester

1565 Jefferson Road, Building 300, Suite 360, Rochester, NY 14623
Lisa Reyes Phone: 585-288-5380

Accreditation is granted to the facility to perform the following testing:

Matrix	Standard/Method	Technology	Analyte
Aqueous	EPA 8310	HPLC-UV/FLUOR	Benzo(a)antracene
Aqueous	EPA 8310	HPLC-UV/FLUOR	Benzo(a)pyrene
Aqueous	EPA 8310	HPLC-UV/FLUOR	Benzo(b)fluoranthene
Aqueous	EPA 8310	HPLC-UV/FLUOR	Benzo(g,h,i)perylene
Aqueous	EPA 8310	HPLC-UV/FLUOR	Benzo(k)fluoranthene
Aqueous	EPA 8310	HPLC-UV/FLUOR	Chrysene
Aqueous	EPA 8310	HPLC-UV/FLUOR	Dibenzo(a,h)anthracene
Aqueous	EPA 8310	HPLC-UV/FLUOR	Fluoranthene
Aqueous	EPA 8310	HPLC-UV/FLUOR	Fluorene
Aqueous	EPA 8310	HPLC-UV/FLUOR	Indeno(1,2,3-cd)pyrene
Aqueous	EPA 8310	HPLC-UV/FLUOR	Naphthalene
Aqueous	EPA 8310	HPLC-UV/FLUOR	Phenanthrene
Aqueous	EPA 8310	HPLC-UV/FLUOR	Pyrene
Aqueous	EPA 9040B, C	POT	pH
Aqueous	EPA 9060, A	UV-VIS	Total organic carbon
Aqueous	EPA 9066	UV-VIS	Phenolics, total
Aqueous	MA VPH	GC	Aliphatics and Aromatics
Aqueous	RSK-175	GC-FID	Ethane
Aqueous	RSK-175	GC-FID	Ethylene
Aqueous	RSK-175	GC-FID	Methane
Aqueous	RSK-175	GC-FID	Propane
Aqueous	RSK-175	GC-FID	Acetylene
Aqueous	SM 2320B	Titration	Alkalinity, total, carbonate, and bicarbonate
Aqueous	SM 2340C	Titration	Hardness, total
Solids	(CAS SOP) GEN-351.2	UV-VIS	Nitrogen, total Kjeldahl
Solids	(CAS SOP) GEN-420.4/9066	UV-VIS	Phenolics, total
Solids	EPA Lloyd Kahn	UV-VIS	Total organic carbon
Solids	EPA 300.0	IC	Chloride
Solids	EPA 300.0	IC	Fluoride
Solids	EPA 300.0	IC	Nitrate
Solids	EPA 300.0	IC	Sulfate
Solids	EPA 350.1 MOD	Colorimetric	Ammonia
Solids	EPA 7471B	CVAA	Mercury
Solids	EPA 8330A	HPLC-UV	1,3,5-Trinitrobenzene
Solids	EPA 8330A	HPLC-UV	1,3-Dinitrobenzene
Solids	EPA 8330A	HPLC-UV	2,4,6-Trinitrotoluene

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Solids	EPA 8330A	HPLC-UV	2,4-Dinitrotoluene
Solids	EPA 8330A	HPLC-UV	2,6-Dinitrotoluene
Solids	EPA 8330A	HPLC-UV	2-Amino-4,6-dinitrotoluene
Solids	EPA 8330A	HPLC-UV	2-Nitrotoluene
Solids	EPA 8330A	HPLC-UV	3-Nitrotoluene
Solids	EPA 8330A	HPLC-UV	4-Amino-2,6-dinitrotoluene
Solids	EPA 8330A	HPLC-UV	4-Nitrotoluene
Solids	EPA 8330A	HPLC-UV	HMX
Solids	EPA 8330A	HPLC-UV	Nitrobenzene
Solids	EPA 8330A	HPLC-UV	RDX
Solids	EPA 8330A	HPLC-UV	Tetryl
Solids	EPA 9045C, D	POT	pH
Solids	SM 5220B	Titration	Chemical oxygen demand
Aqueous/Solids	EPA 1010A	Pensky Martin	Ignitability
Aqueous/Solids	EPA 353.2	UV-VIS	Nitrate/nitrite as N
Aqueous/Solids	EPA 6010C	ICP-AES	Aluminum
Aqueous/Solids	EPA 6010C	ICP-AES	Antimony
Aqueous/Solids	EPA 6010C	ICP-AES	Arsenic
Aqueous/Solids	EPA 6010C	ICP-AES	Barium
Aqueous/Solids	EPA 6010C	ICP-AES	Beryllium
Aqueous/Solids	EPA 6010C	ICP-AES	Boron
Aqueous/Solids	EPA 6010C	ICP-AES	Cadmium
Aqueous/Solids	EPA 6010C	ICP-AES	Calcium
Aqueous/Solids	EPA 6010C	ICP-AES	Chromium
Aqueous/Solids	EPA 6010C	ICP-AES	Cobalt
Aqueous/Solids	EPA 6010C	ICP-AES	Copper
Aqueous/Solids	EPA 6010C	ICP-AES	Iron
Aqueous/Solids	EPA 6010C	ICP-AES	Lead
Aqueous/Solids	EPA 6010C	ICP-AES	Magnesium
Aqueous/Solids	EPA 6010C	ICP-AES	Manganese
Aqueous/Solids	EPA 6010C	ICP-AES	Nickel
Aqueous/Solids	EPA 6010C	ICP-AES	Potassium
Aqueous/Solids	EPA 6010C	ICP-AES	Selenium

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Matrix	Standard/Method	Technology	Analyte
Aqueous/Solids	EPA 6010C	ICP-AES	Silver
Aqueous/Solids	EPA 6010C	ICP-AES	Sodium
Aqueous/Solids	EPA 6010C	ICP-AES	Thallium
Aqueous/Solids	EPA 6010C	ICP-AES	Tin
Aqueous/Solids	EPA 6010C	ICP-AES	Vanadium
Aqueous/Solids	EPA 6010C	ICP-AES	Zinc
Aqueous/Solids	EPA 6020A	ICP-MS	Arsenic
Aqueous/Solids	EPA 6020A	ICP-MS	Antimony
Aqueous/Solids	EPA 6020A	ICP-MS	Barium
Aqueous/Solids	EPA 6020A	ICP-MS	Beryllium
Aqueous/Solids	EPA 6020A	ICP-MS	Cadmium
Aqueous/Solids	EPA 6020A	ICP-MS	Chromium
Aqueous/Solids	EPA 6020A	ICP-MS	Cobalt
Aqueous/Solids	EPA 6020A	ICP-MS	Copper
Aqueous/Solids	EPA 6020A	ICP-MS	Lead
Aqueous/Solids	EPA 6020A	ICP-MS	Manganese
Aqueous/Solids	EPA 6020A	ICP-MS	Nickel
Aqueous/Solids	EPA 6020A	ICP-MS	Selenium
Aqueous/Solids	EPA 6020A	ICP-MS	Silver
Aqueous/Solids	EPA 6020A	ICP-MS	Thallium
Aqueous/Solids	EPA 6020A	ICP-MS	Vanadium
Aqueous/Solids	EPA 6020A	ICP-MS	Zinc
Aqueous/Solids	EPA 680	GC-MS	Monochlorobiphenyls, Total
Aqueous/Solids	EPA 680	GC-MS	Dichlorobiphenyls, Total
Aqueous/Solids	EPA 680	GC-MS	Trichlorobiphenyls, Total
Aqueous/Solids	EPA 680	GC-MS	Tetrachlorobiphenyls, Total
Aqueous/Solids	EPA 680	GC-MS	Pentachlorobiphenyls, Total
Aqueous/Solids	EPA 680	GC-MS	Hexachlorobiphenyls, Total
Aqueous/Solids	EPA 680	GC-MS	Heptachlorobiphenyls, Total
Aqueous/Solids	EPA 680	GC-MS	Octachlorobiphenyls, Total
Aqueous/Solids	EPA 680	GC-MS	Nonachlorobiphenyls, Total
Aqueous/Solids	EPA 680	GC-MS	Decachlorobiphenyls, Total
Aqueous/Solids	EPA 6850	HPLC-MS	Perchlorate

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Accreditation is granted to the facility to perform the following testing:

Matrix	Standard/Method	Technology	Analyte
Aqueous/Solids	EPA 7196A	UV-VIS	Chromium, hexavalent
Aqueous/Solids	EPA 7199	IC-UV	Chromium, hexavalent
Aqueous/Solids	EPA 8015C	GC-FID	Gasoline range organics
Aqueous/Solids	EPA 8015C	GC-FID	Diesel range organics
Aqueous/Solids	EPA 8081B	GC-ECD	4,4'-DDD
Aqueous/Solids	EPA 8081B	GC-ECD	4,4'-DDE
Aqueous/Solids	EPA 8081B	GC-ECD	4,4'-DDT
Aqueous/Solids	EPA 8081B	GC-ECD	Aldrin
Aqueous/Solids	EPA 8081B	GC-ECD	α-BHC
Aqueous/Solids	EPA 8081B	GC-ECD	Alpha-chlordane
Aqueous/Solids	EPA 8081B	GC-ECD	β-BHC
Aqueous/Solids	EPA 8081B	GC-ECD	Chlordane, technical
Aqueous/Solids	EPA 8081B	GC-ECD	δ-BHC
Aqueous/Solids	EPA 8081B	GC-ECD	Dieldrin
Aqueous/Solids	EPA 8081B	GC-ECD	Endosulfan I
Aqueous/Solids	EPA 8081B	GC-ECD	Endosulfan II
Aqueous/Solids	EPA 8081B	GC-ECD	Endosulfan sulfate
Aqueous/Solids	EPA 8081B	GC-ECD	Endrin
Aqueous/Solids	EPA 8081B	GC-ECD	Endrin aldehyde
Aqueous/Solids	EPA 8081B	GC-ECD	Endrin ketone
Aqueous/Solids	EPA 8081B	GC-ECD	γ-BHC (Lindane)
Aqueous/Solids	EPA 8081B	GC-ECD	γ-Chlordane
Aqueous/Solids	EPA 8081B	GC-ECD	Heptachlor
Aqueous/Solids	EPA 8081B	GC-ECD	Heptachlor epoxide
Aqueous/Solids	EPA 8081B	GC-ECD	Hexachlorobenzene
Aqueous/Solids	EPA 8081B	GC-ECD	Methoxychlor
Aqueous/Solids	EPA 8081B	GC-ECD	Toxaphene
Aqueous/Solids	EPA 8082A	GC-ECD	PCB 1016
Aqueous/Solids	EPA 8082A	GC-ECD	PCB 1221
Aqueous/Solids	EPA 8082A	GC-ECD	PCB 1232
Aqueous/Solids	EPA 8082A	GC-ECD	PCB 1242
Aqueous/Solids	EPA 8082A	GC-ECD	PCB 1248
Aqueous/Solids	EPA 8082A	GC-ECD	PCB 1254

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Accreditation is granted to the facility to perform the following testing:

Matrix	Standard/Method	Technology	Analyte
Aqueous/Solids	EPA 8082A	GC-ECD	PCB 1260
Aqueous/Solids	EPA 8082A	GC-ECD	PCB 1268
Aqueous/Solids	EPA 8151A	GC-ECD	2,4-D
Aqueous/Solids	EPA 8151A	GC-ECD	Dicamba
Aqueous/Solids	EPA 8151A	GC-ECD	2,4,5-T
Aqueous/Solids	EPA 8151A	GC-ECD	2,4,5-TP
Aqueous/Solids	EPA 8151A	GC-ECD	Pentachlorophenol (PCP)
Aqueous/Solids	EPA 8260C	GC-MS	1,1,1,2-Tetrachloroethane
Aqueous/Solids	EPA 8260C	GC-MS	1,1,1-Trichloroethane
Aqueous/Solids	EPA 8260C	GC-MS	1,1,2,2-Tetrachloroethane
Aqueous/Solids	EPA 8260C	GC-MS	1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113)
Aqueous/Solids	EPA 8260C	GC-MS	1,1,2-Trichloroethane
Aqueous/Solids	EPA 8260C	GC-MS	1,1-Dichloroethane
Aqueous/Solids	EPA 8260C	GC-MS	1,1-Dichloroethene
Aqueous/Solids	EPA 8260C	GC-MS	1,1-Dichloropropene
Aqueous/Solids	EPA 8260C	GC-MS	1,2,3-Trichlorobenzene
Aqueous/Solids	EPA 8260C	GC-MS	1,2,3-Trichloropropane
Aqueous/Solids	EPA 8260C	GC-MS	1,2,4-Trichlorobenzene
Aqueous/Solids	EPA 8260C	GC-MS	1,2,4-Trimethylbenzene
Aqueous/Solids	EPA 8260C	GC-MS	1,2-Dibromo-3-chloropropane
Aqueous/Solids	EPA 8260C	GC-MS	1,2-Dibromoethane
Aqueous/Solids	EPA 8260C	GC-MS	1,2-Dichloro-1,1,2,2-tetrafluoroethane (Freon-114)
Aqueous/Solids	EPA 8260C	GC-MS	1,2-Dichloro-1,1,2-trifluoroethane (Freon 123a)
Aqueous/Solids	EPA 8260C	GC-MS	1,2-Dichlorobenzene
Aqueous/Solids	EPA 8260C	GC-MS	1,2-Dichloroethane
Aqueous/Solids	EPA 8260C	GC-MS	1,2-Dichloroethene, total
Aqueous/Solids	EPA 8260C	GC-MS	1,2-Dichloropropane
Aqueous/Solids	EPA 8260C	GC-MS	1,3,5-Trimethylbenzene
Aqueous/Solids	EPA 8260C	GC-MS	1,3-Dichlorobenzene
Aqueous/Solids	EPA 8260C	GC-MS	1,3-Dichloropropane
Aqueous/Solids	EPA 8260C	GC-MS	1,4-Dichlorobenzene
Aqueous/Solids	EPA 8260C	GC-MS	1,4-Dioxane

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ALS Environmental-Rochester

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Accreditation is granted to the facility to perform the following testing:

Matrix	Standard/Method	Technology	Analyte
Aqueous/Solids	EPA 8260C	GC-MS	2,2-Dichloro-1,1,1-trifluoroethane (Freon 123)
Aqueous/Solids	EPA 8260C	GC-MS	2,2-Dichloropropane
Aqueous/Solids	EPA 8260C	GC-MS	2-Butanone (MEK)
Aqueous/Solids	EPA 8260C	GC-MS	2-Chloro-1,3-butadiene
Aqueous/Solids	EPA 8260C	GC-MS	2-Chloroethylvinyl ether
Aqueous/Solids	EPA 8260C	GC-MS	2-Chlorotoluene
Aqueous/Solids	EPA 8260C	GC-MS	2-Hexanone
Aqueous/Solids	EPA 8260C	GC-MS	2-Methyl-1-propanol (Isobutlyl alcohol)
Aqueous/Solids	EPA 8260C	GC-MS	2-Methyl-2-propanol (Tertbutyl alcohol)
Aqueous/Solids	EPA 8260C	GC-MS	2-Nitropropane
Aqueous/Solids	EPA 8260C	GC-MS	2-Propanol
Aqueous/Solids	EPA 8260C	GC-MS	3-Chloro-1-propene (Allyl chloride)
Aqueous/Solids	EPA 8260C	GC-MS	4-Chlorotoluene
Aqueous/Solids	EPA 8260C	GC-MS	4-Ethyltoluene
Aqueous/Solids	EPA 8260C	GC-MS	4-Isopropyltoluene
Aqueous/Solids	EPA 8260C	GC-MS	4-Methyl-2-pentanone (MIBK)
Aqueous/Solids	EPA 8260C	GC-MS	Acetone
Aqueous/Solids	EPA 8260C	GC-MS	Acetonitrile
Aqueous/Solids	EPA 8260C	GC-MS	Acrolein
Aqueous/Solids	EPA 8260C	GC-MS	Acrylonitrile
Aqueous/Solids	EPA 8260C	GC-MS	Benzene
Aqueous/Solids	EPA 8260C	GC-MS	Benzyl chloride
Aqueous/Solids	EPA 8260C	GC-MS	Bromobenzene
Aqueous/Solids	EPA 8260C	GC-MS	Bromochloromethane
Aqueous/Solids	EPA 8260C	GC-MS	Bromodichloromethane
Aqueous/Solids	EPA 8260C	GC-MS	Bromoform
Aqueous/Solids	EPA 8260C	GC-MS	Bromomethane
Aqueous/Solids	EPA 8260C	GC-MS	Carbon disulfide
Aqueous/Solids	EPA 8260C	GC-MS	Carbon tetrachloride
Aqueous/Solids	EPA 8260C	GC-MS	Chlorobenzene
Aqueous/Solids	EPA 8260C	GC-MS	Chloroethane
Aqueous/Solids	EPA 8260C	GC-MS	Chloroform
Aqueous/Solids	EPA 8260C	GC-MS	Chloromethane

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Accreditation is granted to the facility to perform the following testing:

Matrix	Standard/Method	Technology	Analyte
Aqueous/Solids	EPA 8260C	GC-MS	cis-1,2-Dichloroethene
Aqueous/Solids	EPA 8260C	GC-MS	cis-1,3-Dichloropropene
Aqueous/Solids	EPA 8260C	GC-MS	Cyclohexane
Aqueous/Solids	EPA 8260C	GC-MS	Cyclohexanone
Aqueous/Solids	EPA 8260C	GC-MS	Dibromochloromethane
Aqueous/Solids	EPA 8260C	GC-MS	Dibromomethane
Aqueous/Solids	EPA 8260C	GC-MS	Dichlorodifluoromethane (Freon 12)
Aqueous/Solids	EPA 8260C	GC-MS	Dichlorofluoromethane (Freon 21)
Aqueous/Solids	EPA 8260C	GC-MS	Dichloromethane
Aqueous/Solids	EPA 8260C	GC-MS	Diethyl ether
Aqueous/Solids	EPA 8260C	GC-MS	Diisopropyl ether
Aqueous/Solids	EPA 8260C	GC-MS	Ethyl methacrylate
Aqueous/Solids	EPA 8260C	GC-MS	Ethyl tert-butyl ether
Aqueous/Solids	EPA 8260C	GC-MS	Ethylbenzene
Aqueous/Solids	EPA 8260C	GC-MS	Hexachlorobutadiene
Aqueous/Solids	EPA 8260C	GC-MS	Iodomethane
Aqueous/Solids	EPA 8260C	GC-MS	Isopropylbenzene
Aqueous/Solids	EPA 8260C	GC-MS	m- + p-Xylene
Aqueous/Solids	EPA 8260C	GC-MS	Methacrylonitrile
Aqueous/Solids	EPA 8260C	GC-MS	Methyl acetate
Aqueous/Solids	EPA 8260C	GC-MS	Methyl methacrylate
Aqueous/Solids	EPA 8260C	GC-MS	Methylcyclohexane
Aqueous/Solids	EPA 8260C	GC-MS	Methyl-tert-butyl ether (MTBE)
Aqueous/Solids	EPA 8260C	GC-MS	Napthalene
Aqueous/Solids	EPA 8260C	GC-MS	N-butylacetate
Aqueous/Solids	EPA 8260C	GC-MS	N-butylbenzene
Aqueous/Solids	EPA 8260C	GC-MS	N-heptane
Aqueous/Solids	EPA 8260C	GC-MS	N-propylbenzene
Aqueous/Solids	EPA 8260C	GC-MS	o-Xylene
Aqueous/Solids	EPA 8260C	GC-MS	Propionitrile
Aqueous/Solids	EPA 8260C	GC-MS	sec-butylbenzene
Aqueous/Solids	EPA 8260C	GC-MS	Styrene
Aqueous/Solids	EPA 8260C	GC-MS	tert-amyl methyl ether

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Aqueous/Solids	EPA 8260C	GC-MS	tert-butylbenzene
Aqueous/Solids	EPA 8260C	GC-MS	Tetra hydrofuran
Aqueous/Solids	EPA 8260C	GC-MS	Tetrachloroethene
Aqueous/Solids	EPA 8260C	GC-MS	Toluene
Aqueous/Solids	EPA 8260C	GC-MS	trans-1,2-Dichloroethene
Aqueous/Solids	EPA 8260C	GC-MS	trans-1,3-Dichloropropene
Aqueous/Solids	EPA 8260C	GC-MS	trans-1,4-Dichloro-2-butene
Aqueous/Solids	EPA 8260C	GC-MS	Trichloroethene
Aqueous/Solids	EPA 8260C	GC-MS	Trichlorofluoromethane (Freon 11)
Aqueous/Solids	EPA 8260C	GC-MS	Vinyl acetate
Aqueous/Solids	EPA 8260C	GC-MS	Vinyl chloride
Aqueous/Solids	EPA 8260C	GC-MS	Xylenes, total
Aqueous/Solids	EPA 8270D	GC-MS	1,2,4,5-Tetrachlorobenzene
Aqueous/Solids	EPA 8270D	GC-MS	1,2,4-Trichlorobenzene
Aqueous/Solids	EPA 8270D	GC-MS	1,2-Dichlorobenzene
Aqueous/Solids	EPA 8270D	GC-MS	1,2-Diphenylhydrazine
Aqueous/Solids	EPA 8270D	GC-MS	1,3,5-Trinitrobenzene
Aqueous/Solids	EPA 8270D	GC-MS	1,3-Dichlorobenzene
Aqueous/Solids	EPA 8270D	GC-MS	1,3-Dinitrobenzene
Aqueous/Solids	EPA 8270D	GC-MS	1,4-Dichlorobenzene
Aqueous/Solids	EPA 8270D	GC-MS	1,4-Dioxane
Aqueous/Solids	EPA 8270D	GC-MS	1,4-Naphthoquinone
Aqueous/Solids	EPA 8270D	GC-MS	1-Methyl-2-pyrrolidinone
Aqueous/Solids	EPA 8270D	GC-MS	1-Methylnaphthalene
Aqueous/Solids	EPA 8270D	GC-MS	1-Naphthylamine
Aqueous/Solids	EPA 8270D	GC-MS	2,3,4,6-Tetrachlorophenol
Aqueous/Solids	EPA 8270D	GC-MS	2,4,5-Trichlorophenol
Aqueous/Solids	EPA 8270D	GC-MS	2,4,6-Trichlorophenol
Aqueous/Solids	EPA 8270D	GC-MS	2,4-Dichlorophenol
Aqueous/Solids	EPA 8270D	GC-MS	2,4-Dimethylphenol
Aqueous/Solids	EPA 8270D	GC-MS	2,4-Dinitrophenol
Aqueous/Solids	EPA 8270D	GC-MS	2,4-Dinitrotoluene
Aqueous/Solids	EPA 8270D	GC-MS	2,6-Dichlorophenol

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Aqueous/Solids	EPA 8270D	GC-MS	2,6-Dinitrotoluene
Aqueous/Solids	EPA 8270D	GC-MS	2-Acetylaminofluorene
Aqueous/Solids	EPA 8270D	GC-MS	2-Chloronaphthalene
Aqueous/Solids	EPA 8270D	GC-MS	2-Chlorophenol
Aqueous/Solids	EPA 8270D	GC-MS	2-Methyl-5-nitroaniline (5-Nitro-o-toluidine)
Aqueous/Solids	EPA 8270D	GC-MS	2-Methylnaphthalene
Aqueous/Solids	EPA 8270D	GC-MS	2-Methylphenol
Aqueous/Solids	EPA 8270D	GC-MS	2-Naphthylamine
Aqueous/Solids	EPA 8270D	GC-MS	2-Nitroaniline
Aqueous/Solids	EPA 8270D	GC-MS	2-Nitrophenol
Aqueous/Solids	EPA 8270D	GC-MS	2-Picoline
Aqueous/Solids	EPA 8270D	GC-MS	3,3'-Dichlorobenzidine
Aqueous/Solids	EPA 8270D	GC-MS	3,3'-Dimethylbenzidine
Aqueous/Solids	EPA 8270D	GC-MS	3+4-Methylphenol
Aqueous/Solids	EPA 8270D	GC-MS	3-Methylcholanthrene
Aqueous/Solids	EPA 8270D	GC-MS	3-Nitroaniline
Aqueous/Solids	EPA 8270D	GC-MS	4,6-Dinitro-2-methylphenol
Aqueous/Solids	EPA 8270D	GC-MS	4-Aminobiphenyl
Aqueous/Solids	EPA 8270D	GC-MS	4-Bromophenyl-phenylether
Aqueous/Solids	EPA 8270D	GC-MS	4-Chloro-3-methylphenol
Aqueous/Solids	EPA 8270D	GC-MS	4-Chloroaniline
Aqueous/Solids	EPA 8270D	GC-MS	4-Chlorophenyl-phenylether
Aqueous/Solids	EPA 8270D	GC-MS	4-Nitroaniline
Aqueous/Solids	EPA 8270D	GC-MS	4-Nitrophenol
Aqueous/Solids	EPA 8270D	GC-MS	4-Nitroquinoline-1-oxide
Aqueous/Solids	EPA 8270D	GC-MS	7,12-Dimethylbenz(a)anthracene
Aqueous/Solids	EPA 8270D	GC-MS	α,α-Dimethylphenethylamine
Aqueous/Solids	EPA 8270D	GC-MS	Acenaphthene
Aqueous/Solids	EPA 8270D	GC-MS	Acenaphthylene
Aqueous/Solids	EPA 8270D	GC-MS	Acetophenone
Aqueous/Solids	EPA 8270D	GC-MS	Aniline
Aqueous/Solids	EPA 8270D	GC-MS	Anthracene
Aqueous/Solids	EPA 8270D	GC-MS	Aramite

Certificate of Accreditation: Supplement

ISO/IEC 17025:2005 and DoD-ELAP

ALS Environmental-Rochester

1565 Jefferson Road, Building 300, Suite 360, Rochester, NY 14623
Lisa Reyes Phone: 585-288-5380

Accreditation is granted to the facility to perform the following testing:

Matrix	Standard/Method	Technology	Analyte
Aqueous/Solids	EPA 8270D	GC-MS	Atrazine
Aqueous/Solids	EPA 8270D	GC-MS	Benzaldehyde
Aqueous/Solids	EPA 8270D	GC-MS	Benzidine
Aqueous/Solids	EPA 8270D	GC-MS	Benzo(a)anthracene
Aqueous/Solids	EPA 8270D	GC-MS	Benzo(a)pyrene
Aqueous/Solids	EPA 8270D	GC-MS	Benzo(b)fluoranthene
Aqueous/Solids	EPA 8270D	GC-MS	Benzo(g,h,i)perylene
Aqueous/Solids	EPA 8270D	GC-MS	Benzo(k)fluoranthene
Aqueous/Solids	EPA 8270D	GC-MS	Benzoic acid
Aqueous/Solids	EPA 8270D	GC-MS	Benzyl alcohol
Aqueous/Solids	EPA 8270D	GC-MS	Biphenyl
Aqueous/Solids	EPA 8270D	GC-MS	Bis(1-chloroisopropyl)ether
Aqueous/Solids	EPA 8270D	GC-MS	Bis(-2-chloroethoxy)methane
Aqueous/Solids	EPA 8270D	GC-MS	Bis(2-chloroethyl)ether
Aqueous/Solids	EPA 8270D	GC-MS	Bis(2-ethylhexyl)phthalate
Aqueous/Solids	EPA 8270D	GC-MS	Butyl benzyl phthalate
Aqueous/Solids	EPA 8270D	GC-MS	Caprolactam
Aqueous/Solids	EPA 8270D	GC-MS	Carbazole
Aqueous/Solids	EPA 8270D	GC-MS	Chlorobenzilate
Aqueous/Solids	EPA 8270D	GC-MS	Chrysene
Aqueous/Solids	EPA 8270D	GC-MS	Cyclohexane, isothiocyanato-
Aqueous/Solids	EPA 8270D	GC-MS	Diallate
Aqueous/Solids	EPA 8270D	GC-MS	Dibenzo(a,h)anthracene
Aqueous/Solids	EPA 8270D	GC-MS	Dibenzofuran
Aqueous/Solids	EPA 8270D	GC-MS	Diethylphthalate
Aqueous/Solids	EPA 8270D	GC-MS	Dimethoate
Aqueous/Solids	EPA 8270D	GC-MS	Dimethyl phthalate
Aqueous/Solids	EPA 8270D	GC-MS	Di-n-butylphthalate
Aqueous/Solids	EPA 8270D	GC-MS	Di-n-octyl phthalate
Aqueous/Solids	EPA 8270D	GC-MS	Dinoseb
Aqueous/Solids	EPA 8270D	GC-MS	Diphenylamine
Aqueous/Solids	EPA 8270D	GC-MS	Disulfoton
Aqueous/Solids	EPA 8270D	GC-MS	Ethyl methanesulfonate

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ALS Environmental-Rochester

1565 Jefferson Road, Building 300, Suite 360, Rochester, NY 14623
Lisa Reyes Phone: 585-288-5380

Accreditation is granted to the facility to perform the following testing:

Matrix	Standard/Method	Technology	Analyte
Aqueous/Solids	EPA 8270D	GC-MS	Fluoranthene
Aqueous/Solids	EPA 8270D	GC-MS	Fluorene
Aqueous/Solids	EPA 8270D	GC-MS	Hexachlorobenzene
Aqueous/Solids	EPA 8270D	GC-MS	Hexachlorobutadiene
Aqueous/Solids	EPA 8270D	GC-MS	Hexachlorocyclopentadiene
Aqueous/Solids	EPA 8270D	GC-MS	Hexachloroethane
Aqueous/Solids	EPA 8270D	GC-MS	Hexachlorophene
Aqueous/Solids	EPA 8270D	GC-MS	Hexachloropropene
Aqueous/Solids	EPA 8270D	GC-MS	Indeno(1,2,3-cd)pyrene
Aqueous/Solids	EPA 8270D	GC-MS	Isodrin
Aqueous/Solids	EPA 8270D	GC-MS	Isophorone
Aqueous/Solids	EPA 8270D	GC-MS	Isosafrole
Aqueous/Solids	EPA 8270D	GC-MS	Methapyrilene
Aqueous/Solids	EPA 8270D	GC-MS	Methyl methanesulfonate
Aqueous/Solids	EPA 8270D	GC-MS	Methyl parathion
Aqueous/Solids	EPA 8270D	GC-MS	Naphthalene
Aqueous/Solids	EPA 8270D	GC-MS	Nitrobenzene
Aqueous/Solids	EPA 8270D	GC-MS	N-nitrosodiethylamine
Aqueous/Solids	EPA 8270D	GC-MS	N-nitrosodimethylamine
Aqueous/Solids	EPA 8270D	GC-MS	N-nitrosodi-n-butylamine
Aqueous/Solids	EPA 8270D	GC-MS	N-nitroso-di-n-propylamine
Aqueous/Solids	EPA 8270D	GC-MS	N-nitrosodiphenylamine
Aqueous/Solids	EPA 8270D	GC-MS	N-nitrosomethylethylamine
Aqueous/Solids	EPA 8270D	GC-MS	N-nitrosomorpholine
Aqueous/Solids	EPA 8270D	GC-MS	N-nitrosopiperidine
Aqueous/Solids	EPA 8270D	GC-MS	N-nitrosopyrolidine
Aqueous/Solids	EPA 8270D	GC-MS	Octachlorostyrene
Aqueous/Solids	EPA 8270D	GC-MS	o,o,o-triethyl phosphorothioate
Aqueous/Solids	EPA 8270D	GC-MS	o-toluidine
Aqueous/Solids	EPA 8270D	GC-MS	Parathion (ethyl)
Aqueous/Solids	EPA 8270D	GC-MS	p-dimethylaminoazobenzene
Aqueous/Solids	EPA 8270D	GC-MS	Pentachlorobenzene
Aqueous/Solids	EPA 8270D	GC-MS	Pentachloroethane

Certificate of Accreditation: Supplement

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ALS Environmental-Rochester

1565 Jefferson Road, Building 300, Suite 360, Rochester, NY 14623
Lisa Reyes Phone: 585-288-5380

Accreditation is granted to the facility to perform the following testing:

Matrix	Standard/Method	Technology	Analyte
Aqueous/Solids	EPA 8270D	GC-MS	Pentachloronitrobenzene
Aqueous/Solids	EPA 8270D	GC-MS	Pentachlorophenol
Aqueous/Solids	EPA 8270D	GC-MS	Phenacetin
Aqueous/Solids	EPA 8270D	GC-MS	Phenanthrene
Aqueous/Solids	EPA 8270D	GC-MS	Phenol
Aqueous/Solids	EPA 8270D	GC-MS	Phorate
Aqueous/Solids	EPA 8270D	GC-MS	Phthalimide
Aqueous/Solids	EPA 8270D	GC-MS	Pyrene
Aqueous/Solids	EPA 8270D	GC-MS	Pyridine
Aqueous/Solids	EPA 8270D	GC-MS	Safrole
Aqueous/Solids	EPA 8270D	GC-MS	Sulfotepp
Aqueous/Solids	EPA 8270D	GC-MS	Thionazin
Aqueous/Solids	EPA 8270D	GC-MS-LL	1,4-Dioxane
Aqueous/Solids	EPA 8270D	GC-MS-LL	1-Methylnaphthalene
Aqueous/Solids	EPA 8270D	GC-MS-LL	2-Methylnaphthalene
Aqueous/Solids	EPA 8270D	GC-MS-LL	Acenaphthene
Aqueous/Solids	EPA 8270D	GC-MS-LL	Acenaphthylene
Aqueous/Solids	EPA 8270D	GC-MS-LL	Anthracene
Aqueous/Solids	EPA 8270D	GC-MS-LL	Benzo(a)anthracene
Aqueous/Solids	EPA 8270D	GC-MS-LL	Benzo(a)pyrene
Aqueous/Solids	EPA 8270D	GC-MS-LL	Benzo(b)fluoranthene
Aqueous/Solids	EPA 8270D	GC-MS-LL	Benzo(g,h,i)perylene
Aqueous/Solids	EPA 8270D	GC-MS-LL	Benzo(k)fluoranthene
Aqueous/Solids	EPA 8270D	GC-MS-LL	Bis(2-ethylhexyl)phthalate
Aqueous/Solids	EPA 8270D	GC-MS-LL	Butyl benzyl phthalate
Aqueous/Solids	EPA 8270D	GC-MS-LL	Carbazole
Aqueous/Solids	EPA 8270D	GC-MS-LL	Chrysene
Aqueous/Solids	EPA 8270D	GC-MS-LL	Dibenzo(a,h)anthracene
Aqueous/Solids	EPA 8270D	GC-MS-LL	Dibenzofuran
Aqueous/Solids	EPA 8270D	GC-MS-LL	Diethyl phthalate
Aqueous/Solids	EPA 8270D	GC-MS-LL	Dimethyl phthalate
Aqueous/Solids	EPA 8270D	GC-MS-LL	Di-n-butyl phthalate
Aqueous/Solids	EPA 8270D	GC-MS-LL	Di-n-octyl phthalate

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ALS Environmental-Rochester

1565 Jefferson Road, Building 300, Suite 360, Rochester, NY 14623
Lisa Reyes Phone: 585-288-5380

Accreditation is granted to the facility to perform the following testing:

Matrix	Standard/Method	Technology	Analyte
Aqueous/Solids	EPA 8270D	GC-MS-LL	Fluoranthene
Aqueous/Solids	EPA 8270D	GC-MS-LL	Fluorene
Aqueous/Solids	EPA 8270D	GC-MS-LL	Hexachlorobenzene
Aqueous/Solids	EPA 8270D	GC-MS-LL	Indeno(1,2,3-cd)pyrene
Aqueous/Solids	EPA 8270D	GC-MS-LL	Naphthalene
Aqueous/Solids	EPA 8270D	GC-MS-LL	Nitrobenzene
Aqueous/Solids	EPA 8270D	GC-MS-LL	Octachlorostyrene
Aqueous/Solids	EPA 8270D	GC-MS-LL	Phenanthrene
Aqueous/Solids	EPA 8270D	GC-MS-LL	Pyrene
Aqueous/Solids	EPA 8270D	GC-MS-LL	Pyridine
Aqueous/Solids	EPA 9012A, B	UV-VIS	Cyanide, total
Aqueous/Solids	EPA 9034	Titration	Sulfide, acid soluble
Aqueous/Solids	EPA 9056A	IC	Bromide
Aqueous/Solids	EPA 9056A	IC	Chloride
Aqueous/Solids	EPA 9056A	IC	Fluoride
Aqueous/Solids	EPA 9056A	IC	Nitrate as Nitrogen
Aqueous/Solids	EPA 9056A	IC	Nitrite as Nitrogen
Aqueous/Solids	EPA 9056A	IC	Sulfate
Aqueous/Solids	GEN-AVS	Titrimetric	Acid Volatile Sulfide
Aqueous/Solids	EPA 8330B	HPLC	1,3,5-Trinitrobenzene
Aqueous/Solids	EPA 8330B	HPLC	1,3-Dinitrobenzene
Aqueous/Solids	EPA 8330B	HPLC	2,4,6-Trinitrotoluene (TNT)
Aqueous/Solids	EPA 8330B	HPLC	2,4-Dinitrotoluene
Aqueous/Solids	EPA 8330B	HPLC	2,6-Dinitrotoluene
Aqueous/Solids	EPA 8330B	HPLC	2-Amino 4,6-Dinitrotoluene
Aqueous/Solids	EPA 8330B	HPLC	2-Nitrotoluene
Aqueous/Solids	EPA 8330B	HPLC	3,5-Dinitroaniline
Aqueous/Solids	EPA 8330B	HPLC	3-Nitrotoluene
Aqueous/Solids	EPA 8330B	HPLC	4-Amino 2,6-Dinitrotoluene
Aqueous/Solids	EPA 8330B	HPLC	4-Nitrotoluene
Aqueous/Solids	EPA 8330B	HPLC	Hexahydro 1,3,5-Trinitro 1,3,5-Triazine
Aqueous/Solids	EPA 8330B	HPLC	Methyl 2,4,6 Trinitrophenylnitramine
Aqueous/Solids	EPA 8330B	HPLC	Nitrobenzene
Aqueous/Solids	EPA 8330B	HPLC	Nitroglycerin

Certificate of Accreditation: Supplement

ISO/IEC 17025:2005 and DoD-ELAP

ALS Environmental-Rochester

1565 Jefferson Road, Building 300, Suite 360, Rochester, NY 14623
Lisa Reyes Phone: 585-288-5380

Accreditation is granted to the facility to perform the following testing:

Matrix	Standard/Method	Technology	Analyte
Aqueous/Solids	EPA 8330B	HPLC	Octahydro 1.3.5.7 Tetranitro 1,3,5,7 Tetraz
Aqueous/Solids	EPA 8330B	HPLC	Pentaerythritol Tetranitrate (PETN)
Aqueous/Solids	HPLC-METACID	HPLC	Acetic Acid
Aqueous/Solids	HPLC-METACID	HPLC	Butanoic Acid (Butyric Acid)
Aqueous/Solids	HPLC-METACID	HPLC	Lactic Acid
Aqueous/Solids	HPLC-METACID	HPLC	Propionic Acid
Aqueous/Solids	HPLC-METACID	HPLC	Pyruvic Acid

Matrix	Standard/Method	Technology	Analyte
Aqueous	(CAS SOP)	SPE Extraction	1,4-Dioxane
Aqueous	EPA 3010A	Acid Digestion	Metals prep
Aqueous	EPA 3510C	SF Extraction	Semivolatiles, pesticides, PCBs, DRO
Aqueous	EPA 5030B	P&T	Volatiles
Solids	EPA 3050B	Acid Digestion	Metals prep
Solids	EPA 3060A	Digestion	Hexavalent chromium digestion
Solids	EPA 3541	SOX Extraction	Semivolatiles, pesticides, PCBs, DRO
Solids	EPA 5035	P&T closed	Volatiles
Aqueous/Solids	EPA 1311	TCLP	Physical Extraction
Aqueous/Solids	EPA 1312	SPLP	Physical Extraction
Aqueous/Solids	EPA 3620B	Florisil Cleanup	Semivolatiles, pesticides, PCBs
Aqueous/Solids	EPA 3660B	Sulfur Cleanup	Semivolatiles, pesticides, PCBs
Aqueous/Solids	EPA 3665A	Sulfuric Acid Cleanup	PCBs
Aqueous/Solids	EPA 9012A, B	Distillation	Cyanide
Aqueous/Solids	EPA 9030B	Distillation	Sulfide, acid soluble

Perry Johnson Laboratory Accreditation, Inc.

April 7, 2012

Ms. Lisa Reyes
ALS Environmental-Rochester
1565 Jefferson Road, Building 300
Suite 360
Rochester, NY 14623

Dear Ms. Reyes

This letter is to confirm that you have successfully completed your reaccreditation assessment. A certificate has now been granted and posted on our website. As you are aware, PJLA will no longer be issuing expiration dates on our certificates. Your certificate # **L12-48 R1** will remain valid as long as you continue to maintain your annual assessments and reaccreditation assessments as stated in your customer agreement with PJLA. At this time, we have confirmed that your annual assessments will be conducted during the month of **October** each calendar year. This will include an interim surveillance assessment and a full system reassessment to be completed by **October 2013**. Once your reassessment is conducted and approved by our accreditation committee a revised status letter will be provided to you. Please allow PJLA at least 120 days from your assessment due date to issue this letter.

Please feel free to release this letter to any interested parties as confirmation of your certificate validity. Also, please remind them that your certificate is posted on our website at all times. Any changes in regards to your accreditation status will be reflected on our website.

We would like to thank you for your patronage over the past years and look forward to continuously serving your accreditation needs in the future. If we can assist you any further, please feel free to contact us at any time.

Sincerely,

Tracy Szerszen
President/Operations Manager

755 W. Big Beaver Rd. · Suite 1325 · Troy, MI 48084 · Phone: 1-877-369-LABS or 248-519-2603 · Fax: 248-213-0737

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).

LABORATORY ACCREDITATION BUREAU

Certificate # L2223

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	MCPP
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-butuene
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
Caculation	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 4500NH3 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 4500NO3 F	Nitrate + Nitrite
UV/VIS	EPA 353.2; SM 4500NO3 F	Nitrate as N
UV/VIS	EPA 353.2; SM 4500NO3 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-proplybenzene
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-butuene
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: _____ Date: March 13, 2013

R. Douglas Leonard
Chief Technical Officer

Re-issued: 2/1/13 Revised: 3/13/13

Attachment 3
Environmental Protection Plan

Final

Environmental Protection Plan Preliminary Assessment/Site Inspection; Unexploded Ordnance (UXO) Site UXO-22 Battery Disposal Area Investigation

Marine Corps Base Camp Lejeune North Carolina

Contract Task Order WE1A

February 2014

Prepared for

Department of the Navy
Naval Facilities Engineering Command

Under the

NAVFAC CLEAN 8012 Program
Contract N62470-11-D-8012

Prepared by

CH2MHILL

Charlotte, North Carolina

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SECTION 1

Environmental Protection Plan

This Environmental Protection Plan (EPP) is a supplement to the Marine Corps Base Camp Lejeune (MCIEAST-MCIEAST-MCB CAMLEJ) Master EPP (Section 9 of the MCIEAST-MCB CAMLEJ Munitions Response Program [MRP] Master Project Plans [MPP] [CH2M HILL, 2008]) from the MCIEAST-MCIEAST-MCB CAMLEJ MRP Project Plan (CH2M HILL, 2008) and provides additional site specific details related to the environmental protection procedures to be implemented at the Site UXO-22, MCIEAST-MCB CAMLEJ, North Carolina. Only additional detail, modifications or additions to the information provided in the Master EPP from the MRP MPP are discussed herein.

1.1 Regional Ecological Summary

A summary of the regional ecology is provided in Section 9.1 of the MRP Master Project Plans (CH2M HILL, 2008).

1.2 Endangered/Threatened Species within the Project Site

Many protected species have been sighted in the vicinity of and aboard MCIEAST-MCB CAMLEJ, such as American alligator, green sea turtle, loggerhead sea turtle, piping plover, red-cockaded woodpecker (RCW), seabeach amaranth, and rough-leaf loosestrife (USMC, 2006). **Table 1** lists those species that could occur in or adjacent to MCIEAST-MCB CAMLEJ that are listed as threatened, endangered, or of special concern by the United States Fish and Wildlife Service (USFWS) under the Endangered Species Act of 1973, as amended.

MCIEAST-MCB CAMLEJ has active programs in place to protect the two federally protected avian species (piping plover and RCW) that are known to occur on the Base. Site UXO-22 is not within the vicinity of any of these management areas. Suitable habitat for the piping plover does not exist at Site UXO-22. No impacts to this species would result.

MCIEAST-MCB CAMLEJ worked with the USFWS to establish guidelines for military training in RCW cluster sites. Additionally, through Section 7 Consultation, the Base implemented measures to properly manage the RCW habitats located on base (loblolly pine [*Pinus taeda*], longleaf [*Pinus palustris*], and pond pine [*Pinus serotina*] areas). These guidelines and measures are presented in the *2007-2011 Integrated Natural Resource Management Plan (INRMP)* (USMC, 2006). MCIEAST-MCB CAMLEJ's RCW population has been monitored since 1985. Reproductive success, population demographics, and habitat use are recorded annually to help successfully manage the population while facilitating the military use of the land. Site UXO-22 is not within the vicinity of any current RCW management areas and the closest active RCW habitat is located approximately 2 miles southwest of the site. No impacts to this species would result.

Site UXO-22 contains no open water habitat and does not connect to the ocean. Therefore, the federally protected marine species (e.g., green sea turtle, leatherback sea turtle, loggerhead sea turtle, West Indian manatee) listed in **Table 1** would not occur in the area. No impacts to these species would result.

The American alligator is listed on the Federal Threatened and Endangered species list due to its similarity of appearance to the American crocodile. There is no potentially suitable habitat for the American alligator in Site UXO-22 investigation area and the species would not occur in the project area. No impact to this species is expected.

Two of the five federally listed plant species identified in Table 1 have been identified on the Base: rough-leaved loosestrife and seabeach amaranth. Approximately 22 rough-leaved loosestrife sites are found on MCIEAST-MCB CAMLEJ with 76 acres buffered and marked to protect this species. Rough-leaved loosestrife sites are visited annually to visually inspect for changes in extent and apparent health. Approximately half of the rough-leaved loosestrife sites occur within protected RCW sites, obviating the need for marking each of these sites individually. The other sites, mostly falling within the Greater Sandy Run Area are marked with white paint around a perimeter that extends 100 ft from the outermost individuals. None of these sites are located on or adjacent to Site UXO-22. No impacts to rough-leaved loosestrife are expected.

Seabeach amaranth is an annual that has been described as a dune-builder because it frequently occupies areas seaward of primary dunes often growing closer to the high tide line than any other coastal plant. As such, this plant is generally found along Onslow Beach. Seabeach amaranth does not occur on or adjacent to Site UXO-22 because there is no beach or dune habitat. No impacts to this species would occur.

The eastern cougar is the only federally listed mammal species that could occur in Onslow County. The only extant population of eastern cougar is located in south Florida and the species has not been observed in North Carolina in over 50 years. Suitable habitat for the eastern cougar does not exist at Site UXO-22 and the level of human activity would tend to make the species avoid the area. Because the eastern cougar has not been verified in the area in more than 50 years and there is human activity at Site UXO-22, it is very unlikely that the eastern cougar would occur on the site and no impacts are expected.

Environmental reviews completed in preparation for the INRMP determined that the remaining species listed in **Table 1** are not expected to exist at the site. No adverse impacts to listed species are expected to result from the proposed work at Site UXO-22. Project design features have been developed to prevent impacts to listed species.

1.3 Wetlands Within the Project Site

There are no jurisdictional wetland areas within UXO-22.

1.4 Cultural and Archaeological Resources within the Project Site

The probability that any significant cultural or archeological resources will be impacted by the field investigation is low. Consultation with the Base archaeologist confirmed that no cultural or archaeological resource is known to lie within the Site UXO-22 boundary. If any unmapped cultural or archaeological materials or resources are discovered within the project investigation area, the Base archaeologist will be notified to provide guidance on performing further work in the area.

1.5 Water Resources within the Project Site

As shown in Figure **2** of the UFP-SAP, a Wallace Creek is approximately 0.3 miles north of Site UXO-22.

1.6 Vegetation to be removed within the Project Site

Vegetation clearance will be conducted over approximately 10 percent of the site to provide access for DGM and sampling activities. Vegetation less than 6 inches in diameter will be removed to within 6 inches of the ground surface. Brush clearing will be conducted in approximately 1.2-meter (4-foot) wide paths in order that a 1 meter wide instrument can traverse along the paths. Vegetation clearing will be accomplished using mechanical methods. The brush and trees will be mulched and left in place. Trees greater than 6 inches in diameter will not be removed.

In the event that plant species are encountered that are listed by the United States Fish and Wildlife Service as threatened or endangered, steps will be taken to manage site activities in accordance with this document.

1.7 Existing Waste Disposal Sites within the Project Site

Historically, the site was used for disposal and storage of wastes and supplies. During subsequent remedial investigations and land clearing activities, material presenting a potential explosive hazard (MPPEH) and munitions and explosives of concern (MEC) were also discovered at the site.

1.8 Compliance with Applicable or Relevant and Appropriate Requirements

CH2M HILL will follow all applicable regulations concerning environmental protection, pollution control, and abatement for the proposed project work as described in Section 9.3 of the MRP Master Project Plans (CH2M HILL, 2008). No permits have been determined to be required for the proposed work.

1.9 Detailed Procedures and Methods to Protect and/or Mitigate the Resources/Sites Identified

During the proposed work, a general survey of the project area will be conducted by the field personnel to identify obvious environmental concerns. The PM, in conjunction with a qualified ecologist, will provide instructions to field personnel regarding the protection of onsite environmental resources. Such protective measures will include, but are not limited to, the following:

- Should a federally protected plant species be identified within the project area, specimens will be flagged for easy relocation and verification
- Should cultural or archaeological material or resources be discovered within the project area, the Base archaeologist will be notified to provide guidance on performing further work in the area
- The PM will seek the guidance of a qualified ecologist to determine appropriate mitigation measures in the event that the performed work activities impact an environmental resource

1.10 References

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TABLE 1-1
Species Potentially Occurring on or Adjacent to Camp Lejeune, in Onslow County, Listed as Threatened, Endangered, or of Special Concern by the USFWS
Site UXO-22, Battery Disposal Area Investigation
MCIEAST-MCB CAMLEJ, North Carolina

Scientific Name	Common Name	Federal Status	Habitat
Anguilla rostrata	American eel	FSC	The American eel is catadromous; it spawns in oceanic waters but uses freshwater, brackish and estuarine systems for most of its developmental life. Migrates in autumn to the Sargasso Sea to spawn. Occurs usually in permanent streams with continuous flow. Hides during the day in undercut banks and in deep pools near logs and boulders.
Chelonia mydas	Green sea turtle	T	Green turtles are generally found in fairly shallow waters (except when migrating) inside reefs, bays, and inlets. The turtles are attracted to lagoons and shoals with an abundance of marine grass and algae. Open beaches with a sloping platform and minimal disturbance are required for nesting.
Caretta caretta	Loggerhead sea turtle	T	The loggerhead is widely distributed within its range. It may be found hundreds of miles out to sea, as well as in inshore areas such as bays, lagoons, salt marshes, creeks, ship channels, and the mouths of large rivers.
Dermochelys coriacea	Leatherback sea turtle	E	An open ocean species, it sometimes moves into shallow bays, estuaries and even river mouths.
Trichechus manatus	West Indian Manatee	E	Manatees inhabit both salt and fresh water of sufficient depth (1.5 meters to usually less than 6 meters) throughout their range.
Alligator mississippiensis	American alligator	T(S/A)	Rivers, swamps, estuaries, lakes, and marshes
Charadrius melodus	Piping plover	T	Open, sandy beaches close to the primary dune of the barrier islands and coastlines of the Atlantic for breeding. They prefer sparsely vegetated open sand, gravel, or cobble for a nest site. They forage along the rack line where the tide washes up onto the beach.
Aimophila aestivalis	Bachman's sparrow	FSC	Occurs only in pine forests of the southeastern U.S.
Haliaeetus leucocephalus	American bald eagle	T	A single bald eagle's nest is found on Camp Lejeune- at the junction of Sneads Creek and the New River near the back gate. Three protective buffers have been established at approximately 750', 1000', and 1500' from the nest site.
Laterallus jamaicensis	Black rail	FSC	Marsh/wetlands; The "Eastern" Black Rail can be found in appropriate saltmarsh habitat along the eastern seaboard from Connecticut to Florida and along the Gulf Coast.

TABLE 1-1
Species Potentially Occurring on or Adjacent to Camp Lejeune, in Onslow County, Listed as Threatened, Endangered, or of Special Concern by the USFWS
Site UXO-22, Battery Disposal Area Investigation
MCIEAST-MCB CAMLEJ, North Carolina

Scientific Name	Common Name	Federal Status	Habitat
Acipenser brevirostrum	Shortnose sturgeon	E	Sturgeon inhabits the lower sections of larger rivers and coastal waters along the Atlantic coast. It may spend most of the year in brackish or salt water and move into fresh water only to spawn. The fish feeds on invertebrates (shrimp, worms, etc.) and stems and leaves of macrophytes.
Rana capito capito	Carolina crawfish frog	FSC	Carolina crawfish frogs live primarily in the sandhills and pine barrens of the North Carolina Coastal Plain. Crawfish frogs are more terrestrial than most frogs, generally only coming to the water to breed. They are also nocturnal, spending daylight hours underground in burrows.
Puma concolor couguar	Eastern cougar	E	No preference for specific habitat types has been noted. The primary need is apparently for a large wilderness area with an adequate food supply. Male cougars of other subspecies have been observed to occupy a range of 25 or more square miles, and females from 5 to 20 square miles.
Passerina ciris ciris	Eastern painted bunting	FSC*	Found mainly in southern states and Mexico, where the brushy, weedy shrub-scrub habitat that this bird prefers abound
Ammodramus henslowii	Eastern Henslow's sparrow	FSC	A species of tallgrass prairies, agricultural grasslands, and pine savannas of the eastern U.S.; the species migrates south to spend the non-breeding season in the native pine savanna habitats of the southeastern U.S.
Ophisaurus mimicus	Mimic glass lizard	FSC	This species is found in the southeastern Coastal Plain. They are most common in pine flatwoods and open woodlands.
Picoides borealis	Red-cockaded Woodpecker	E	For nesting/roosting habitat, open stands of pine containing trees 60 years old and older. Red-cockaded woodpeckers need live, older pines in which to excavate their cavities. Longleaf pines (Pinus palustris) are most commonly used, but other species of southern pine are also acceptable. Dense stands (stands that are primarily hardwoods, or that have a dense hardwood understory) are avoided. Foraging habitat is provided in pine and pine hardwood stands 30 years old or older with foraging preference for pine trees 10 inches or larger in diameter. In good, moderately-stocked, pine habitat, sufficient foraging substrate can be provided on 80 to 125 acres.
Heterodon simus	Southern hognose snake	FSC	These snakes are found in sandy fields and woods of the Coastal Plain, particularly in the Sandhills region.

TABLE 1-1
Species Potentially Occurring on or Adjacent to Camp Lejeune, in Onslow County, Listed as Threatened, Endangered, or of Special Concern by the USFWS
Site UXO-22, Battery Disposal Area Investigation
MCIEAST-MCB CAMLEJ, North Carolina

Scientific Name	Common Name	Federal Status	Habitat
Agrotis buchholzi	Buchholz's dart moth	FSC	Found in Forested wetlands, scrub-shrub wetlands, shrubland/chaparral and coniferous woodlands This moth is found mostly in recently burned habitats. Populations can persist up to about a decade or rarely two without fire, until litter accumulates sufficiently to cover foodplants. In most cases habitat is probably suboptimal beginning about 5 years after a fire.
Atrytonopsis sp.	a skipper	FSC	One species, the dusteds are fairly rare at the coast but found throughout North Carolina (*A. hianna*). An assumption is made that the genius is generally defined.
Isoetes microvela	A quillwort	FSC	Quillworts are usually restricted to areas of clean water where other plants are absent. Occasionally, quilwort may grow partly or entirely out of the water.
Rhexia aristosa	Awned meadowbeauty	FSC	Found in a variety of wet habitats in the Coastal Plain from New Jersey to Alabama.
Lobelia boykinii	Boykin's lobelia	FSC	Grows in swamps and cypress ponds from the coastal plain of Delaware to Florida. The lower portion is often immersed in water, at least seasonally.
Solidago pulchra	Coastal goldenrod	FSC	Bogs, freshwater habitats, grasslands.
Parnassia caroliniana	Carolina grass-of-parnassus	FSC	Bogs, freshwater habitats, grasslands.
Trillium pusillum var. pusillum	Carolina trillium	FSC	Grows in alluvial woods, pocosin borders and savannahs.
Asplenium heteroresiliens	Carolina (wagner) spleenwort	FSC	Rock outcrops.
Rhynchospora pleiantha	Coastal beaksedge	FSC	Extremely rare, found at fewer than 25 sites throughout its North Carolina-to-Alabama range.
Solidago villosicarpa	Coastal Goldenrod	FSC	Known to occur in only 5 populations in three counties in eastern North Carolina. Three of these populations occur on Camp Lejeune. The other sites occur in Pender and Brunswick Counties. Currently the North Carolina Natural Heritage Program is conducting a survey of likely habitat to look for coastal goldenrod.
Thalictrum cooleyi	Cooley's meadowrue	E	Cooley's meadowrue occurs in moist to wet bogs and savannahs. It grows along fireplow lines, roadside ditches, woodland clearings, and powerline rights-of-way, and needs some type of disturbance to maintain its open habitat.

TABLE 1-1
Species Potentially Occurring on or Adjacent to Camp Lejeune, in Onslow County, Listed as Threatened, Endangered, or of Special Concern by the USFWS
Site UXO-22, Battery Disposal Area Investigation
MCIEAST-MCB CAMLEJ, North Carolina

Scientific Name	Common Name	Federal Status	Habitat
Carex lutea	Golden sedge	E	Biologists have located golden sedge in only eight locations, all in coastal savannas in Onslow and Pender Counties that are underlain by calcareous, or chalk, deposits.
Sagittaria weatherbiana	Grassleaf arrowhead	FSC	Found in shallow water of brackish swamps
Dichanthelium sp.	Hirst's panic grass	FSC	Worldwide, Hirst's panic grass occurs in four extant populations. Historically, it was found in coastal plain habitats in the states of New Jersey, Delaware, North Carolina and Georgia. Currently Hirst's panic grass is known to exist in one site in Delaware and two known sites in North Carolina, both of which are on Camp Lejeune.
Myriophyllum laxum	Loose watermilfoil	FSC	Riparian habitats.
Calopogon multiflorus	Many-flower grass-pink	FSC	Grasslands, pinelands; typically in wet areas.
Plantago sparsiflora	Pineland plantain	FSC	Savannahs, roadsides and ditches.
Lindera melissifolia	Pondberry	E	Associated with wetland habitats such as bottomland and hardwoods in the interior areas, and the margins of sinks, ponds and other depressions in the more coastal sites. The plants generally grow in shaded areas but may also be found in full sun.
Litsea aestivalis	Pondspice	FSC	Freshwater habitats.
Lysimachia asperulaefolia	Rough-leaved loosestrife	E	Species generally occurs in the ecotones or edges between longleaf pine uplands and pond pine pocosins (areas of dense shrub and vine growth usually on a wet, peaty, poorly drained soil), on moist to seasonally saturated sands and on shallow organic soils overlaying sand. Rough-leaved loosestrife has also been found on deep peat in the low shrub community of large Carolina bays
Amaranthus pumilus	Seabeach amaranth	T	Occurs on barrier island beaches.
Allium sp.	Savanna onion	FSC	Wet savannahs.
Scleria sp.	Smooth-seeded hairy nutrush	FSC	Dry woods, pineland and savannahs (*S. triglomerata*)
Rhynchospora decurrens	Swamp forest beakrush	FSC	Swamp forests, very rare.

TABLE 1-1
Species Potentially Occurring on or Adjacent to Camp Lejeune, in Onslow County, Listed as Threatened, Endangered, or of Special Concern by the USFWS
Site UXO-22, Battery Disposal Area Investigation
MCIEAST-MCB CAMLEJ, North Carolina

Scientific Name	Common Name	Federal Status	Habitat
Solidago verna	Spring-flowering goldenrod	FSC	The only spring-flowering goldenrod that occurs in the Sandhills and Coastal Plain of the Carolinas. It can be found in a wide array of habitats, including pine savannas, pocosins, and pine barrens.
Rhynchospora thornei	Thorne's beaksedge	FSC	Bogs, freshwater habitats, pinelands.
Dionea muscipula	Venus flytrap	FSC	Bogs, pinelands.

E = Endangered—A taxon in danger of extinction throughout all or a significant portion of its range.

T = Threatened—A taxon likely to become endangered within the foreseeable future throughout all or a significant portion of its range.

FSC = Federal species of special concern—species may or may not be listed in the future.

T(S/A)—Threatened due to similarity of appearance (e.g., American alligator)--a species that is threatened due to similarity of appearance with other rare species and is listed for its protection. These species are not biologically endangered or threatened and are not subject to Section 7 consultation.

*Historic record—the species was last observed in the county more than 50 years ago.

Attachment 4
Technical Management Plan

Final

Technical Management Plan for Battery Disposal Area Investigation at Site UXO-22

Marine Corps Installation East- Marine Corps Base Camp Lejeune North Carolina

Task Order WE1A

February 2014

Prepared for

Department of the Navy
Naval Facilities Engineering Command

Under the

NAVFAC CLEAN 8012 Program
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Prepared by

CH2MHILL®

Charlotte, North Carolina

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Acronyms and Abbreviations

BIP	blow in place
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CWM	chemical warfare materiel
DGM	digital geophysical mapping
DoD	Department of Defense
DRMO	Defense Reutilization and Marketing Office
ESS	Explosives Safety Submission
EZ	exclusion zone
HE	High Explosives
HEAT	High Explosive Anti-Tank
MCIEAST-MCB CAMLEJ	Marine Corps Installations East- Marine Corps Base Camp Lejeune
MDAS	material documented as safe
MEC	munitions and explosives of concern
MGFD	munitions with the greatest fragmentation distance
MMRP	Military Munitions Response Program
mm	millimeter
MPP	Master Project Plans
MPPEH	material potentially presenting an explosive hazard
MRP	Munitions Response Program
MRS	Munitions response site
PA/SI	Preliminary Assessment/Site Inspection
RI	Remedial Investigation
UXO	unexploded ordnance

SECTION 1

Introduction

Under the Military Munitions Response Program (MMRP) and pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), Marine Corps Installations East- Marine Corps Base Camp Lejeune (MCIEAST-MCB CAMLEJ) is in the process of investigating an exposed battery disposal area at Site Unexploded Ordnance (UXO) 22. CH2M HILL, on behalf of MCIEAST-MCB CAMLEJ, conducted a Preliminary Assessment/Site Inspection (PA/SI) (CH2M HILL, 2012) and is currently undergoing the next step in the process pursuant to CERCLA, a Remedial Investigation (RI) for Site UXO-22 (CH2M HILL, 2013). The PA/SI also recommended further evaluation of the subsurface soil and surface soil from the ephemeral drainage due to potential unacceptable ecological risks. This Technical Management Plan provides the details associated with the field investigation for the battery disposal area found within the ephemeral drainage at Site UXO-22.

1.1 Background and Project Objectives

Geophysical surveys were conducted as part of the PA/SI and the ongoing RI activities. During the previous and ongoing investigation and remediation activities, munitions and explosives of concern (MEC) and material potentially presenting an explosive hazard (MPPEH) has been discovered at the site. The following MEC items have been discovered :

- 1 mortar shell, 81-millimeter (mm), high explosive, M43 with fuze M45 – 2010 MPPEH pit intrusive investigation
- 1 mortar shell, 60-mm, high explosive, M49 without fuze – 2010 MPPEH pit intrusive investigation
- 1 rocket, 3.5-inch, high explosive anti-tank (HEAT), M28 – 2010 MPPEH pit intrusive investigation
- 7 MK II hand grenades – 1993 RI and 2012 Site 6 and 82 supplemental investigation

More than 2,000 MPPEH items, including rocket motors, various practice projectiles, expended cartridge casings, and expended small arms ammunition casings, have been discovered at Site UXO-22. **Figure 3** presents the locations and types of MEC and MPPEH items discovered.

Following the discovery of a MPPEH burial pit between the former Defense Reutilization and Marketing Office (DRMO) and Base scales in 2008, an Explosives Safety Submission (ESS) (CH2M HILL, 2009a), and subsequent ESS Amendments (CH2M HILL, 2009b) were prepared for completing the MPPEH burial pit investigation and subsequent activities conducted at the site. Site UXO-22 was incorporated into the Munitions Response Program (MRP) in May 2010.

The purpose of the investigation is to define the nature and extent of the battery disposal area at Site UXO-22. Digital geophysical mapping (DGM) will be performed in the investigation area (**Figure 2**) in order to define the horizontal extent of buried batteries/debris and identify the locations for test pits that will be used to delineate the vertical extent of the buried batteries. Data from these activities will be combined with data from previous investigations and used to characterize the nature and extent of buried debris in the battery disposal area.

1.2 Scope of Work

The following activities will be performed at the battery disposal area at Site UXO-22 in accordance with methods and procedures detailed in the MCIEAST-MCB CAMLEJ *Munitions Response Program Master Project Plans* (MRP MPP) (CH2M HILL, 2008):

- DGM of approximately one acre
- Excavation of up to 5 test pits based on results of the DGM and presence of batteries on the surface
- Demolition of MEC (if discovered)
- Inspection and demilitarization of MPPEH (if discovered)
- Transportation of material documented as safe (MDAS) offsite for processing, as needed
- Preparation of a summary technical memorandum documenting the results of the investigation

1.3 Guidance, Regulations, and Policies

The battery disposal area investigation at Site UXO-22 will be conducted under the guidance documents, regulations, and polices described in Section 2.1 of the MRP MPP (CH2M HILL, 2008).

1.4 Explosives Safety Submission

Test pit activities in the battery disposal investigation area in UXO-22 will be conducted in accordance with Amendment 3 of the ESS (CH2M HILL, 2010). The ESS will conform to all applicable Marine Corps, Department of the Navy, and Department of Defense (DoD) requirements for the safe handling of MEC and explosives.

1.5 MEC Contingency Procedures

Based on the documented history of DoD activities at Site UXO-22, it is anticipated that if MEC is discovered it can be destroyed onsite. Therefore, alternatives to onsite disposal are not identified in this Technical Management Plan. Likewise, the discovery of MEC that cannot be identified is not anticipated. If MEC items are discovered that cannot be identified, MEC contingency procedures will be followed in accordance with Section 2.2 of the MRP MPP (CH2M HILL, 2008).

1.6 Chemical Warfare Materiel Contingency Procedures

Based on the documented history of DoD activities at Site UXO-22 and previous investigation results, it is not anticipated that chemical warfare materiel (CWM) will be discovered. However, if it is encountered, all work will immediately cease and contingency procedures will be conducted in accordance with Section 2.3 of the MRP MPP (CH2M HILL, 2008).

SECTION 2

Field Investigation Plan

The following subsections describe the procedures associated with site preparation and restoration, DGM investigation. Section 3 describes procedures for the intrusive investigation and MEC/MPPEH management.

2.1 Site Preparation and Restoration

The following activities will be conducted to prepare and restore the investigation area.

2.1.1 Site Survey

Land surveying will be conducted in accordance with Section 7.4 of the MRP MPP (CH2M HILL, 2008). The surveying services will delineate the extent of the DGM investigation area. MEC avoidance will be conducted in accordance with the site-specific Health and Safety Plan, standard operating procedures (**Attachment 1**), and activity hazard analyses. UXO Technicians will escort surveying personnel while onsite and will practice anomaly avoidance at all locations where stakes are driven.

2.1.2 Vegetation Clearing

Vegetation clearance will be conducted to facilitate access for DGM. Vegetation less than 6 inches in diameter will be removed to within 6 inches of the ground surface using a combination of mechanical and manual methods, depending on site conditions. Felled brush and trees will be mulched and left in place. Trees greater than 6 inches in diameter will not be removed unless necessary. Overhanging vines and protruding branches that could interfere with the safe and effective performance of investigation activities will also be removed.

During the vegetation removal process, UXO technicians will conduct MEC avoidance activities in accordance with the site-specific Health and Safety Plan, standard operating procedures, and activity hazard analyses.

2.2 DGM Investigation

The following subsections summarize the procedures for the DGM investigation and its associated reporting requirements.

2.2.1 Geophysical Survey Work Plan

The Geophysical Survey Work provided in **Attachment 6** of the Uniform Federal Policy – Sampling and Analysis Plan provides details of the equipment, approach, methods, operational procedures, and quality control to be used in performing the geophysical investigation at the battery disposal area.

2.2.2 Geospatial Information and Electronic Submittals

Methods, equipment, accuracy, and submittal requirements for location surveys and mapping are described in Section 7.4 of the MRP MPP (CH2M HILL, 2008).

SECTION 3

Test Pit Excavation Plan

Test pits will be excavated to evaluate the vertical extent the battery disposal area. Test pits will be excavated based on the DGM data, and the presence of batteries on the surface. The primary intrusive investigation activities are:

- Test pitting
- MEC/MPPEH demilitarization

The equipment, approach, methods, operational procedures, and quality control to be used during the intrusive investigations are detailed as follows.

3.1 Test Pit Operations

The locations within the DGM investigation area exhibiting the highest metal concentrations will be investigated by test pitting. The overburden at the selected test pit locations will be excavated using hand tools, such as shovels, spades, trowels, and pry bars. Confirmed MEC will be disposed by controlled detonation and/or consolidated shots if the item is safe to move. The test pits will be excavated with the intent of characterizing the nature of the contents, rather than remediating the disposal area by complete excavation. Material removed from the test pits (except MPPEH and MEC) will be replaced in the excavation.

3.2 Procedures for Reporting and Disposition of MEC and MPPEH Items

This section discusses the procedures for reporting and disposing of MEC and MPPEH items encountered during the project, including the responsibilities of personnel, overall safety precautions, data reporting, transportation, safe holding areas, operations in populated areas, demolition operations, and required engineering controls and exclusion zones (EZs) for intrusive operations and intentional detonations. The general responsibilities of project personnel are described in Section 2.5 of the MRP MPP (CH2M HILL, 2008).

3.2.1 Overall Safety Precautions

The overall safety precautions described in Section 2.5.1 of the MRP MPP (CH2M HILL, 2008) will be adhered to during the intrusive investigation.

Qualified UXO personnel will dispose of all MEC items (including MPPEH if necessary) using explosive demolition procedures by countercharging these items with an explosive donor charge and detonating the donor charge. This will be performed by a demolition team consisting of one UXO Technician III as the Demolition Supervisor and two UXO Technician II personnel, with the Senior UXO Supervisor responsible for the operation.

3.2.2 Operations in Populated and Sensitive Areas

There are populated areas east and south of the site that could be affected by potential explosive demolition procedures. If the unintentional detonation minimum separation distance for public and non-essential personnel during potential explosive demolition operations affects roadways, the Site Manager will coordinate with Base operations to implement traffic controls. Such controls may include temporarily closing roads when vehicular and pedestrian traffic is present.

The EZ for intentional detonation will be defined for each detonation operation. If an inhabited building is affected, the demolition team will attempt to mitigate this impact through the use of engineering controls. If engineering controls do not adequately reduce the EZ, the Site Manager will coordinate with Base operations to evacuate the inhabited buildings. If possible, demolition operations will be performed after regular building occupation hours.

No sensitive habitats are anticipated to be encountered in the investigation area; however, if sensitive habitats are identified, investigation in these areas will be conducted in accordance with the Environmental Protection

Plan presented in **Attachment 4** to be protective of these sensitive areas. No threatened and endangered species or their habitats are known to be present within the site boundaries (CH2M HILL, 2012).

3.2.3 Exclusion Zones and Separation Distance

Munitions response activities within Site UXO-22 are covered by the existing Site UXO-22 ESS (ESS-120) (CH2M HILL, 2010). If any discrepancies exist between this Technical Management Plan and the ESS, the ESS will govern. Based on the munitions identified at the site during previous investigations, the Projectile 81-mm high explosive (HE) M43 will be used for the primary munitions with the greatest fragmentation distance (MGFD). The explosives safety quantity distance arcs for the primary MGFD are presented in the ESS (CH2M HILL, 2010).

The EZ for the primary MGFD for the munitions response site (MRS) are presented in the ESS (CH2M HILL, 2010). If fragmenting MEC is found with a larger MGFD, work at the site will stop and an ESS amendment will be submitted for the MRS to incorporate the change in MGFD.

3.2.4 MEC and MPPEH Hazards Classification, Storage, and Transportation

MEC and MPPEH will be classified and transported as discussed in Section 2.6 of the MRP MPP (CH2M HILL, 2008). A systematic approach will be used for collecting, inspecting, and segregating site debris. The approach is designed so that materials will undergo a continual evaluation/inspection process from the time they are acquired until the time they are removed from the site. Segregation procedures begin at the time the item is discovered by the UXO technician. At this point, the UXO technician makes a preliminary determination as to the classification of the item into one of three categories, and the UXO Technician III confirms the item to be MEC, MPPEH, or other debris.

MPPEH that has undergone two 100 percent visual inspections by two UXO Technician IIIs who are independent of each other in the reporting chain and are authorized to sign the Requisition System Document DD Form 1348-1A as not presenting an explosive hazard will be considered to be MDAS. MDAS will be stored in a locked container at least 50 feet from the MPPEH collection point. MDAS and other debris may be transported offsite via a DD Form 1348-1A.

3.2.5 MEC Disposition

MEC and MPPEH will be demilitarized by blow-in-place (BIP) methods or may be relocated for demolition if the items are determined safe for movement by the Senior UXO Supervisor and UXO Safety Officer.

3.2.6 MPPEH Disposition

MPPEH will be visually inspected and independently re-inspected for explosive hazards as discussed in Section 2.7.2 of the MRP MPP (CH2M HILL, 2008). MPPEH that cannot be classified as MDAS will be disposed of in the same manner as MEC.

3.2.7 Recording, Reporting, and Implementation of Lessons Learned during the Project

Lessons learned will be recorded, reported, and implemented in accordance with Section 2.7 of the MRP MPP (CH2M HILL, 2008).

SECTION 4

Explosives Management Plan

The management of on-call explosives to support disposal of MEC and MPPEH items that may be discovered during the investigation of the battery disposal area will be performed in accordance with Section 3 of the MRP MPP (CH2M HILL, 2008).

SECTION 5

Explosives Siting Plan

Explosives safety criteria for planning and siting explosives operations for MEC/MPPEH disposal at the battery disposal investigation area are provided in Section 4 of the MRP MPP (CH2M HILL, 20008). There are no planned or established MEC detonation areas. MEC that is safe to move may be consolidated for demolition (in accordance with the applicable ESS). MPPEH that cannot be certified and verified as “safe to move” will remain at location of discovery and will be treated in the same manner as MEC.

SECTION 6

References

CH2M HILL, 2013. *Sampling and Analysis Plan Field Sampling Plan and Quality Assurance Project Plan for Munitions Response Remedial Investigation at Site UXO-22 – Former Munitions Disposal Area, Marine Corps Installations East – Marine Corps Base Camp Lejeune, Jacksonville, North Carolina*. August.

CH2M HILL. 2012. *Preliminary Assessment/Site Inspection Report, Site UXO-22 – Former Munitions Disposal Area, Marine Corps Installations East – Marine Corps Base Camp Lejeune, Jacksonville, North Carolina*. October.

CH2M HILL. 2010. *Amendment No. 3 Explosive Safety Submission for Munitions Response Activities Installation Restoration Site 6 and Site 82 (Operable Unit 2) (ESS-120), Marine Corps Base Camp Lejeune, Jacksonville, North Carolina.* May.

CH2M HILL. 2009a. *Explosives Safety Submission for Munitions Response Activities, Site 6 (Operable Unit 2) – Revision 1 (ESS-104), Marine Corps Base Camp Lejeune, Jacksonville, North Carolina.* April.

CH2M HILL. 2009b. *Amendment No. 1 Explosive Safety Submission for Munitions Response Activities Installation Restoration Site 6 and Site 82 (Operable Unit 2) (ESS-107), Marine Corps Base Camp Lejeune, Jacksonville, North Carolina*. May.

CH2M HILL, 2008. *Munitions Response Program Master Project Plans, Marine Corps Base Camp Lejeune*. May.

Attachment 5
Geophysical Survey Work Plan

Final

Geophysical Survey Work Plan
Battery Disposal Investigation
Site UXO-22

Marine Corps Installation East – Marine Corps Base Camp Lejeune
North Carolina

Contract Task Order WE1A

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Acronyms and Abbreviations

CONUS	Continental United States
DGM	digital geophysical mapping
DRMO	Defense Reutilization and Marketing Office
ft	feet
FTP	file transfer protocol
m	meter
MCIEAST _MCB CAMLEJ	Marine Corps Installation East – Marine Corps Base Camp Lejeune
MCIEAST	Marine Corps Installation East
MEC	munitions and explosives of concern
MPPEH	material potentially presenting an explosive hazard
MQO	measurement quality objective
MRS	Munitions Response Site
m	meter(s)
NAD83	North American Datum 1983
nT	nanoTesla
PDF	portable document format
QC	quality control
RF	radio frequency
UTM	Universal Transverse Mercator
UXO	unexploded ordnance

SECTION 1

Geophysical Survey Work Plan

1.1 Introduction

This document presents the *Geophysical Survey Work Plan* (hereafter referred to as the Work Plan) to conduct digital geophysical mapping (DGM) the battery disposal investigation area at Munitions Response Site (MRS) UXO-22, Marine Corps Installation East – Marine Corps Base Camp Lejeune (MCIEAST-MCB CAMLEJ), North Carolina.

This Work Plan provides details of the survey objectives, equipment, technical approach, operational procedures, quality control (QC), and reporting requirements associated with the geophysical survey at the site. It has been prepared on behalf of the Department of the Navy, Naval Facilities Engineering Command Mid-Atlantic, under Contract Task Order WE1A (Mod 1).

1.2 Objective

The objective of the geophysical survey is to delineate the lateral and vertical extent (i.e., footprint) of a suspected battery disposal area at Site UXO-22. Batteries of various shapes and sizes have been identified at the surface within a ravine at the site, and the full extent of the disposal area is not well understood.

The results of the geophysical survey will be used to assist in the selection of planned test pit locations in an attempt to better delineate the lateral and vertical extent of the disposal area.

1.3 Site Description and Background

The suspected battery disposal area encompasses approximately 1 acre (0.4 hectare) within Site UXO-22 and is situated to the northeast of the former Defense Reutilization and Marketing Office (DRMO) storage lot. The DRMO lot is located between Piney Green Road and Holcomb Boulevard, adjacent to Lot 201 and the installation weigh scales (**Figure 1**). An ephemeral drainage swale is located at the base of the suspected disposal area. The site is moderately to densely wooded, with uneven terrain and metallic surface debris scattered throughout the investigation area (**Figure 2**). Batteries and pieces of batteries have been observed mixed within the metallic debris.

Site UXO-22 reportedly has not been historically used as a range, target, impact area, or firing position, although it has been designated as a MRS because munitions and explosives of concern (MEC)/material potentially presenting an explosive hazard (MPPEH) have been identified on-site during previous investigations. MEC/MPPEH have been identified in disposal pits as well as mixed with miscellaneous surface debris. MPPEH has also been identified at the surface within the vicinity of the suspected battery disposal area. Visual inspection of the ground surface by CH2M HILL within the suspected battery disposal area has identified expended 105/106-millimeter recoilless rocket cartridges and a 3.5-inch rocket motor and separate tail fin assembly. Historical information and findings from previous investigations at Site UXO-22 indicate that MEC/MPPEH at this site was likely transported to the site from other locations at the installation.

FIGURE 1
Suspected Battery Disposal Area Location
Site UXO-22, MCIEAST-MCB CAMLEJ
North Carolina

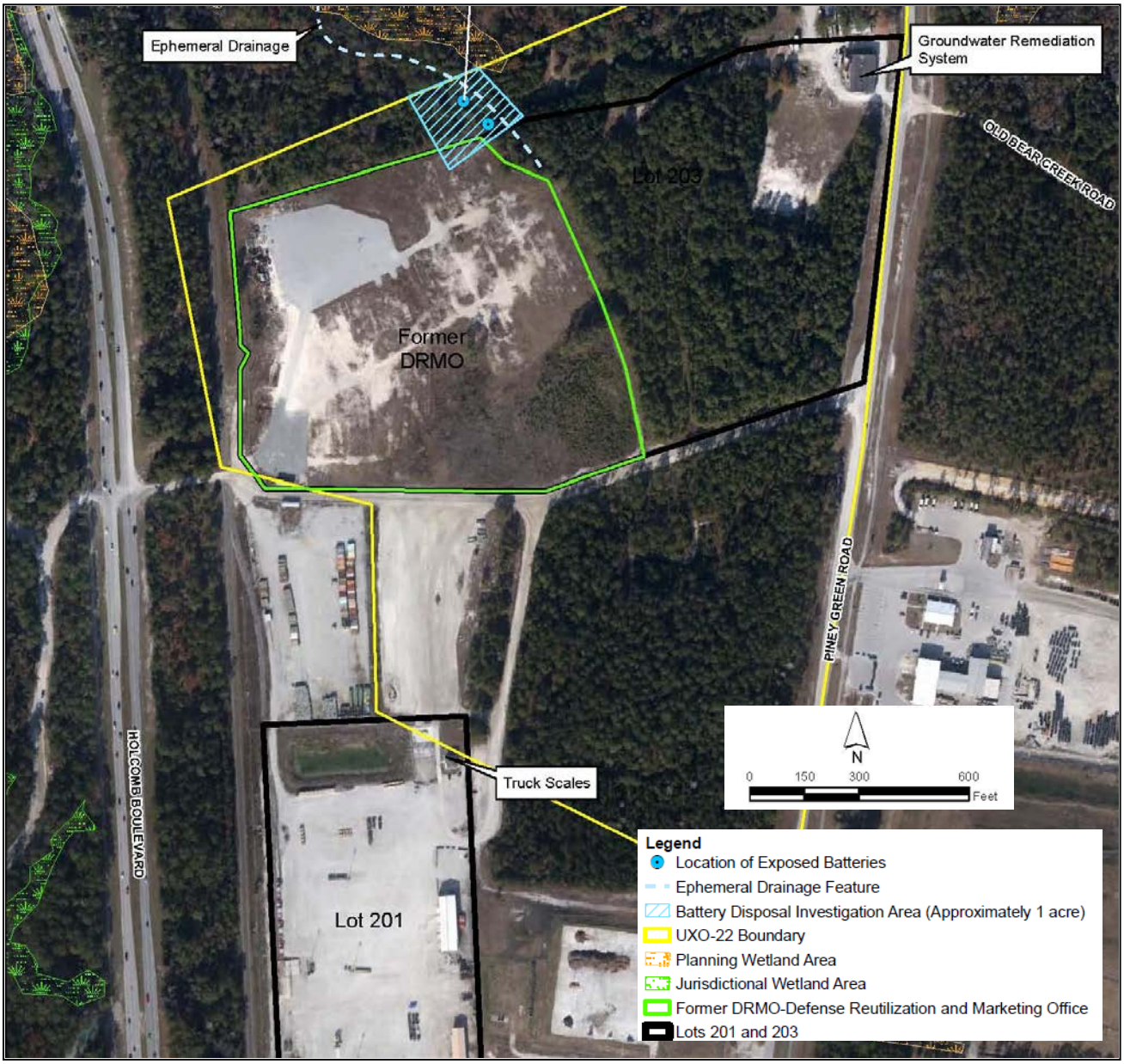

FIGURE 2
Suspected Battery Disposal Area Photos (September 2012)
Site UXO-22, MCIEAST-MCB CAMLEJ
North Carolina

1.4 Safety Issues

Because MEC/MPPEH may be present within the geophysical survey area, DGM personnel are prohibited from touching, handling, or moving items that may resemble MEC/MPPEH. Upon encountering such an item, survey personnel will immediately inform onsite CH2M HILL unexploded ordnance (UXO) personnel. In the event that such an item is discovered, either inside or outside the survey area, and no UXO personnel are present, DGM personnel will conspicuously mark and secure a perimeter around the item and immediately contact the onsite UXO Safety Officer. DGM survey personnel should not remain within 100 feet (ft) (33 meters [m]) of a suspected MEC or MPPEH item.

DGM survey personnel will not be permitted to access areas beyond the access routes and investigation area limits established for this survey. CH2M HILL UXO personnel will conduct MEC avoidance during DGM. DGM personnel will also be required to adhere to the project Health and Safety Plan and Activity Hazard Analysis. Pre-task safety briefings will be conducted each morning before work begins for the day.

SECTION 2

Geophysical Survey

2.1 Approach

The geophysical survey will be conducted using the Geonics, Ltd. EM31-MK2 (or equivalent system) and a Geometrics G-858 gradiometer (or equivalent system). The combination of these two methods is intended to provide added confidence that the survey objective can be met. These two instruments have been presumptively selected based on anticipated site conditions and successful delineation of previous battery (and other wastes) disposal areas at MCIEAST-MCB CAMLEJ.

The EM31-MK2 will be operated in horizontal dipole mode in order to provide enhanced characterization of the shallow subsurface and because it is unlikely, based on observed site conditions, that batteries were disposed of in an excavated pit or trench. EM31-MK2 terrain conductivity (i.e., quadrature) and in-phase response data will be collected simultaneously, evaluated, and presented. Magnetic gradient data and total field data recorded with the G-858 will be evaluated and presented.

EM31-MK2 and G-858 data will be collected along profiles with an intended spacing of 5 ft (1.5 m) across the investigation area, where site conditions permit. Inaccessible portions of the survey area will result in data gaps. The DGM subcontractor will be required to perform preliminary data processing onsite in order to assess whether the survey should be expanded beyond the initial 1-acre (0.4hectare) area. A decision on whether to expand the survey area will be made after a joint review of the preliminary in-field results by the DGM subcontractor and CH2M HILL.

2.2 Project Personnel

DGM operations will involve the following personnel:

- **CH2M HILL Project Manager** – The CH2M HILL Project Manager will liaise directly with the client and will be responsible for subcontract management and project delivery within the established schedule and budget. The CH2M HILL Project Manager will engage CH2M HILL UXO personnel and the CH2M HILL Project Geophysicist, as needed, and will provide final review of the results and report submitted by the subcontractor.
- **Subcontractor Geophysical Personnel** – The DGM subcontractor will assemble a geophysical team that will fulfill, at a minimum, the following roles: oversight/project management, data collection, data analysis, QC, and reporting. Field personnel will be experienced in the safe and proper operation of the geophysical equipment and will have experience working in difficult terrain. The subcontractor Field Team Leader will be the point of contact for CH2M HILL and will serve as the subcontractor's site safety officer. Field team members will also have experience in performing preliminary data processing for evaluation of the results within 24 hours of collection. The subcontractor team will also include a QC Geophysicist (or equivalent role), who will be responsible for compliance with the technical requirements, deliverable formats, and schedule set forth in this Work Plan.
- **CH2M HILL Project Geophysicist** – The CH2M HILL Project Geophysicist will liaise with the subcontractor on technical matters and perform an independent technical review of the geophysical survey data and results. The CH2M HILL Project Geophysicist will also be responsible for reviewing the preliminary processed data, compliance with the requirements of this Work Plan, and for assisting in decisions on whether to expand the geophysical survey area.
- **CH2M HILL UXO Personnel** – A CH2M HILL UXO technician will serve as the site manager and CH2M HILL safety officer during DGM. The UXO technician will provide in-field oversight of subcontractor personnel, perform MEC avoidance, conduct daily pre-task safety briefings, and liaise with installation personnel and site visitors. The UXO technician will also serve the initial point of contact in the event potential MEC/MPPEH item is identified during geophysical operations.

2.3 Geonics, Ltd. EM31-MK2

The EM31-MK2 measures the electrical conductivity of subsurface materials by inducing a time-varying magnetic field and measuring the amplitude and phase shift of an induced secondary magnetic field. Variations in subsurface conductivity may be caused by the presence of buried metal objects, presence of non-metallic wastes and debris, or by changes in geologic conditions that alter the conductive signature of subsurface materials.

The EM31-MK2 operates at a single frequency of 10 kilohertz, has a fixed intercoil spacing of 12 ft (3.7 m), and provides two measurements, quadrature (apparent conductivity) and in-phase (metallic response). One transmitter coil generates the electromagnetic energy, and a second receiver coil detects secondary electromagnetic fields caused by the transmitter as well as fields induced in subsurface conductive regions.

Quadrature and in-phase are the two components of the EM31-MK2 induced magnetic field. The quadrature phase (measured in milliSiemens/meter) component is generally indicative of the bulk soil and groundwater properties, whereas the in-phase component (measured in parts per thousand) is generally indicative of buried metal objects. By recording both the in-phase and quadrature-phase components and comparing the results from these two components, it is possible to evaluate whether a detected change in bulk conductivity is due to the presence of buried metallic objects or to the presence of non-metallic materials that may affect subsurface soil or pore fluid conductivity.

2.4 Geometrics G-858 Gradiometer

The Geometrics G-858 is an optically pumped cesium vapor instrument that measures the intensity of the earth's magnetic field in nanoTeslas (nTs). During operation of the magnetometer, a direct current is used to generate a polarized monochromatic light. Absorption of the light occurs within the naturally precessing cesium atoms found in the instrument's two vapor cells. Precession is the wobbling motion of the axis of a spinning body (in this case, a cesium atom) when there is an external force acting on the axis.

When absorption is complete, the precessing atoms become a transfer mechanism between light and a transverse radio frequency (RF) field at a specific frequency of light known as the Larmor frequency. The light intensity is used to monitor the precession and adjusts the RF frequency, allowing for the determination of the magnetic field intensity.

Anomalies in Earth's magnetic field are caused by remnant or induced magnetism. Remnant magnetism is caused by naturally occurring magnetic materials. Induced magnetic anomalies result from the induction of a secondary magnetic field in a ferromagnetic material by Earth's magnetic field. The shape and amplitude of an induced magnetic anomaly over a ferromagnetic object depend on the geometry, size, depth, and magnetic susceptibility of the object and on the magnitude and inclination of Earth's magnetic field in the study area. Induced magnetic anomalies over buried objects such as drums, pipes, tanks, and buried metallic debris and UXO generally exhibit an asymmetrical, south high/north low signature (maximum amplitude on the south side and minimum on the north).

Earth's magnetic field undergoes low-frequency diurnal variations associated with its rotation, generally referred to as magnetic drift. These variations have their source mainly in the ionosphere, and they are of a magnitude large enough to introduce artificial trends in field data. A base station G-856 magnetometer (or separate G-858) is generally used to monitor and record this drift so that it can be removed from the total field data during processing.

A gradiometer is an instrument in which two magnetometers are mounted either horizontally or vertically relative to each other in to measure the gradient of the magnetic field. Gradient is essentially the difference between the two sensor readings. This emphasizes near-surface features and allows enhanced precision of the survey and the definition and delineation of smaller magnetic anomalies, as well as reducing the effect of Earth's diurnal magnetic drift on the survey results. Depending on the duration of the survey, a base station may not be needed for gradiometer surveys.

2.5 Positional Data

The geophysical survey will be conducted using local coordinates during data collection. Before the DGM crew arrives at the site, a professional land surveyor, licensed and insured in the state of North Carolina, will physically mark the corners of a grid system to be established by CH2M HILL. Individual grids will measure 50 ft by 50 ft (15 m x 15 m). The stake coordinates will be provided to the DGM subcontractor in Universal Transverse Mercator (UTM) Zone 18 North, North American Datum 1983 (NAD83) Continental United States (CONUS), meters. Delivered geophysical results will be presented in this coordinate system. The DGM subcontractor will be responsible for maintaining positioning within each grid.

The DGM subcontractor will be permitted to collect data with the instruments in either automatic survey mode and using fiducial markers inserted in the data or in manual mode (discrete measurements at stations along each survey lane). Fiducial methods use a time-marking procedure to determine the spatial location of the collected data but require that the operator walk a straight line along individual survey lanes. The measurement quality objectives (MQOs) for data positioning are presented in **Section 3**.

SECTION 3

Measurement Quality Objectives

Table 1 presents the MQOs, measurement performance criteria, and test methods for the battery disposal investigation at Site UXO-22.

TABLE 1
Project Measurement Quality Objectives
Site UXO-22, MCIEAST-MCB CAMLEJ
North Carolina

Measurement Quality Objective	Measurement Performance Criteria	Test Method
General System Operation		
System Operation – Geophysical instrument is operating properly.	No excessive data spikes (>5 milliSiemens/meter above the mean for EM31-MK2 quadrature; >2 parts per thousand above the mean for EM31-MK2 inphase; >2 nT above the mean for each G-858 sensor) will be present in static QC test files. Instruments will be free of obvious defects. Cables and system components will be in good working order. System responds consistently to known subsurface or surface metallic object	Battery level will be periodically checked throughout surveys. Instruments will undergo sufficient warm-up period and functional checks before use. Cables, connections, and system components will be inspected daily prior to use. Static background, dynamic response, and azimuth tests will be conducted in accordance with **Section 4** of this Work Plan**.**
Geophysical Survey		
Data Quantity and Spacing – Down line data density is sufficient to achieve project objective.	Maximum permissible spacing between data points will be ≤2.5 ft (0.75 m) unless an obstruction or hazard is present. A spacing greater than this will not meet the MQO. Sensor drop outs (G-858 only) do not result in spacing between data points of >2.5 ft (0.75m) and comprise <1% of daily collected data.	Results of survey will be quantitatively evaluated to ensure compliance. Azimuth test (G-858 only) will be conducted in accordance with **Section 4** of this Work Plan and quantitatively evaluated for compliance**.**
Survey Coverage (Lane Spacing)	Lane spacing varies by no more than 2x the intended lane spacing of 5 ft (1.5 m), unless an obstruction or hazard is present. This results in a maximum permissible lane spacing of 10 ft (3 m).	Results of survey will be quantitatively evaluated to ensure compliance.
Repeatability	2x daily dynamic response data demonstrate relatively high degree of response repeatability from start of the field day through the end of the day.	Repeat data collection will be conducted in accordance with **Section 4** of this Work Plan and qualitatively evaluated for compliance**.**
Data Handling		
Data must be made available to the project team in accordance with the project schedule.	Geophysical data are presented in accordance with **Section 5.6** of this Work Plan.	Results will be evaluated based on actual delivery of data.

SECTION 4

Quality Control

The geophysical instruments will be field tested to confirm proper operating conditions. Several basic QC tests will be performed as part of this investigation.

- **Instrument Warm-up and Functional Checks** – This is an instrument-specific activity, although standard warm-up time is generally 10 to 15 minutes to allow for sufficient sensor warm-up and minimization of drift. Longer warm-up periods may be needed in cold weather. Instrument functional checks will be conducted in accordance with the respective instrument manufacturer specifications. Equipment warm-up will be performed the first time an instrument is turned on for the day or after it has been turned off for an extended period of time.
- **Azimuth/Heading Test (G-858 only)** – This test applies only to the G-858 and is intended to minimize the number of sensor drop outs (that is, readings of 0 nT) or erroneous total field readings due to poor sensor orientation relative to the local angle of the earth's magnetic field. The test will be performed within an area relatively free of interference at the beginning of each day and with the gradiometer at the intended carrying height. The operator will record data in approximate 30-second intervals, where at each interval, the instrument heading is altered by approximately 45 degrees until a full 360 degrees has been collected. Each interval will be recorded in a separate line within the data file and evaluated in the field by the system operator to determine whether adjustments to the intended walking direction and/or sensor orientations are needed. The results of this test will be quantitatively evaluated by the subcontractor and CH2M HILL.
- **Static Background Tests** – Static background tests will be performed at the start and end of each survey day. The test will be conducted in an area that is relatively free of sources of interference and with the instruments kept stationary. For the EM31-MK2, data will be collected for at least 1 minute with the instrument placed on the ground surface. The instrument will then be raised to the intended carrying height for the production survey; a new survey line within the data file will be started; and the process will be repeated. For the G-858, this test will be accomplished at the same time as the azimuth/heading test.

  The purpose of this test is to assess background conditions (that is, the effect of the ground component in EM31-MK2) and determine whether unusual levels of instrument or ambient noise exist in the data from the start of the day through the end of the day. The results of this test will be quantitatively evaluated by the subcontractor and CH2M HILL.
- **Dynamic Response Test** – The dynamic test will be performed at the start and end of each survey day by collecting data along a profile that extends across a surface or subsurface object (such as a metal pipe, manhole lid, metal equipment case on ground surface) capable of producing a measurable response in each instrument. Data collection will occur along the profile in two directions passing over the object in order to also assess lag in data positioning.

  The purpose of the dynamic test is to evaluate whether unusually large noise spikes occur in the data due to vibration of the cables and connectors during walking as well as to demonstrate repeatability in the instrument responses over a known object throughout the duration of the survey. The responses recorded during this test will be qualitatively evaluated due to factors that cannot be strictly controlled while the instruments are in motion.

SECTION 5

Data Acquisition, Processing, and Reporting

5.1 Field Notes

The DGM subcontractor will be responsible for keeping a daily log book. Field notes will include, at a minimum, the following information:

- Field team leader name
- Field team members' names
- Date(s) of data collection
- Working hours onsite
- Instrument used
- Positioning method used
- Production and QC data file names with line numbers labeled with corresponding QC test
- Weather conditions
- Terrain conditions (including obstructions and data gaps)
- Other relevant field notes and observations

These field data will be reviewed on a daily basis and archived at the conclusion of the fieldwork by CH2M HILL. Pertinent field data will be compiled and summarized in support of the data summary report (described below).

5.2 Data Processing

Data processing will be system-specific, but the general final processing steps that may be performed on the data include the following:

- Sensor bias, background leveling, and/or standardization adjustment
- Sensor drift removal
- Latency or lag correction
- Geophysical noise identification and removal (spatial, temporal, motional, terrain-induced)
- Contour level selection with background shading
- Digital filtering and enhancement (low pass, high pass, band pass, convolution, correlation, nonlinear, and so forth)

5.3 Interpretation

The DGM subcontractor will interpret the geophysical results by annotating the final contour maps to indicate the lateral extent of the suspected disposal area. Annotations will also be provided depicting inaccessible survey areas (data gaps) and suspected or known sources of interference.

QC test results will be presented in an appropriate graphical format (such as line plot or Geosoft static test format) that demonstrates the data are meeting the quality objectives listed in this Work Plan.

5.4 Final Maps

The results of the geophysical investigation will be presented as a series of plan-view, color-contoured maps depicting instrument response (quadrature, in-phase, magnetic total field, gradient) across the survey areas. Interpretations will be made directly on the maps as well as addressed in the accompanying report. The results maps will contain the following:

- Client name
- Project number
- Subcontractor name
- Map creator
- Map approver
- Date of map creation
- Scale bar
- Color bar for geophysical data (with units)
- Displayed map coordinates in project-specific coordinate system and units
- North arrow, legend, title block

5.5 Records Management

CH2M HILL will create and manage a project-specific file transfer protocol (FTP) or SharePoint site before the start of data collection. Raw data files will be posted by the subcontractor to the FTP site at the end of each survey day (or emailed to CH2M HILL as zip files if individual files are less than 3 megabytes in size).

Relevant field notes will be uploaded to the FTP site or emailed within **1 week** of completion of the field survey. Upon project completion and submission of the final deliverable, all data and information (original and copies) will be surrendered to the CH2M HILL Project Manager.

5.6 Deliverables and Schedule

The DGM subcontractor will provide preliminary in-field processed results within **12 hours** of data collection and before demobilization for review by CH2M HILL.

Draft results and a draft report (in Microsoft Word format) shall be provided within **2 weeks** of demobilization. The draft report will present a description of the survey methods, survey execution, encountered site conditions, data processing steps and data adjustments, results and interpretation, discussion of QC results, limitations, and any other relevant information pertaining to the interpretation of the results.

In addition to the report, the draft data delivery package will include the following:

- Raw EM31-MK2 and G-858 instrument files
- Pre-processed EM31-MK2 and G-858 instrument files
- Portable document format (PDF) and native files of QC test results
- Initial processed survey and QC files in a format that can be directly read by Geosoft (.XLS, .GDB, .XYZ format)
- Draft PDF maps depicting contoured results
- Native map files (note: if Geosoft .MAP files provided, files must be packed .MAP files)
- Grid (.GRD) files and color mapping files

The final report will be available within **1 week** of receipt of comments from CH2M HILL on the draft report and figures. Submitted data files will include, at a minimum, Easting and Northing values (in the specified project coordinate system), raw instrument channels, time stamp, pre-processed, and processed data channels. The final data delivery package will include the following:

- Updated pre-processed EM31-MK2 and G-858 instrument files (if applicable)
- Updated PDF and native files of QC test results (if applicable)
- Final processed survey and QC files in a format that can be directly read by Geosoft (.XLS, .GDB, .XYZ format)
- Final PDF maps depicting contoured results
- Final native map files (note: if Geosoft .MAP files provided, files must be packed .MAP files)
- Final grid (.GRD) files and color mapping files