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FULL RESOURCE CONSERVATION AND RECOVERY ACT FACILITY INVESTIGATION SAMPLING AND ANALYSIS PLAN (FIELD SAMPLING PLAN AND QUALITY ASSURANCE PROJECT PLAN) FOR SOLID WASTE MANAGEMENT UNIT 77 (SWMU 77) NAVAL ACTIVITY PUERTO RICO

08/01/2012

TETRA TECH

FULL RCRA FACILITY INVESTIGATION SAMPLING AND ANALYSIS PLAN

(Field Sampling Plan and Quality Assurance Project Plan)

for

SWMU 77 – SMALL ARMS RANGE

Naval Activity Puerto Rico
Ceiba, Puerto Rico

Naval Facilities Engineering Command Southeast

Contract Number N62470-08-D-1001
Contract Task Order JM04

August 2012

Volume 1 of 2
Text and Appendices B through D

SAP Worksheet #1 – Title and Approval Page

MUNITIONS CONSTITUENTS
FULL RCRA FACILITY INVESTIGATION
SAMPLING AND ANALYSIS PLAN

(Field Sampling Plan and Quality Assurance Project Plan)
August 2012

SWMU 77 - Small Arms Range
Naval Activity Puerto Rico, Ceiba, Puerto Rico

Prepared for:
Naval Facilities Engineering Command Southeast
2155 Eagle Drive
North Charleston, South Carolina 29406

Prepared by:
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Prepared under:
Contract Number N62470-08-D-1001
Contract Task Order JM04

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SAP Worksheet #1 – Title and Approval Page

DRAFT
MUNITIONS CONSTITUENTS
FULL RCRA FACILITY INVESTIGATION
SAMPLING AND ANALYSIS PLAN

(Field Sampling Plan and Quality Assurance Project Plan)
November 2011

SWMU 77 - Small Arms Range
Naval Activity Puerto Rico, Ceiba, Puerto Rico

Prepared for:
Naval Facilities Engineering Command Southeast
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I certify under penalty of law that I have examined and am familiar with the information submitted in this document and all attachments and that this document and its attachments were prepared either by me personally or under my direction or supervision in a manner designed to ensure that qualified and knowledgeable personnel properly gather and present the information contained therein. I further certify, based on my personal knowledge or on my inquiry of those individuals immediately responsible for obtaining the information, that the information is true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fines and imprisonment for knowingly and willfully submitting a materially false statement.

Signature: _____

Name: David Criswell

Title: BRAC Environmental Coordinator

Date: August 24, 2012

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ACRONYMS

AFWTF	Atlantic Fleet Weapons Training Facility
ARAR	Applicable or Relevant and Appropriate Requirement
BEC	BRAC Environmental Coordinator
BFB	Bromofluorobenzene
bgs	Below Ground Surface
BNA	Base, Neutral, Acid
BRAC	Base Realignment and Closure
ºC	Degree Celsius
CA	Corrective Action
CAS	Chemical Abstract System
CCB	Continuing Calibration Blank
CCC	Calibration Check Compound
CCV	Continuing Calibration Verification
CCVA	Chemical Coating Value Analysis
CD	Compact Disk
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
CFR	Code of Federal Regulations
CLEAN	Comprehensive Long-Term Environmental Action Navy
CLP	Contract Laboratory Program
CMS	Corrective Measures Study
COPC	Chemical of Potential Concern
CPR	Cardiopulminary Resuscitation
CSM	Conceptual Site Model
CTO	Contract Task Order
CVAA	Cold Vapor Atomic Absorption
%D	Percent Drift
DDESB	Department of Defense Explosives Safety Board
DFTPP	Decafluorotriphenyltrichloroethane
DGM	Digital Geophysical Mapping
DL	Detection Limit
DoD	Department of Defense
DQI	Data Quality Indicator
DQM	Data Quality Manager

DQO	Data Quality Objective
DQR	Data Quality Review
DVM	Data Validation Manager
Eco-SSL	Ecological Soil Screening Level
EDD	Electronic Data Deliverable
ELAP	Environmental Laboratory Approval Program
EOD	Explosive Ordnance Disposal
ERA	Ecological Risk Assessment
ERP	Environmental Restoration Program
ESL	Ecological Screening Level
ESQD	Explosives Safety Quantity-Distance
ESS	Explosives Safety Submission
FBL	Fixed-Base Laboratory
FOL	Field Operations Leader
FTMR	Field Task Modification Request
GC/ECD	Gas Chromatography/Electron Capture Detector
GC/MS	Gas Chromatography/Mass Spectrometry
GIS	Geographic Information Systems
GPS	Global Positioning System
HA	Hazard Assessment
HASP	Health and Safety Plan
HAZWOPER	Hazardous Waste Operations and Emergency Response
HDOP	Horizontal dilution of precision
HH PAL	Human Health Project Action Limit
HHRA	Human Health Risk Assessment
HPLC	High-Performance Liquid Chromatography
HQ	Hazard Quotient
HSM	Health and Safety Manager
ICAL	Initial Calibration
ICB	Initial Calibration Blank
ICP	Inductively Coupled Plasma
ICP-AES	Inductively Coupled Plasma - Atomic Emission Spectrometer
ICS	Interference Check Standards
ICV	Initial Calibration Verification
IDW	Investigation-Derived Waste
ILCR	Incremental Lifetime Cancer Risk

IS	Internal Standard
LANL	Los Alamos National Laboratory
LANT	Mid-Atlantic
LCS	Laboratory Control Sample
LCSD	Laboratory Control Sample Duplicate
LIMS	Laboratory Information Management System
LOD	Limit of Detection
LOQ	Limit of Quantitation
MC	Munitions Constituents
MDAS	Material Documented As Safe
MDL	Method Detection Limit
MEC	Munitions and Explosives of Concern
mg/kg	Milligram per Kilogram
mm	Millimeter
MPC	Measurement Performance Criterion
MPPEH	Material Potentially Presenting an Explosive Hazard
MRP	Munitions Response Program
MS/MSD	Matrix Spike/Matrix Spike Duplicate
NA	Not Applicable
NAD83	North American Datum of 1983
NAPR	Naval Activity Puerto Rico
NAVFAC	Naval Facilities Engineering Command
NC	No Criterion
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
ND	Non-Detect
NEDD	NIRIS Electronic Data Deliverable
NEW	Net Explosive Weight
NG	Nitroglycerin
NIRIS	Naval Installation Restoration Information Solution
NOSSA	Naval Ordnance Safety and Security Activity
NRHP	National Register of Historic Places
NSRR	Naval Station Roosevelt Roads
OB/OD	Open Burn/Open Detonation
OIC	Officer in Charge
OSHA	Occupational Safety and Health Administration
PAL	Project Action Limit

PCBs	Polychlorinated biphenyl
PID	Photoionization Detector
PM	Project Manager
PMO	Program Management Office
PPE	Personal Protective Equipment
POC	Point of Contact
ppt	Parts Per Thousand
PQLG	Project Quantitation Limit Goal
PREQB	Puerto Rico Environmental Quality Board
psi	Pounds Per Square Inch
QA	Quality Assurance
QAM	Quality Assurance Manager
QAO	Quality Assurance Officer
QAPP	Quality Assurance Project Plan
QC	Quality Control
QSM	Quality Systems Manual
%R	Percent Recovery
%RSD	Percent Relative Standard Deviation
RCRA	Resource Conservation and Recovery Act
RDX	Cyclotrimethylenetrinitramine
R-RSL	Residential – Regional Screening Level
RAGS	Risk Assessment Guidance for Superfund
RBSSL	Risk-Based Soil Screening Level
RF	Response Factor
RFI	RCRA Facility Investigation
RPD	Relative Percent Difference
RPM	Remedial Project Manager
RSD	Relative Standard Deviation
RT	Retention Time
SAP	Sampling and Analysis Plan
SDG	Sample Delivery Group
SE	Southeast
SHPO	State Historic Preservation Officer
SOP	Standard Operating Procedure
SPCC	System Performance Check Compound
SQL	Structured Query Language

SSL	Soil Screening Level
SSO	Site Safety Officer
SWMU	Solid Waste Management Unit
SVOC	Semi-volatile Organic Compounds
TBD	To Be Determined
TCLP	Toxicity Characteristic Leachate Procedure
TDS	Total Dissolved Solids
TP	Technical Paper
TPH	Total Petroleum Hydrocarbon
Tetra Tech	Tetra Tech, Inc.
UFP	Uniform Federal Policy
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
UV	Ultraviolet
UXO	Unexploded Ordnance
VOC	Volatile Organic Compound
XRF	X-Ray Fluorescence

EXECUTIVE SUMMARY

Tetra Tech, Inc. (Tetra Tech) has been retained by the United States Department of Naval Facilities Engineering Command (NAVFAC) Atlantic to perform a Full Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI) at Naval Activity Puerto Rico (NAPR), Ceiba, Puerto Rico. The work is being conducted for Contract Task Order (CTO) JM04 under the Comprehensive Long-term Environmental Action Navy CLEAN Contract No. N62470-08-D-1001.

This document is Volume 1 of the Uniform Federal Policy (UFP) Sampling and Analysis Plan (SAP), which was prepared in accordance with the UFP for Quality Assurance Project Plans (UFP-QAPP) (USEPA, 2005) and the United States Environmental Protection Agency (USEPA) Guidance for QAPPs (2002). This UFP-Sampling and Analysis Plan (SAP) describes the scope of work required to investigate potential munitions constituents (MC), and other analytes as warranted, in surface and subsurface soil at Solid Waste Management Unit (SWMU) 77 at Naval Activity Puerto Rico, Cieba, Puerto Rico. The munitions and explosives of concern (MEC) portion of the Full RFI is described in Appendix A in Volume 2 of this UFP-SAP.

SWMU 77 is located on the Punta Medio Mundo on the northeastern boundary of NAPR, Ceiba, Puerto Rico. SWMU 77 contains six munitions subareas: Rifle Range Subarea, Potential Open Burn/Open Detonation (OB/OD) Subarea, Potential Munitions Trench Subarea, Detonation Area Near Concrete Pad Subarea, Pistol Range Subarea, and Former Pistol Range Subarea.

The planned Full RFI activities are described briefly below and summarized in Table ES-1 for each subarea. MEC activities (detailed in the MEC SAP Volume 2) will be completed before MC activities begin at each site.

The Pistol Range Subarea is located in a level area north of the entrance road to SWMU 77. The Pistol Range was closed January 1, 2010, and until that time was maintained via grass cutting. An earthen berm that serves as the bullet backstop is present just beyond the target area and numerous bullets are visible on the surface. There are six firing lines (1.5-yard, 3-yard, 7-yard, 10-yard, 15-yard, and 25-yard) across two 50-foot-wide side-by-side ranges. The southern half of the range has been used exclusively since 2004.

Nitroglycerin (NG) at the firing lines and metals (antimony, arsenic, copper, lead, and zinc) and explosives at the berm area were investigated in surface soil during the Phase I RFI. Based on the Phase I RFI

findings, NG was determined to be neither a human health nor ecological issue. For the berm, metals, particularly the primary contaminant lead, were elevated and present both a human health and ecological risk issue. A high density of bullets and fragments were ubiquitous on the main side of the earthen berm directly behind the target areas, and much less present on the far right side to the north; similarly, lead contamination in soil was much higher on the main side of the berm versus the northern side. A Full RFI was recommended for the Pistol Range Subarea to delineate the metals contamination (Tetra Tech, 2011, results presented in Appendix B-3, Volume I). Additionally NG will be investigated at select firing lines.

The Former Pistol Range Subarea is now overgrown with trees, and no visible evidence remains of the former pistol range located northeast of the current pistol range and southwest of the Detonation Area Near Concrete Pad Subarea. Historical aerial photographs show the area cleared in 1964 and overgrown by 1976.

NG and metals (antimony, arsenic, copper, lead, and zinc) were investigated in soil during the Phase I RFI. Surface soil was investigated along each side of the subarea to investigate berm potential historical locations, and inside the perceived historical range boundaries to obtain data concerning firing lines. NG did not exceed the project action limit (PAL). For the berm, metals, particularly the primary contaminant lead, were elevated, which would present both a human health and ecological risk issue. The most highly contaminated area was encountered in the northwestern area of the subarea. A low density of bullets and fragments were observed in the area. A Full RFI was recommended for the Former Pistol Range Subarea to delineate the metals contamination (Tetra Tech, 2011, results presented in Appendix B-3, Volume I).

The Detonation Area Near Concrete Pad Subarea is located southeast of the Potential OB/OD Subarea between the 300-yard and 500-yard Rifle Range firing lines on the southern side of the unpaved road. Clearing of the subarea occurred sometime between 1977 and 1985, and construction of the concrete pad used for target assembly occurred by 1995. The area around the pad is level, grassy, and not maintained. A small open depression located at the northern corner of the pad was observed during the August 2009 site visit but no evidence of MEC has been observed (the depression contained standing water). The depression is reported to be a detonation pit used for a one-time detonation event.

Surface soil was investigated at two biased locations during the Phase I RFI, the remaining depression area where the one-time detonation occurred and the low-lying drainage area for the subarea. Lead concentrations in Phase I data were less than human health screening levels and greater than ecological screening levels. Further sampling was recommended for this subarea during the Full RFI to supplement

and confirm the Phase I RFI results via a large enough database to support risk assessment (Tetra Tech, 2011, results presented in Appendix B-3, Volume I). Additionally NG will be investigated.

The Rifle Range Subarea is a 500-yard narrow feature centrally located in SWMU 77 and orientated such that shots were fired toward the outer point of the peninsula. Construction of the range occurred sometime between 1940 and 1958. The range has 100-yard, 200-yard, 300-yard, and 500-yard elevated firing lines and a short-yardage range formerly used as a pistol range. The short-yardage range is located in front of a fixed target area. The target berm consists of a constructed earthen berm that served the short-yardage range, a concrete wall at the rear of the earthen berm equipped with a target carrier mechanism to raise (and lower) targets, and a natural steep wooded hillside beyond the earthen berm/concrete wall that serves as the backstop for these elevated targets. MEC/material potentially presenting an explosive hazard (MPPEH) items were observed on the constructed earthen berm and grassy strip at the toe of the wooded embankment, and these items were removed when SWMU 77 was closed in January 2010.

NG at the firing lines and metals (antimony, arsenic, copper, lead, and zinc) and explosives at berm/embankment areas were investigated in surface soil during the Phase I RFI. Based on the Phase I RFI findings, NG was only a potential risk concern at the 200-yard firing line for the Rifle Range, which may have been more heavily used than the other firing lines. For the earthen constructed berm area/wooded embankment, metals, particularly the primary contaminant lead, were present at elevated concentrations compared to the PALs. A high density of bullets was observed on the constructed earthen berm and, also, a high density of bullets may be present on the wooded embankment (heavily wooded vegetation prevented visual observation) due to its location relative to the constructed earthen berm. The explosive, cyclotrimethylenetrinitramine (RDX), was detected, but did not exceed the PAL. A Full RFI was recommended to determine lateral and vertical extent of MC, in particular metals (antimony, arsenic, copper, lead, and zinc) in and around the constructed earthen berm and wooded embankment and further investigate NG at the Rifle Range firing lines (Tetra Tech, 2011, results presented in Appendix B-3, Volume I). Additionally, NG will be investigated at the firing lines.

The Potential OB/OD Subarea is on the northern side of the unpaved road on the northwestern portion of the peninsula. Based on historical aerial photographs, operation of this subarea occurred possibly as early as 1961 and ended sometime prior to 1985. The subarea is flat, grassy, with a small depression is present in the middle of the grassy area. No evidence of OB/OD operations is apparent to date, other than the suspicious historical aerial photographs. The terrain inclines steeply beyond the level area, with scrubby brush and trees present on the hillside north of the subarea.

NG, metals (antimony, arsenic, copper, lead, and zinc), and explosives were investigated during the Phase I RFI. Based on the Phase I RFI, where surface and subsurface soil were investigated in anomalous areas identified during the geophysical survey, only lead was of potential ecological concern based on evaluation of analytical results. The data from the Phase I RFI is inconclusive until intrusive subsurface investigation is conducted.

A Full RFI was recommended to be coordinated with the MEC/MPPEH Full RFI to collect biased maximum concentration samples if and where subsurface materials are encountered during intrusive investigation that could be sources of contamination, either MC or non-MC related. Also, additional soil sampling was recommended for the Full RFI in and around the area, targeting anomaly areas as well as additional locations within the historical berm locations to adequately characterize these areas (Tetra Tech, 2011, results presented in Appendix B-3, Volume I).

The Potential Munitions Trench Subarea is located between the 200-yard and 100-yard firing lines of the Rifle Range, south of the existing unpaved road. Based on historical aerial photographs, operation of the suspected trenching subarea occurred sometime prior to 1958 (possibly as early as 1940) until October 1961. No evidence of munitions operations is apparent to date, other than the suspicious historical aerial photographs. The area is heavily wooded except over the suspect potential trenches, which are covered with overgrown grasses. No evidence of MEC has been observed to date.

NG, metals (antimony, arsenic, copper, lead, and zinc), and explosives were investigated during the Phase I RFI. The Phase I RFI sampling was limited in that only a few surface soil samples were collected, although no PALs were exceeded. For clarification purposes, the project action limits for the Phase I RFI did not include screening levels for the protection of groundwater (otherwise known as migration to groundwater soil screening levels) and the Full RFI will evaluate the potential for mobile constituents to leach to groundwater. The data is from the Phase I RFI inconclusive until intrusive subsurface investigation is conducted.

A Full RFI was recommended to be coordinated with the MEC/MPPEH Full RFI to collect biased maximum concentration samples if and where subsurface materials are encountered during intrusive investigation that could be sources of contamination, either MC or non-MC related. Also, additional soil sampling was recommended for the Full RFI in and around the area, targeting anomaly areas in the northeastern portion of the subarea and also including the southwestern portion of the subarea to adequately characterize these areas (Tetra Tech, 2011, results presented in Appendix B-3, Volume I).

Table ES-1
Full RFI Scope Summary

Subarea	MC Sampling (Volume 1)					MEC Investigation (Volume 2)		
	Surface Soil				Subsurface Soil (same analysis as surface soil)	Detector-Aided Surface Survey	Digital Geophysics Survey of Subsurface	Intrusive Investigation
	NG	Select Metals[1]	Explosives	Non-MC[1] and NG				Subsurface
Pistol Range [2]	--	✓	--	--	✓ (NG at select firing lines)	--	--	--
Former Pistol Range [2]	--	✓	--	--	--	--	--	--
Detonation Area Near Concrete Pad	✓	✓	--	--	✓	--	--	--
Rifle Range[2]	✓ (firing line only)	✓	✓	--	✓ (NG only at firing lines)	✓	--	✓
Potential OB/OD	--	✓	✓	✓?	✓	✓	✓	✓
Potential Munitions Trench	--	✓	✓	✓?	✓ (plus explosives)	✓	✓	✓

1 Specific analytes associated with potential MC include:
Select Metals= antimony, arsenic, copper, lead, and zinc
Non-MC= Appendix IX volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), pesticides, herbicides, polychlorinated biphenyls (PCBs), and metals
2 A bucket evaluation will be conducted at this subarea and sample(s) will be collected for pH analysis.
✓ = Planned
✓? = Potentially Scheduled based on outcome of Investigation
-- = Not Planned

SAP Worksheet #2 -- SAP Identifying Information

(UFP-QAPP Manual Section 2.2.4)

Site Name/Number: Naval Activity Puerto Rico (NAPR) Solid Waste Management Unit (SWMU) 77
- Rifle Range Subarea
- Pistol Range Subarea
- Former Pistol Range Subarea
- Potential Open Burn/Open Detonation (OB/OD) Subarea
- Potential Munitions Trench Subarea
- Detonation Area Near Concrete Pad Subarea

Operable Unit: Not applicable (NA)
Contractor Name: Tetra Tech, Inc. (Tetra Tech)
Contract Number: No. N62470-08-D-1001
Contract Title: Comprehensive Long-Term Environmental Action Navy (CLEAN) Contract Task Order (CTO): JM04

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

2. Identify regulatory program: Department of Defense (DoD) Munitions Response Program (MRP), Resource Conservation and Recovery Act (RCRA) as per the January 29, 2007, Consent Order for NAPR and consistent with the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) and the processes established by the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980

3. This SAP is a project-specific SAP.

4. List dates of scoping sessions that were held:

Scoping Session	Date
Planning meeting, data collection, and Data Quality Objective (DQO) development with Navy, regulatory agencies, and Tetra Tech	September 29, 2011

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

Title	Date
Phase 1 RCRA Facility Investigation, Sampling and Analysis Plan (Field Sampling Plan and Quality Assurance Project Plan) for SWMU 77 – Small Arms Range	March 2010

6. List organizational partners (stakeholders) and connection with lead organization: United States Environmental Protection Agency (USEPA) Region 2 – regulatory stakeholder overseeing RCRA Ceiba Environmental Restoration Program (ERP) implemented by lead organization, Puerto Rico Environmental Quality Board (PREQB) – regulatory stakeholder overseeing RCRA Ceiba ERP implemented by lead organization

7. Lead organization (see Worksheet #7 for detailed list of data users)
Naval Facilities Engineering Command (NAVFAC)

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

UFP-QAPP Worksheet #	Required Information	Crosswalk to Related Information
A. Project Management		
Documentation		
1	Title and Approval Page	NA
2	SAP Identifying Information	NA
3	Distribution List	NA
4	Project Personnel Sign-Off Sheet	NA
Project Organization		
5	Project Organizational Chart	NA
6	Communication Pathways	NA
7	Personnel Responsibilities and Qualifications Table	NA
8	Special Personnel Training Requirements Table	NA
Project Planning/Problem Definition		
9	Project Scoping Session Participants Sheet	NA
10	Problem Definition, Site History, and Background	NA
11	Project Quality Objectives/Systematic Planning Process Statements	NA
12	Measurement Performance Criteria Table	NA
13	Secondary Data Criteria and Limitations Table	NA
14	Summary of Project Tasks	NA
15	Reference Limits and Evaluation Table	NA
16	Project Schedule/Timeline Table	NA
B. Measurement Data Acquisition		
Sampling Tasks		
17	Project Design and Rationale	NA

UFP-QAPP Worksheet #	Required Information	Crosswalk to Related Information
18	Sampling Locations and Methods/Standard Operating Procedure (SOP) Requirements Table	NA
19	Analytical Methods/SOP Requirements Table	NA
20	Field Quality Control (QC) Sample Summary Table	NA
21	Project SOP References Table	NA
22	Field Equipment Calibration, Maintenance, Testing, and Inspection Table	NA
Analytical Tasks		
23	Analytical SOP References Table	NA
24	Analytical Instrument Calibration Table	NA
25	Analytical Instrument and Equipment Maintenance, Testing, and Inspection Table	NA
Sample Collection		
26	Sample Handling System	NA
27	Sample Custody Requirements Table	NA
Quality Control Samples		
28	Laboratory QC Samples Table	NA
Data Management Tasks		
29	Project Documents and Records Table	NA
30	Analytical Services Table	NA
C. Assessment Oversight		
31	Planned Project Assessments Table	NA
32	Assessment Findings and Corrective Action Responses Table	NA
33	Quality Assurance (QA) Management Reports Table	NA
D. Data Review		
34	Verification (Step I) Process Table	NA
35	(Tier 2) QC Process Summary Table - Follow-Up Inspections	NA
36	Analytical Data Validation (Steps IIa and IIb) Summary Table	NA
37	Data Usability Assessment	NA

SAP Worksheet #3 -- Distribution List

(UFP-QAPP Manual Section 2.3.1)

Name of SAP Recipient	Title/Role	Organization	Telephone Number	E-Mail Address or Mailing Address	Document Control Number
Stacin Martin (one shared with David Criswell)	Navy Remedial Project Manager (RPM)/Manages project activities for Navy	NAVFAC Atlantic	757.322.4780	stacin.martin@navy.mil	NA
David Criswell (one shared copy with Stacin Martin)	Navy Base Realignment and Closure (BRAC) Environmental Coordinator (BEC)/Coordinates environmental projects for the Navy	BRAC Project Management Office (PMO) Southeast (SE)	843.743.2130	david.criswell@navy.mil	NA
Debbie Sanders (cover letter only)	NAVFAC SE/ BRAC PMO SE/ Supervise project activities for Navy	NAVFAC SE/ BRAC PMO SE	843.743.2145	debbie.sanders@navy.mil	NA
Jonathan Tucker (electronic upload of draft SAP only)	NAVFAC Chemist/Quality Assurance Officer (QAO)/ Reviews SAP and QA documentation for Navy	NAVFAC Atlantic	757.322.8288	jonathan.tucker@navy.mil	NA
Commander Dan Kalal	Navy Officer in Charge (OIC)/Manages site activities	NAPR	787.685.3450	kalald@napr.navy.mil	NA

Name of SAP Recipient	Title/Role	Organization	Telephone Number	E-Mail Address or Mailing Address	Document Control Number
Pedro Ruiz	NAPR Facility Contact/ Facility Point of Contact (POC)	NAPR/NAVFAC Atlantic	757.286.9139	Naval Activity Puerto Rico Building 2439 Ceiba, Puerto Rico 00735	NA
Darrell Gundrum [Compact disk (CD) only]	NAVFAC Archeologist/Reviews potential archeologically significant sites	NAVFAC SE	904.542.6844	darrell.gundrum@navy.mil	NA
Bonnie Capito (final cover letter only)	Administrative Record Librarian/Manages Navy project records	NAVFAC Mid-Atlantic	757.322.4785	bonnie.capito@navy.mil	NA
J.Mentz (CD only)	Consultant Activity Manager/Maintains Administrative Record	Michael Baker Jr., Inc.	412.269.2000	jmentz@mbakercorp.com	
Phil Flax	USEPA Region 2 of the Resource Conservation and Special Projects Section/Manages Region 2 Programs	USEPA Region 2	212.637.1469	flax.phil@epa.gov	NA
Doug Pocze	USEPA Region 2 RPM/Provides USEPA regulatory input	USEPA Region 2	212.637.4432	pocze.doug@epa.gov	NA
Jose Font (CD only)	USEPA Caribbean Office Director/Director for USEPA Caribbean Office	USEPA Region 2 Caribbean Office	787.977.5870	NA	NA

Name of SAP Recipient	Title/Role	Organization	Telephone Number	E-Mail Address or Mailing Address	Document Control Number
Wilmarie Rivera	PREQB RPM/ Provides Puerto Rico regulatory input	PREQB	787.767.8181 x6129	wilmarierivera@jca.pr.gov	NA
Gloria Toro-Agrait	PREQB Environmental Permits Officer/Provides Puerto Rico regulatory input	PREQB	787.767.8181 x3586	gloriatoro@jca.pr.gov	NA
Felix Lopez	United States Fish and Wildlife Service (USFWS)/Provides ecological project assistance for Puerto Rico	USFWS	787.851.7297 x226	P.O. Box 491 Road 301 Km 5.1 Boqueron, Puerto Rico 00622	NA
Jim Pastoric (if directed by PREQB, CD only)	PREQB Consultant/Provides unexploded ordnance (UXO) technical expertise to PREQB	UXO PRO	703.548.5300	jim@uxopro.com	NA
Connie Crossley (if directed by USEPA, CD only)	USEPA Consultant/Provides project assistance for USEPA	Booze Allen Hamilton	919.462.9004	1324 Queenssferry Road Cary, North Carolina 27511	NA
Katarina Rutkowski (if directed by PREQB, CD only)	PREQB Consultant/Provides project assistance for PREQB	TRC Environmental	860.298.9692	21 Griffin Road North Windsor, Connecticut 06095	NA

Name of SAP Recipient	Title/Role	Organization	Telephone Number	E-Mail Address or Mailing Address	Document Control Number
John Trepanowski (letter only)	Program Manager/Manages the Navy CLEAN Program for Tetra Tech	Tetra Tech	610.491.9688	john.trepanowski@tetratech.com	NA
Linda Klink	Project Manager (PM)/Manages project activities for Tetra Tech	Tetra Tech	412.921.8650	linda.klink@tetratech.com	NA
Ralph Brooks	UXO/Munitions and Explosives of Concern (MEC) Manager/Manages corporate MEC hazards and risks	Tetra Tech	770.413.0965 x231	ralph.brooks@tetratech.com	NA
James Rossi	Project UXO Manager/Manages project MEC hazards and risks	Tetra Tech	770.413.0965 x233	james.rossi@tetratech.com	NA
Glen Wagner	Administrative Record Manager/Maintains Administrative Record	Tetra Tech	412.920.8603	glen.wagner@tetratech.com	NA
TBD	Field Operations Leader (FOL)/Site Safety Officer (SSO)/Manages field operations and site safety	Tetra Tech	TBD	TBD	NA

Name of SAP Recipient	Title/Role	Organization	Telephone Number	E-Mail Address or Mailing Address	Document Control Number
Matt Soltis [(Health and Safety Plan [HASP] only)	Tetra Tech Health and Safety Manager (HSM)/Manages Corporate Health and Safety Program	Tetra Tech	412.921.8912	matt.soltis@tetratech.com	NA
Thomas Johnston	Tetra Tech QAM/Manages project QC	Tetra Tech	412.921.8615	tom.johnston@tetratech.com	NA
Kelly Carper (shared copy with Joe Samchuck)	Tetra Tech Project Chemist/Provides technical coordination with laboratories	Tetra Tech	412.921.7273	kelly.carper@tetratech.com	NA
Joe Samchuck (shared copy with Kelly Carper)	Tetra Tech Data Validation Manager (DVM)/Manages data validation	Tetra Tech	412.921.8510	joseph.samchuck@tetratech.com	NA
Brian Richard (electronic copy only)	Laboratory PM/ Representative for laboratory and analytical issues	Empirical Laboratories	877.345.1113 x249	brichard@empirlabs.com Empirical Laboratories 621 Mainstream Drive, Suite 270 Nashville, TN 37228	NA
Lidya Gulizia (electronic copy only)	Laboratory PM/ Representative for laboratory and analytical issues	TestAmerica Laboratories	912.354.7858 x3007	lidya.gulizia@testamericainc.com TestAmerica Laboratories 5102 LaRoche Avenue Savannah, GA 31404	NA

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

(UFP-QAPP Manual Section 2.3.2)

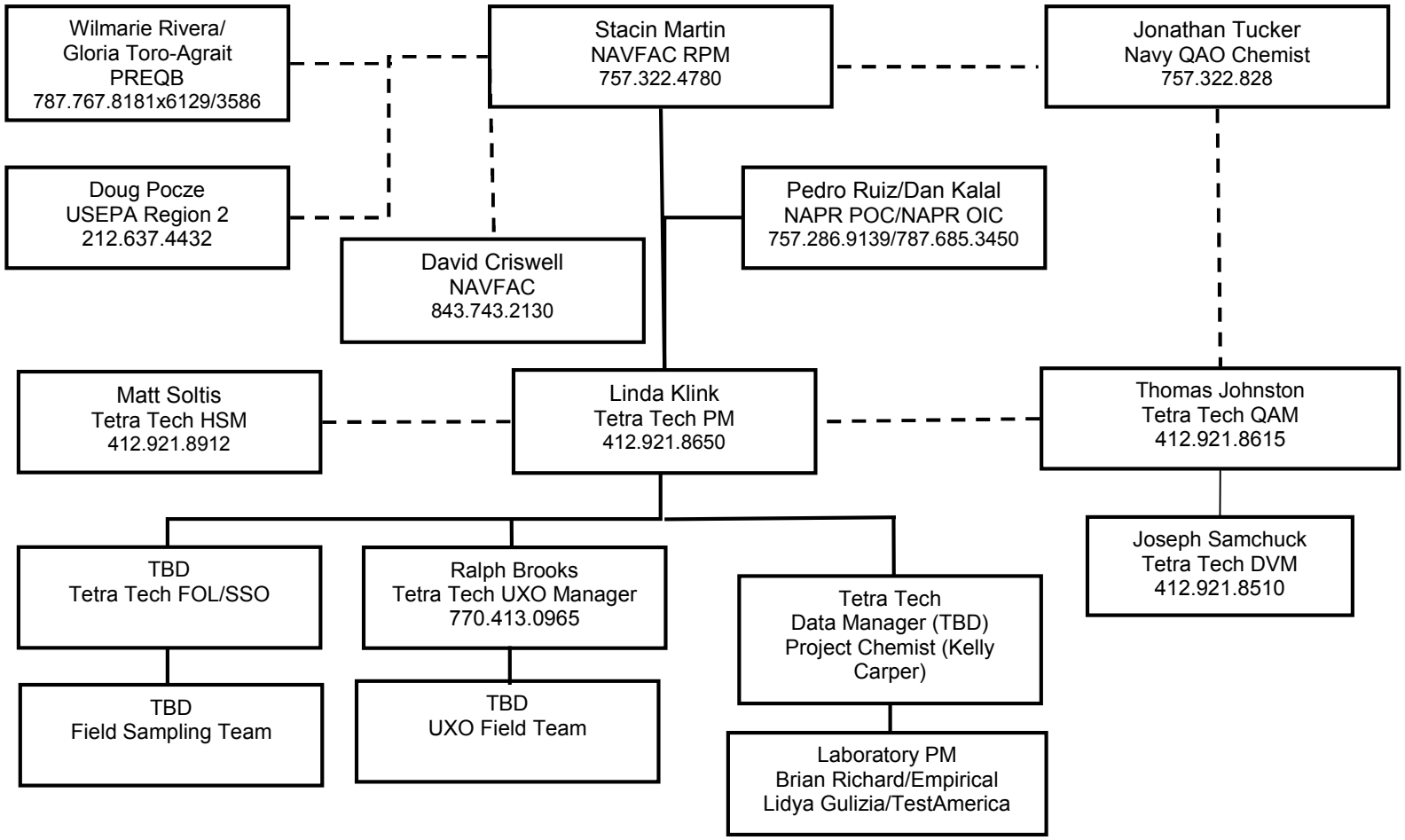
Name	Organization/Title/Role	Telephone Number (optional)	Signature/E-Mail Receipt	SAP Section Reviewed	Date SAP Read
Linda Klink	Tetra Tech PM/Manages project activities for Tetra Tech	412.921.8650	See title page signature	All	NA
Ralph Brooks	Tetra Tech UXO/MEC Manager/Manages corporate MEC hazards and risks	770.413.0965 x231		All except Worksheet #s 12, 14, 15, 19, 20, 23-28, 30, 34-37	
James Rossi	Tetra Tech/Project UXO Manager/Manages project MEC hazards and risks	770.413.0965 x233		All except Worksheet #s 12, 14, 15, 19, 20, 23-28, 30, 34-37	
TBD	Tetra Tech FOL/SSO/Manages field operations and site safety	TBD	TBD	All	
Tom Johnston	Tetra Tech QAM/Manages project QC	412.921.8615	See title page signature	Worksheet #s 12, 14, 15, 19, 20, 23-28, 30, 34-37	
Matt Soltis	Tetra Tech HSM/Manages Corporate Health and Safety Program	412.921.8912	See HASP signature Page	HASP	NA
Joe Samchuck	Tetra Tech DVM/Manages data validation	412.921.8510		Worksheet #s 12, 14, 15, 19, 20, 23-28, 30, 34-37	
Kelly Carper	Tetra Tech Project Chemist/Provides technical coordination with laboratories	412.921.7273		Worksheet #s 12, 14, 15, 19, 20, 23-28, 30, 34-37	

Name	Organization/Title/Role	Telephone Number (optional)	Signature/E-Mail Receipt	SAP Section Reviewed	Date SAP Read
Brian Richard	Empirical/Laboratory PM/ Representative for laboratory and analytical issues	877.345.1113 x249		Worksheet #s 6, 12, 14, 15, 19, 23-28, 30, and 34-36	
Lidya Gulizia	TestAmerica/Laboratory PM/ Representative for laboratory and analytical issues	912.354.7858 x3007		Worksheet #s 6, 12, 14, 15, 19, 23-28, 30, and 34-36	

SAP Worksheet #5 -- Project Organizational Chart

(UFP-QAPP Manual Section 2.4.1)

Lines of Authority ———— Lines of Communication



SAP Worksheet #6 -- Communication Pathways

Communication Driver	Responsible Person Affiliation	Name	Phone Number and/or E-Mail	Procedure
MEC find or other reportable (i.e., hazardous waste source/dangerous item find)	Tetra Tech Field Team Staff	TBD	TBD	Within 30 minutes, Tetra Tech UXO Technicians will verbally notify field staff, secure area, and contact Tetra Tech UXO/MEC Manager and Tetra Tech Project UXO Manager.
	Tetra Tech UXO/MEC Manager	Ralph Brooks	770.413.0965 x231	Tetra Tech UXO Manager will verbally inform Tetra Tech PM the same day.
	Tetra Tech Project UXO Manager	James Rossi	770.413.0965 x233	Tetra Tech PM will verbally inform Navy RPM and NAPR OIC the same day.
	Tetra Tech PM	Linda Klink	412.921.8650	NAPR OIC will make base emergency notifications.
	Navy RPM	Stacin Martin	757.322.4780	Navy RPM will inform Naval Ordnance Safety and Security Activity (NOSSA) on the same day as an MEC find if the explosives safety quantity-distance (ESQD) or net explosive weight (NEW) increases beyond those identified in the approved Explosives Safety Submission (ESS) or if other explosive safety concerns warrant.
	NAPR OIC	Dan Kalal	787.685.3450	

Communication Driver	Responsible Person Affiliation	Name	Phone Number and/or E-Mail	Procedure
Field issue that requires changes in field tasks	Tetra Tech FOL/SSO Tetra Tech PM Navy RPM NAVFAC Contracting Officer USEPA POC PREQB POC	TBD Linda Klink Stacin Martin TBD Doug Pocze Wilmarie Rivera	TBD 412.921.8650 757.322.4780 TBD 212.637.4432 787.767.8181 x6129	Tetra Tech FOL will inform Tetra Tech PM on the same day the issue is discovered. Tetra Tech PM will inform Navy RPM and the NAVFAC Contracting Officer within 1 business day; NAVFAC Contracting Officer will issue scope change approval (verbally or via e-mail) if warranted; scope change will be implemented before work is executed. Tetra Tech FOL will document change via Field Task Modification Request (FTMR) form within 2 days of identifying the need for change and obtain required approvals within 5 days of initiating the form. Tetra Tech PM will inform USEPA POC and PREQB POC within 2 business days.
SAP/QAPP amendment	Tetra Tech PM Navy RPM	Linda Klink Stacin Martin	412.921.8650 757.322.4780	Tetra Tech PM will notify Navy RPM via e-mail within 1 business day.
Field work schedule change	Tetra Tech PM NAPR OIC	Linda Klink Dan Kalal	412.921.8650 787.685.3450	Tetra Tech PM will verbally inform NAPR OIC on the day that schedule change is known and document via schedule impact letter as soon as impact is realized.

Communication Driver	Responsible Person Affiliation	Name	Phone Number and/or E-Mail	Procedure
Field issue that requires changes in scope of field work	Tetra Tech FOL/SSO	TBD	TBD	Tetra Tech FOL will verbally inform Tetra Tech PM on the day the issue is discovered. Tetra Tech PM will inform Navy RPM, NAVFAC Contracting Officer, and NAPR OIC within 1 business day of discovery. NAVFAC Contracting Officer will issue scope change (verbally or via e-mail), if warranted; scope change to be implemented before further work is executed. Tetra Tech PM will document the change via FTMR form within 2 days of identifying the need for change and obtain required approvals within 5 days of initiating the form. Tetra Tech PM will inform (verbally or via e-mail) the listed Project Team members within 2 business days.
	Tetra Tech PM	Linda Klink	412.921.8650	
	NAPR OIC	Dan Kalal	787.685.3450	
	Navy RPM	Stacin Martin	757.322.4780	
	NAVFAC Contracting Officer	TBD	TBD	
	USEPA POC	Doug Pocze	212.637.4432	
	PREQB POC	Wilmarie Rivera	787.767.8181 x6129	
Recommendation to stop work and initiate work upon corrective action (CA)	Tetra Tech PM	Linda Klink	412.921.8650	Within 1 hour, the responsible party will (verbally or via e-mail) inform , the Navy RPM, NAPR OIC, Tetra Tech PM, Tetra Tech FOL, Tetra Tech QAM, Tetra Tech Project Chemist, and Tetra Tech HSM. Tetra Tech PM will inform (verbally or via e-mail) Navy RPM and NAPR OIC of any work stoppage within 1 day.
	Tetra Tech FOL/SSO	TBD	TBD	
	Tetra Tech QAM	Tom Johnston	412.921.8615	
	Tetra Tech Project Chemist	Kelly Carper	412.921.72.73	
	Tetra Tech HSM	Matt Soltis	412.921.8912	
	Navy RPM	Stacin Martin	757.322.4780	
	NAPR OIC	Dan Kalal	787.685.3450	
Field data quality issue	Tetra Tech FOL/SSO	TBD	TBD	Tetra Tech FOL will inform Tetra Tech PM verbally or by e-mail on the same day that a field data quality issue is discovered.
	Tetra Tech PM	Linda Klink	412.921.8650	

Communication Driver	Responsible Person Affiliation	Name	Phone Number and/or E-Mail	Procedure
Analytical data quality issues	Empirical Laboratory PM TestAmerica Tetra Tech Project Chemist Tetra Tech DVM Tetra Tech PM Navy RPM	Brian Richard Lidya Gulizia Kelly Carper Joseph Samchuck Linda Klink Stacin Martin	877.345.1113 x249 912.354.7858 x3007 412.921.7273 412.921.8510 412.921.8650 757.322.4780	Laboratory PM will notify (verbally or via e-mail) Tetra Tech Project Chemist within 1 business day of when an issue related to laboratory data is discovered. Tetra Tech Project Chemist will notify (verbally or via e-mail) data validation staff and Tetra Tech PM within 1 business day. Tetra Tech DVM or Project Chemist will notify Tetra Tech PM verbally or via e-mail within 48 hours of validation completion that a non-routine and significant laboratory quality deficiency has been detected that could affect this project and/or other projects. Tetra Tech PM will verbally advise NAVFAC RPM within 24 hours of notification from Project Chemist or DVM. NAVFAC RPM will take CA appropriate for the identified deficiency. Examples of significant laboratory deficiencies include data reported that has a corresponding failed tune or initial calibration verification. CAs may include a consult with Navy Chemist.
CA for field program	Tetra Tech QAM Tetra Tech PM	Thomas Johnston Linda Klink	412.921.8615 412.921.8650	Tetra Tech QAM will notify Tetra Tech PM within 1 business day that the CA has been completed. Tetra Tech PM will then notify Navy RPM within 1 business day.

SAP Worksheet #7 – Personnel Responsibilities and Qualifications Table

Name	Title/Role	Organizational Affiliation	Responsibilities
Stacin Martin	RPM/Manages Project Activities for the Navy	NAVFAC Atlantic	Participates in scoping, data review, and evaluation of the SAP, Interim report/memorandum, and Full RFI Report.
David Criswell	Navy BEC/ Coordinates environmental projects for the Navy	BRAC PMO SE	Participates in scoping, data review, and evaluation of the SAP, Interim report/memorandum, and Full RFI Report.
NAVFAC Chemist	QAO	Jonathan Tucker	Reviews and approves the MC portion of the UFP-SAP (Volume I).
Darrell Gundrum	NAVFAC Archeologist	NAVFAC SE	Reviews the UFP-SAP for potential archeologically significant sites.
Wilmarie Rivera	PREQB RPM/ Provides Puerto Rico regulatory input	PREQB	Participates in scoping, data review, and evaluation of the SAP, Interim report/memorandum, and Full RFI Report.
Gloria Toro-Agrait	PREQB Environmental Permits Officer/Provides Puerto Rico regulatory input	PREQB	Participates in scoping, data review, and evaluation of the SAP, Interim report/memorandum, and Full RFI Report.
Felix Lopez	USFWS	USFWS	Provides ecological project assistance for Puerto Rico.

Name	Title/Role	Organizational Affiliation	Responsibilities
Doug Pocze	USEPA Region 2 RPM/ Provides USEPA regulatory input	USEPA Region 2	Participates in scoping, data review, and evaluation of the SAP, Interim report/memorandum, and Full RFI Report.
Phil Flaz	Resource Conservation and Special Programs Section	USEPA Region 2	Oversees programs for USEPA Region 2.
Jose Font	USEPA Caribbean Office Director	USEPA Region 2 Caribbean Office	Provided regulator guidance.
Connie Crossley	USEPA Consultant	Booze Allen Hamilton	Provides technical support for USEPA.
Dan Kalal	NAPR OIC/Manages Site Activities	NAPR	Participates in scoping, data review, and evaluation of the SAP, Interim report/memorandum, and Full RFI Report.
Pedro Ruiz	POC	NAPR/NAVFAC Atlantic	Participates in scoping, NAPR point of contact during field activities.
J.Mentz	Consultant Activity Manager	Michael Baker	Maintains NAPR Administrative Record, including upload of UFP-SAP.
Linda Klink	PM/Manages project activities	Tetra Tech	Oversees project, financial, schedule, and technical day-to-day management of the project.

Name	Title/Role	Organizational Affiliation	Responsibilities
Ralph Brooks	UXO/MEC Manager/ Manages Corporate MEC hazards and risks	Tetra Tech	Oversees selection of qualified UXO personnel, establishes overall QC program for UXO activities, and addresses UXO-related issues as identified by field personnel.
James Rossi	Project UXO Manager	Tetra Tech	Oversees implementation of daily UXO-related activities.
TBD	FOL/SSO/ Manages field operations	Tetra Tech	As FOL, supervises, coordinates, and performs field sampling activities. As SSO, responsible for on-site project specific health and safety training and monitoring site conditions. Details of these responsibilities are presented in the HASP.
Thomas Johnston	QAM/Manages Corporate QA program and implementation	Tetra Tech	Ensures that quality aspects of the CLEAN program are implemented, documented, and maintained.
Kelly Carper	Project Chemist/ Provides technical coordination with laboratories	Tetra Tech	Participates in project scoping, prepares laboratory scopes of work, and coordinates laboratory-related functions with laboratories. Oversees data quality reviews and QA of data validation deliverables.
Joseph Samchuck	DVM/ Manages Corporate QA Program and Implementation	Tetra Tech	Manages data validation activities within Tetra Tech, including ensuring QA of data validation deliverables, providing technical advice on data usability, and coordinating and maintaining the data validation review schedule.

Name	Title/Role	Organizational Affiliation	Responsibilities
Matt Soltis	HSM/ Manages Corporate Health and Safety Program	Tetra Tech	Oversees CLEAN Program Health and Safety Program.
Brian Richard	Laboratory PM	Empirical Laboratories	Representative for laboratory and analytical issues.
Lidya Guilizia	Laboratory PM	TestAmerica Laboratories	Representative for laboratory and analytical issues.

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

SAP Worksheet #8 -- Special Personnel Training Requirements Table

(UFP-QAPP Manual Section 2.4.4)

Project Function	Specialized Training by Title or Description of Course	Training Provider	Training Date	Personnel/ Groups Receiving Training	Personnel Titles/ Organizational Affiliation	Location of Training Records/Certificates
UXO Avoidance	Various training elements as required in DoD Explosives Safety Board (DDESB) Technical Paper (TP)-18	DoD or other approved formal course	Current	UXO Technicians supporting UXO avoidance	UXO Technicians/ Tetra Tech	Tetra Tech project office and field office

1 Each site worker will be required to have completed appropriate Hazardous Waste Operations and Emergency Response (HAZWOPER) training underspecified in Occupational Safety and Health Administration (OSHA) 29 Code of Federal Regulations (CFR) 1910.120(e). Project-specific safety requirements are addressed in greater detail in the site-specific HASP.

SAP Worksheet #9 -- Project Scoping Session Participants Sheet

(UFP-QAPP Manual Section 2.5.1)

Project Name: Full RFI, SWMU 77 **Projected Date(s) of Sampling:** April/May 2012 **Project Manager:** Linda Klink	**Site Name:** SWMU 77 – Pistol Range Subarea, Former Pistol Range Subarea, Detonation Area Near Concrete Pad Subarea, Rifle Range Subarea, Potential OB/OD Subarea, Potential Munitions Trench Subarea **Site Location:** NAPR, Ceiba, Puerto Rico

Date of Session: September 29, 2011
Scoping Session Purpose: The purpose of the meeting was to discuss a general project approach and overall schedule, obtain other relevant supplemental information available to support update of the Conceptual Site Model (CSM), develop the Full RFI field sampling program, and revise project DQOs.

Name	Title	Affiliation	Phone Number	E-Mail Address	Project Role
Stacin Martin	RPM	NAVFAC Atlantic	757.322.4780	stacin.martin@ navy.mil	RPM
Mark Davidson	BEC	BRAC PMO SE	843.743.2124	mark.e.davidson@ navy.mil	BEC
Gloria M. Toro-Agrait	RPM	PREQB	787.767.8181 x3586	gloriatoro@ jca.pr.gov	State Regulator
Wilmarie Rivera	RPM	PREQB	787.767.8181 x6129	wilmarie.rivera@ jca.pr.gov	State Regulator
Linda Klink	PM	Tetra Tech	412.921.8650	linda.klink@ tetratech.com	PM
Pedro Ruiz	NA	NAPR/ NAVFAC Atlantic	757.286.9139	NA	NAPR POC
Jamie Butler*	PM	CH2MHill	NA	jamie.butler@CH2M. com	Consultant
Mark Kimes*	Activity Manager	Michael Baker Jr., Inc.	412.269.2009	mkimes@ mbakercorp.com	Consultant
Scott Moffit*	PM	Michael Baker Jr. Inc.	NA	smoffit@mbakercorp .com	Consultant
Timothy Gordon	RPM	USEPA Region 2	212.637.4167	gordon.timothy@ epa.gov	RPM
Michelle Coffman	Munitions Scientist	Tetra Tech	412.921.8549	michelle.coffman@ tetratech.com	Technical Support
Commander Dan Kalal	OIC	NAPR	787.685.3450	kalald@ napr.navy.mil	NAPR OIC
Cathy Dare (via phone)	USEPA Consultant	TechLaw	NA	NA	USEPA Consultant
Travis Kline (via phone)	USEPA Consultant	TechLaw	NA	NA	USEPA Consultant
Tom Hall (via phone)	USEPA Consultant	TechLaw	NA	NA	USEPA Consultant

* Present at meeting for other NAPR sites under discussion.

Comments/Discussions:

Pertinent to all SAPs under discussion at the meeting, groundwater needs to be addressed consistently and consider non-potability. After a groundwater evaluation paper/memo is developed to address this topic, it can be used to assess SWMU 77 (when groundwater is evaluated for this SWMU). If groundwater samples are collected at SWMU 77 and if the SWMU 77 data meet the criteria, this site may be evaluated as a non-potable/non-usable groundwater source and for industrial land use. Puerto Rico Water Quality Standards are an applicable or relevant and appropriate requirement (ARAR).

Tetra Tech completed the Phase I RFI for SWMU 77. The Full RFI UFP-SAP will address data gaps and unresolved comments on the Phase I RFI. The Phase I RFI data will be combined with the Full RFI data for evaluation. Both human health and ecological risk assessments will be conducted as part of the Full RFI. (Tetra Tech, 2011, Phase I results are presented in Appendix B-3 of Volume I and Attachment 1-4 of Volume II)

A Tier II UFP-SAP is in preparation for the Munitions Constituents (MC) portion of the SWMU 77 Full RFI. Stacin Martin informed the team that Tier II UFP-SAPs are streamlined versions of full UFP-SAPs. The Navy will provide the regulators with the Navy's requirements/guidance for Tier II SAPs, and the regulators will make a decision as to whether this is acceptable. [The Navy independently decided after the meeting to convert the Tier II SAP in progress to a Tier I SAP so as not to hold up progress on the project.]

The team discussed how groundwater should be evaluated during the Full RFI and the placement of monitoring wells in terms of topography, subarea placement, and access to subareas. It was suggested and discussed by the team that because the munitions and soil investigations might be conducted during this phase of investigation and that groundwater could be investigated in another phase, it may be premature to determine monitoring well locations at this point. It was agreed by the team that groundwater will be evaluated after the munitions and soil results are known, and, if necessary, the groundwater investigation can be handled via an addendum to the Full RFI UFP-SAP for munitions and soil. Further, it was suggested that the Navy consider evaluating the SWMU 77 area/peninsula to see if there are discharges or seeps into the surface water body that surrounds SWMU 77 on three sides (a similar type of investigation was conducted at Vieques Island). Where would there be exposure to groundwater, what receptors would be exposed to groundwater? Most likely exposure would be to ecological receptors as a result of groundwater discharge to surface water. However, upon further discussion, it was agreed that discharges, if any, would likely be low in concentration and subsequently

greatly diluted by the sea. SWMU 77 future land use will be as an ecotourism area (e.g., camping activities), and human exposure to groundwater under this land use is unlikely.

Facility background soil concentrations were discussed in regards to SWMU 77. It was determined that facility background levels would be applicable for use at SWMU 77; most likely the weathered bedrock soil levels would be appropriate for SWMU 77. Because facility-wide background concentrations are applicable to this area, site-specific background samples do not need to be collected for SWMU 77. Those site-specific background samples proposed in the seed package handout will be deleted from the Full RFI.

The Full RFI UFP-SAP will need to explain the phased approach to the field investigation, i.e., the munitions investigations will be conducted and then the soil investigation at subareas where both are proposed. After these phases of investigation are complete, the need for a groundwater investigation will be evaluated.

The overall investigative approach for the SWMU 77 Full RFI, as presented in the seed package handout, was reviewed, and the following items were noted:

- Samples will be analyzed for additional suites of analytes (Appendix IX), as necessary, depending on the results of the intrusive investigations at the Potential OB/OD Subarea and Potential Munitions Trench Subarea.

- Former Pistol Range Subarea: Soil sample locations will be revised to reflect a “cross” pattern rather than placing soil samples in two rows as shown in the seed package handout.

- Rifle Range Subarea: The Phase I detector-aided survey area for the wooded embankment will be expanded during the Full RFI. Four transects, approximately 50 feet apart, will be added running north-northeast beginning at the edge of the Phase I RFI meandering path survey area (Tetra Tech, 2011, results are presented in Attachment 1-4 of Volume II).

- Potential OB/OD Subarea and Potential Munitions Trench Subarea: The regulators had questions about some of the proposed MEC intrusive hand-dig locations and whether some need to be moved or if some need to be added to the southwestern cluster area. Hand digs will continue to a maximum depth of 2 feet below ground surface (bgs), and test pits (mechanical excavation) will continue to a maximum depth of 4 feet bgs unless bedrock is encountered. Hand digs and test pits will terminate if bedrock is reached prior to achieving the depths listed above. The UFP-SAP will contain decisions/a

decision tree to determine if landfill activity has occurred in an area and how to decide if additional analytical parameters are warranted.

- Potential Munitions Trench Subarea: Test pits (mechanical excavation) will continue to a maximum depth of 4 feet bgs. If no munitions-related items or evidence of landfilling is found to this depth, a magnetometer will be used to survey the bottom of the trench to determine if any anomalies are present at deeper depths. This information will be used during evaluation of remedial actions as part of the Corrective Measures Study (CMS). Subsurface soil samples will be collected from each test pit in biased locations dependent on the results of the intrusive investigations. A minimum of one subsurface soil sample will be collected from each of the proposed test pits.

USEPA requested an interim report/memorandum so that the team can address groundwater and munitions characterization of the hillside at the Rifle Range Subarea. An interim review of results and recommendations should be included in this report. A full risk assessment does not need to be included, but the CSM should be refined in the report to assess exposure pathways. The format of this report will be presented in the Full RFI UFP-SAP (see Worksheet 14).

Consensus Decisions:

1. Soil Potential to Impact Groundwater: All contractors should include the Protection of Groundwater Soil Screening Levels (SSLs) when screening soil concentrations for their subject SAPs to assess leaching potential for contaminants found in soil.

2. It was agreed to continue to call SWMU 77 the “Small Arms Range” rather that the name provided in the RCRA permit.

3. SWMU 77 groundwater will be deferred to a later phase of investigation, after the munitions and soil results are known, if determined to be necessary after evaluation of these results.

4. Background: The upper value of mean concentration from the Baker background report will be used in the risk assessment, as previously agreed (Baker (CH2MHill & CDM), 2010). Risk assessment will use this value and often the maximum concentration as well. A Revised Final Background Study Report with Addendum has been issued by Baker. Facility background levels are applicable for use at SWMU 77 and can be used in evaluating background risk versus total risk. Therefore, site-specific background samples will not be collected at SWMU 77 during the Full RFI.

5. Risk Assessment: Risk assessment should use the Risk Assessment Guidance for Superfund (RAGS) tables (tables for total risk, site background/anthropogenic risk, site-related risk) (USEPA, 2001). An unrestricted use scenario and an industrial scenario will need to be evaluated for those sites where industrial land use is appropriate. The team discussed risk assessment levels and determined the following thresholds:

   - 10^{-4} should be used for industrial land use.
   - 10^{-6} should be used for residential land use.
   - If calculated risks are at/greater than 10^{-6}, then it becomes a risk management question for the team to discuss.

6. Potential Groundwater Use: Sites should be evaluated on an individual basis to determine whether groundwater at the site is non-potable/non-usable. Data to be evaluated may include total dissolved solids (TDS) and salinity levels and groundwater yields from wells. After the groundwater evaluation paper/memo is developed, if groundwater is sampled at SWMU 77 and if the SWMU 77 data meet the criteria, the site may be evaluated as a non-potable/non-usable groundwater source and for industrial land use. The Navy and their contractors will develop criteria and rationale to be used across NAPR to determine whether groundwater is non-potable/non-usable. A report/memo will be developed that will explain how to evaluate the usability of groundwater at NAPR. Note that since the meeting the subject report/memo has been developed but the issue has not yet been resolved. Regardless, Puerto Rico Water Quality Standards are an ARAR.

Action Items:

1. Mark Kimes (Michael Baker Jr., Inc.) will send a link for the Revised Final Background Report with Addendum (Baker and CH2MHill, 2010), to all team members.

2. Stacin Martin (NAVFAC Atlantic) will send a copy of the Navy guidance on Tier II UFP-SAPs to the team for review, and the team will make a decision on whether the document will be a Tier I or Tier II SAP. [The Navy independently decided after the meeting to convert the Tier II SAP in progress to a Tier I SAP so as not to hold up progress on the project.]

3. Stacin Martin (NAVFAC Atlantic) will e-mail USEPA revised document submittal dates for their concurrence and will follow up with the formal request to change document submittal dates.

4. The Navy and its contractors will prepare a paper/memo concerning evaluation of groundwater (non-potable/non-usable) at NAPR that will be sent to the regulators by October 28, 2011, for review. The paper/memo will develop criteria and rationale to be used across NAPR to determine whether groundwater is non-potable/non-usable. Note that since the meeting the subject report/memo has been developed but the issue has not yet been resolved. Regardless, Puerto Rico Water Quality Standards are an ARAR.

5. The Tetra Tech Project Geophysicist will review the test pit and hand-dig locations at the Potential OB/OD Subarea southwestern area cluster to determine if additional hand digs should be added and/or if some test pit or hand-dig locations should be moved.

SAP Worksheet #10 – Conceptual Site Model

(UFP-QAPP Manual Section 2.5.2)

10.1 GENERAL FACILITY AND SITE BACKGROUND

NAPR, formerly known as Naval Station Roosevelt Roads (NSRR), is located on the eastern coast of Puerto Rico in the municipality of Ceiba, approximately 33 miles southeast of San Juan (Figure 10-1). The nearest major town is Fajardo, which is 10 miles north of the station. The facility occupies approximately 8,600 acres, and except for two adjacent unpopulated islands (Pineros and Cabeza de Perro) off the northeastern coast of the facility, it is bordered on the north, south, and east by the marine waters of the Atlantic Ocean, Caribbean Sea, and Vieques Passage.

The property was acquired by the Navy between 1941 and 1945. In 1941, Fort Bundy was established in the southwestern portion of the property as the United States Army headquarters for coastal artillery emplacements. In 1943, the northeastern portion of NSRR was commissioned as a Naval Operating Base to provide training for Atlantic Fleet Operations in the Caribbean. Both areas remained active until the end of World War II. Between the end of World War II and 1957, Fort Bundy and NSRR were deactivated and reactivated several times. In 1957, NSRR was reactivated as home of the new Atlantic Fleet Guided Missile Training Operations Center, which provided missile support to facilities and missile training to the Atlantic Fleet's submarine units (NAVFAC Atlantic, 2005).

In 1963, the Atlantic Fleet Weapons Training Facility (AFWTF) was commissioned to support communications and weapons technology, maintenance and operation of weapons testing and exercises, and military maneuvers training. The administrative functions of AFWTF, which were carried out from NSRR property, peaked in 1969 and declined significantly thereafter.

NSRR was officially closed on March 31, 2004; the Navy established NAPR to serve as the caretaker of the property associated with NSRR and to assist in transfer of the property (NAVFAC Atlantic, 2005).

10.2 SITE BACKGROUND AND PHYSICAL SETTING

10.2.1 Site History

SWMU 77 – Small Arms Range, covers approximately 66 acres and is located on the peninsula of Punta Medio Mundo at the northeastern boundary of the facility (Figure 10-2). Historical records and interviews indicate that SWMU 77 was used as a small arms range, and additionally, solely based on analysis of

aerial photographs, potentially for munitions disposal or detonation. SWMU 77 has been divided into six subareas with different potentials for MC and/or MEC contamination based on historical site literature and project team experience on similar sites. Specifically, SWMU 77 subareas include the Pistol Range, Former Pistol Range, Detonation Area Near Concrete Pad (apparently used for a one-time detonation event), Rifle Range (including a short-yardage range formerly used as a pistol range), Potential OB/OD, and Potential Munitions Trench (Figure 10-2).

Analysis of aerial photographs from 1936 to 1999 aided in identifying some of the SWMU 77 subareas and aided in estimating periods of operation for each. The historical aerial photographs and associated analysis are included in Appendix B of this SAP, along with additional supplemental historical information. Estimated operational periods for the SWMU 77 subareas identified during Phase I of the RFI are presented below.

Table 10-1
Subarea Estimated Dates of Operation

SWMU 77 Subarea	Estimated Dates of Operation	
	Start(1)	End
Pistol Range Subarea	By 1976	January 1, 2010(2)
Former Pistol Range Subarea	By 1962	By 1964
Detonation Area Near Concrete Pad Subarea	By 1995 (earliest 1985)	January 1, 2010(2)
Rifle Range Subarea (Including short-yardage pistol range)	By 1958 and as early as 1940 (1985)	January 1, 2010(2)
Potential OB/OD Subarea	Exact date unknown. By 1976, as early as 1961	Exact date unknown. By 1985
Potential Munitions Trench Subarea	By 1958, as early as 1940	By 1961

1 The earliest start date is based on the facility military use start date of 1940.
2 See letter documentation provided in Appendix B.

10.2.2 Location and Setting

The pistol range within SWMU 77 has been periodically relocated on the Punta Medio Mundo peninsula since initial construction, which has resulted in the presence of several pistol-related subareas (Former Pistol Range, Pistol Range, and short-yardage range included as part of the Rifle Range subarea).

10.2.3 Current Land Use and Anticipated Future Land Use

SWMU 77, Small Arms Range was closed on January 1, 2010. Several of the subareas, as shown on Table 10-1, became inactive prior to closure of SWMU 77. The subareas are no longer maintained. According to the Supplemental Environmental Assessment, SWMU 77 is located in Zone 5, designated as an Environmental Retreat and the anticipated future use as an environmental retreat area includes hostels, cabanas and campsites (Navy, 2011).

10.3 SITE ENVIRONMENTAL CHARACTERISTICS

The following sections summarize the most pertinent information related to site physical and environmental characteristics. Much of the information discussed is summarized from the Phase I/II Environmental Condition of Property Report (NAVFAC Atlantic, 2005), and associated key figures are presented in Appendix B.

10.3.1 Climate

NAPR has a tropical-marine climate characterized by minimal temperature fluctuations, relatively moderate humidity, and frequent rain showers. The rainy season is typically defined as May through November. Hurricane season is from June 1 through November 30.

10.3.2 Topography and Hydrology

Ground surface elevations within NAPR range from 0 to 131 feet above mean sea level. At SWMU 77, the access road entrance area is low lying, but otherwise SWMU 77 is hilly and vegetated except where areas have been cleared and leveled for operational purposes. Vegetative cover limits the amount of erosion that occurs at the site. No floodplains or significant surface water bodies including lakes, ponds, streams, or creeks are present within SWMU 77. However, the site is a peninsula bordered by water on all sides except the west.

10.3.3 Geology

Except for tidal swamp soils associated with the access road entrance area, SWMU 77 consists of Descalabrado and Guyana soils, which consist of shallow, well-drained, moderately permeable soils that formed in moderately fine-textured residuum derived from volcanic rock. Slopes are steep, ranging from 5 to 60 percent. These soils have no value as cropland and are suited only for low-intensity grazing or

wildlife habitat. The underlying geology of NAPR is predominantly volcanic, composed of lava and tuff, as well as sedimentary rocks derived from discontinuous beds of limestone (NAVFAC Atlantic, 2005).

10.3.4 Vegetation

The three primary vegetative cover types found at NAPR include upland forest, mangrove, and beach strand associations. At SWMU 77, upland forests generally consist of stands of relatively small trees, with grasses and shrubs prevalent. The upland forest vegetation has minimal commercial value but does provide valuable watershed protection by preventing erosion and promoting groundwater recharge. SWMU 77 mangrove areas are limited to the access road entrance area consisting of low-lying tidal swamps. Three species of mangroves occur at the facility, the black (*Avicennia germinans*), red (*Rhizophora mangle)*, and white (*Laguncularia racemosa*) mangrove. The red mangrove flourishes in areas of high salinity and is generally found in pure stands on the seaward edge of a mangrove forest. The black mangrove is usually found just landward of the pure red mangrove stands. The white mangrove is found in upland areas that are rarely subject to inundation by the sea. Beach strand ecosystems are limited to the fringe area of SWMU 77 and are outside of the subareas under investigation.

10.3.5 Hydrogeology

Although no groundwater information is available for SWMU 77, the nearby marine waters suggest that salt-water intrusion may have occurred on the peninsula. No drinking water wells have been installed at SWMU 77.

10.3.6 Ecology and Natural Resources

10.3.6.1 Endangered and Special Status Species

NAPR supports the plant (*Cobana negra*) classified as threatened in 1990 by USFWS. The black mangrove (*Avicennia germinans)* is also classified as threatened under federal law. Because the mangrove areas are considered wetlands, they are conservation zones protected under federal law and are critical habitat for the endangered yellow-shouldered blackbird (*Agelaius xanthomus*).

Because of its island ecosystem, abundant and diverse species of terrestrial vertebrates are not found on Puerto Rico. The facility supports several wildlife that have been listed by either the federal or commonwealth governments as threatened, endangered, or vulnerable (commonwealth only), including: five sea turtle species [green (*Chelonia mydas)*, loggerhead (*Agelaius xanthomus)*, hawksbill

(*Eretmochelys imbricate*), leatherback (*Dermochelys coriacea)*, and olive ridley (Lepidochelys olivacea)], one snake [Puerto Rican boa constrictor (*Epicrates inornatus)*], 12 birds; and one mammal [West Indian manatee (*Trichechus manatus*)]. The species observed at the facility that are classified as endangered under federal law, any of which could be present within the boundary of SWMU 77, include hawksbill and leatherback sea turtles, Puerto Rican boa, yellow-shouldered blackbird, brown pelican, and West Indian Manatee.

The major mammal population in and near NAPR consists of introduced species such a stray dogs and cats, Norway and gray-bellied rats, mice, and mongooses. The reptile population (especially snakes) has been significantly reduced because of the large mongoose population.

Thirteen species of bats are known to occur on Puerto Rico. None of the bats found on Puerto Rico are exclusive to the island nor are they listed under provisions of the Endangered Species Act of 1973. The bat species known to occur on Puerto Rico include the following:

- Fruit-eating bats: Jamaican fruit bat (Artibeus jamaicensis), Antillean fruit bat (*Brachyphylla cavernarum*), and red fig-eating bat (*Stenoderma rufum*).

- Nectivorous bats: brown flower bat (*Erophylla sezekoni bombifrons*) and greater Antillean long-tongued bat (*Monophyllus redmani*).

- Insectivorous bats: Antillean ghost-faced bat (*Mormoops blainvillii*), Parnell's mustached bat (*Pteronotus parnellii*), sooty mustached bat (*Pteronotus quadridens*), big brown bat (*Eptesicus fuscus*), red bat (*Lasiurus borealis*), velvety free-tailed bat (*Molossus molossus*), and Brazilian free-tailed bat (*Tadarida brasiliensis*).

- Piscivorous bats: Mexican bulldog bat (*Noctilio leporinus*).

10.3.6.2 Wetlands

According to USFWS, three primary types of wetlands occur at NAPR. Wetlands are limited to the outer fringes of SWMU 77 and do not occur within any of the subareas under investigation but are discussed because they are inside the boundaries of SWMU 77.

The wetland classification M1AB3L describes the coastal wetlands at the eastern, northern, and western borders of SWMU 77. These wetlands are marine systems with high-energy coastlines and salinities

exceeding 30 parts per thousand (ppt). The habitats are permanently flooded with tidal water and include plants that grow principally on or below the surface of the water, including vascular species commonly referred to as grass flats.

Wetlands with the classification of E2FO3N occur slightly inland from the coast at the southeastern and northwestern portions of the site. These wetlands are deepwater tidal habitats and adjacent tidal wetlands that are influenced by water runoff and often semi-enclosed in land. Plants consist of woody vegetation that is at least 6 meters tall, including angiosperms with relatively wide flat leaves that generally remain green.

A third type of wetland with a classification of M2US2P occurs on the northern tip of the site. These wetland habitats have unconsolidated substrates with less than 75-percent areal cover of stones, boulders, or bedrock and less than 30 percent areal vegetation coverage. The unconsolidated particles that are smaller than stones are predominantly sand. Tidal waters flood the land less often than daily.

10.3.7 Cultural and Natural Resources

Three locations (RR-9, RR-10, and RR-11) within SWMU 77 have previously been identified as archeological sites and have been under investigation. These locations are not shown on figures to safeguard the locations from looters, but maps were provided to the Phase I RFI field team and will be provided to the Full RFI field team to ensure that the areas are not disturbed as part of the Full RFI work effort. The Puerto Rico State Historic Preservation Officer (SHPO) has concurred with the Navy's findings that RR-9 is eligible for the National Register of Historic Places (NRHP) and that RR-10 and RR-11 are not eligible for the NRHP.

10.3.8 Water Resources

The available groundwater on NAPR is generally acceptable for most industrial and commercial uses. The groundwater has a predominance of calcium, bicarbonate, and magnesium ions but at concentrations within normally acceptable ranges. As the depths of wells increase and distances to the sea decrease, the levels of salt-water intrusion rise. No wells have been installed within NAPR. Several wells were installed upgradient of NAPR in Ceiba but were later abandoned due to high levels of salinity. Under a 1942 agreement, NAPR gets raw water from the Rio Blanco watershed.

10.4 PREVIOUS ENVIRONMENTAL INVESTIGATIONS

Phase I RFI (Tetra Tech, 2011, Phase I results are presented in Appendix B-3 of Volume I and Attachment 1-4 of Volume II)

A Phase I RFI was conducted at SWMU 77 in 2010 (Tetra Tech, 2011). The Phase I RFI approach included the use of surface and subsurface geophysical equipment to locate metallic items that could be suspect MEC, Material Potentially Presenting an Explosive Hazard (MPPEH), or non-munitions-related debris. Initially, visual and UXO detector-aided surface surveys were performed at four of the six subareas (Rifle Range Subarea, Detonation Area Near Concrete Pad Subarea, Potential OB/OD Subarea, and the Potential Munitions Trench Subarea) to investigate the presence of surface items. Following these analog detector-aided surveys, a digital geophysical mapping (DGM) survey was completed at two of the subareas (Potential OB/OD Subarea and the Potential Munitions Trench Subarea) where subsurface operations/disposal was of concern to identify potential subsurface anomalies. Intrusive investigations were not conducted during the Phase I RFI. Analysis of surface and subsurface survey results guided the positioning of MC soil sampling locations, anomaly avoidance was practiced during sampling. The MC soil sampling effort followed the analog detector-aided surface surveys and digital geophysical investigations and included collection of environmental samples (surface soil and subsurface soil) in areas most likely to have been impacted by munitions-related activities at all subareas. Finally, areas surrounding each of the subareas were walked to observe whether any additional suspect areas were evident at SWMU 77. The recommendation of the Phase I RFI was to move forward to a Full RFI for all of the subareas at SWMU 77.

Subarea-specific MC results are discussed below and in the CSM in Section 10.5. Appendix B-3 presents the results tables and figures for all of the subareas and MEC finds table. SWMU 77 site visit and Phase I RFI photographs are also presented in Appendix B-4.

Pistol Range Subarea

Nitroglycerin (NG) at the firing lines and metals (antimony, arsenic, copper, lead, and zinc) and explosives at the berm area were investigated in surface soil during the Phase I RFI. Based on the findings, NG was determined to be neither a human health nor ecological issue. XRF sampling for lead was also conducted at this subarea. For the berm, concentrations of metals, particularly the primary contaminant lead, were elevated [maximum lead concentration of 58,400 milligram per kilogram (mg/kg)] and present both a human health and ecological risk issue. A high density of bullets and fragments was found on the main side of earthen berm directly behind the target areas and was much less prevalent on the far right

side to the north of the earthen berm. Similarly, lead contamination in soil was much greater on the main side of the berm compared to the northern side.

Based on Phase I results, a Full RFI was recommended to determine the lateral and vertical extent of metals (antimony, arsenic, copper, lead, and zinc) contamination in and around the berm. Moreover, the high density of bullets observed on the berm directly behind the targets will ultimately need to be addressed.

Former Pistol Range Subarea

NG and metals (antimony, arsenic, copper, lead, and zinc) were investigated during the Phase I RFI. Surface soil was investigated on each side of the subarea to investigate potential historical berm locations and inside the estimated historical range boundaries to obtain data concerning firing lines. Measured NG concentrations did not exceed the Project Action Limit (PAL) in any of the soil samples. XRF sampling for lead was also conducted at this subarea. In samples from the berm, concentrations of metals, particularly the primary contaminant lead, were elevated (maximum concentration of 12,295 mg/kg) and present both a human health and ecological risk issue. The most highly contaminated soil was encountered in the northwestern portion of the subarea. A low density of bullets and fragments was observed at this subarea.

Based on Phase I results, a Full RFI was recommended to determine the lateral and vertical extent of metals chemicals of potential concern (COPCs) (antimony, arsenic, copper, lead, and zinc) located in and around the northwestern portion of the subarea.

Detonation Area Near Concrete Pad Subarea

During the Phase I RFI, surface soil was investigated at two biased locations, the remaining depression area where the one-time detonation occurred and the low-lying drainage area for the subarea. Samples were analyzed for select metals, explosives, and NG. A human health and ecological screening level hazard/risk assessment of chemical concentrations detected in surface soil was conducted in the Phase I RFI (Tetra Tech, 2011), only lead was found to be of concern. Lead concentrations in Phase I data were less than human health screening levels and greater than ecological screening levels. Although lead concentrations were not elevated at the Detonation Area Near Concrete Pad Subarea (40.7 mg/kg maximum), lead may present an ecological risk. A Full RFI was recommended to further characterize and delineate metals considered to be COPCs RFI (antimony, arsenic, copper, lead, and zinc).

Prior to the MC investigation, visual and UXO detector-aided surface surveys were performed at the Detonation Area Near Concrete Pad Subarea to investigate the presence of surface items. No MEC/MPPEH was discovered during the Phase I RFI of the Detonation Area Near Concrete Pad Subarea. No evidence of subsurface detonation activities was present other than the one-time event of concern. No subsurface anomalies were present within the depression area where the one-time event occurred, which indicates the one-time detonation was complete and no MEC/MPPEH remained from the detonation.

Rifle Range Subarea

During the Phase I RFI, NG at the firing lines and metals (antimony, arsenic, copper, lead, and zinc) and explosives at the berm/embankment areas were investigated in surface soil. Based on the findings, NG presented a potential risk at the 200-yard firing line of the Rifle Range, which may have been more heavily used than the other firing lines, where risk was determined to be acceptable. XRF sampling for lead was also conducted at this subarea. For the earthen constructed berm area/wooded embankment, metals, particularly the primary contaminant lead, were present at elevated concentrations compared to the PAL. Maximum lead concentrations for the constructed earthen berm and wooded embankment were 89,000 and 118,000 mg/kg, respectively. A high density of bullets was observed on the constructed earthen berm and also, a high density of bullets may be present on the wooded embankment (heavily wooded vegetation prevented visual observation) due to its location relative to the constructed earthen berm. The explosive cyclotrimethylenetrinitramine (RDX) was detected but at concentrations less than the PAL.

Based on Phase I results, a Full RFI was recommended to determine the lateral and vertical extent of MC, in particular metals (antimony, arsenic, copper, lead, and zinc) in and around the constructed earthen berm and wooded embankment and to further investigate NG at the 200-yard Rifle Range firing line.

Prior to the MC investigation, visual and UXO detector-aided surface surveys were performed at the Rifle Range Subarea to investigate the presence of surface items. MPPEH items previously observed on the constructed earthen berm and the grassy strip at the toe of the wooded embankment during site walks in support of Phase I RFI SAP planning were removed when SWMU 77 was closed in January 2010; no MPPEH items remain on the ground surface in this area. For the wooded embankment, eight munitions items were encountered during the meandering path analog detector aided survey of the Phase I RFI; one of the items, a CS M651 grenade, was classified as MEC. Those MEC/MPPEH items warranting detonation were addressed by Mayport EOD on August 19, 2010 (EOD Report presented in Volume II,

Attachment 1). The detector-aided survey of the wooded embankment entailed meandering pathways through thickly vegetated areas did not provide 100 percent coverage; therefore, MEC/MPPEH items may still be present in this area. The Phase I RFI information was determined to be adequate to recommend a path forward for surface MEC/MPPEH at the wooded embankment without additional investigation during the Full RFI. More than 50 random subsurface anomalies were identified during the detector-aided survey of the earthen constructed berm area and wooded embankment. Although MEC/MPPEH is not expected in the subsurface, there is a probability that the subsurface anomalies could be MEC/MPPEH considering the history of MEC/MPPEH in and around the area. A Full RFI was recommended to include intrusive investigation to determine the source of the subsurface anomalies.

Potential OB/OD Subarea

During the Phase I RFI, the presence of NG, metals (antimony, arsenic, copper, lead, and zinc), and explosives in soil was investigated. Based on the results of the Phase I RFI, during which surface and subsurface soil were investigated in anomalous areas identified during the geophysical survey, only lead was of potential ecological concern. The PAL for lead is the facility background concentration, and although lead concentrations are not elevated at the Potential OB/OD Subarea (74 mg/kg maximum), lead may present an ecological risk. The data are inconclusive until intrusive subsurface investigation is conducted.

Based on Phase I results, a Full RFI was recommended to investigate areas where subsurface materials are encountered during intrusive investigation that could be sources of contamination, either MC COPCs (antimony, arsenic, copper, lead, and zinc), explosives, or non-MC related will be analyzed in soil. Also, additional soil sampling is warranted in anomaly areas and additional locations within the historical berm locations will be targeted to adequately characterize these areas.

Prior to the MC investigation, visual and UXO detector-aided surface surveys were performed at the Potential OB/OD Subarea to investigate the presence of surface items. No MEC/MPPEH was discovered on the ground surface during the Phase I RFI of the OB/OD Subarea. Subsurface anomalies were indicated during the analog detector-aided survey; the locations generally matched that of the electromagnetic (EM) geophysical surveys subsequently conducted. For the OB/OD Subarea, EM geophysical data was collected (EM-61 inphase response, EM-31 quadrature response, and EM-31 inphase response). The EM-61 results were most instructive of shallow anomalies; 58 anomalies were identified and most were indicative of individual items, although four clusters of anomalies were identified. The EM-31 data was more instructive of potential deeper anomalies. The source of the anomalies is unknown and may be munitions related, non-munitions debris, or simply outcrops of volcanic bedrock

present at SWMU 77. Weathered bedrock was exposed at the land surface, particularly at steep embankments and, moreover, refusal due to bedrock during soil boring occurred at shallow depths. Although a limited subsurface investigation was conducted, bedrock was encountered consistently at shallow locations throughout the subarea; therefore, it is believed that if subsurface disposal occurred, it would have taken place at shallow rather than deep subsurface. There is also a possibility that landfilling activities may have occurred at the subarea. Surface OB/OD operations may have also occurred at this site, although not supported by the findings of the Phase I RFI. A Full RFI was recommended to include intrusive investigation of the subsurface anomalies encountered during the Phase I RFI to determine the source of the anomalies. The intrusive investigation should focus on, but not be limited to, the four clusters of anomalies encountered.

Potential Munitions Trench Subarea

During the Phase I RFI, the presence of NG, metals (antimony, arsenic, copper, lead, and zinc), and explosives in soil were investigated. Phase I sampling was limited in that only a few surface soil samples were collected; no soil concentrations exceeded the PALs. The data were determined to be inconclusive until an intrusive subsurface investigation is conducted.

Based on Phase I results, a Full RFI was recommended to collect biased samples if and where subsurface materials are encountered during intrusive investigation that could be sources of contamination, either MC COPCs (antimony, arsenic, copper, lead, and zinc), explosives, or non-MC related will be analyzed in soil.

Prior to the MC investigation, visual and UXO detector-aided surface surveys were performed at the Potential Munitions Trench Subarea to investigate the presence of surface items. No surface MEC/MPPEH was discovered during the Phase I RFI of the Potential Munitions Trench Subarea. More than 70 subsurface anomalies were encountered during the detector-aided survey. The general locations matched that of the EM geophysical surveys subsequently conducted over the main suspect trench area in the eastern portion of the subarea. Geophysical survey data were collected for the EM-61 inphase response, EM-31 quadrature response, and EM-31 inphase response. For the northeastern side of the subarea, lines of anomalies were identified trending northwest to southeast, aligned in the same direction as the orientation of the suspect trenches shown on the historical aerial photographs. For the western portion of the subarea, no subsurface anomalies were encountered during the detector-aided survey and the area was too thickly wooded to conduct a geophysical survey. The source of the anomalies detected cannot be determined from the geophysical survey alone. Moreover, anomalies are not necessarily indicative of buried metal but instead could be reflective of outcrops of naturally occurring volcanic

bedrock present at SWMU 77. Weathered bedrock was exposed at the Potential Munitions Trench Subarea land surface, particularly at steep embankments and, moreover, refusal due to bedrock during soil boring occurred at shallow depths. A limited subsurface investigation was conducted; however, it is unlikely that subsurface disposal would have been conducted if bedrock is encountered consistently at shallow locations throughout the subarea. A Full RFI was recommended to include intrusive investigation to determine the source of the anomalies. The intrusive investigation should focus on, but not be limited to, the six linear anomaly lines identified, recognizing the anomalies may be wider than they appear considering the geophysical survey did not extend out into the wooded areas.

10.5 CSM SUMMARY FOR SWMU 77 – ALL SUBAREAS

The following presents the CSM for the six SWMU 77 subareas. Figures 10-3 through 10-14 present the subarea-specific graphical CSM and MC exposure pathway analysis figures, respectively.

Profile Type	Information Needs	Findings
Range/Site Profile	Installation Name	NAPR, SWMU 77-Small Arms Range
	Installation Location	NAPR, formerly known as NSRR, is located on the eastern coast of Puerto Rico in the municipality of Ceiba, approximately 33 miles southeast of San Juan. The nearest major town is Fajardo, which is 10 miles north of the station. The facility occupies approximately 8,600 acres, and except for two adjacent unpopulated islands (Pineros and Cabeza de Perro) off the northeastern coast of the facility, it is bordered on the north, south, and east by the marine waters of the Atlantic Ocean, Caribbean Sea, and Vieques Passage.
	Installation History	The facility was used as a military base from 1940 until 2004 and included a port facility and major airfield complex. The facility ceased operation as an active Naval Station on March 31, 2004, at which point it was designated NAPR.
	Site (and Subarea) Descriptions	SWMU 77 was historically used for small arms operations; however, potential munitions disposal or detonation operations are suspected based solely on historical aerial photographs (presented in Appendix B). Operations were conducted at SWMU 77 from 1940 to January 1, 2010. The SWMU 77 subareas of concern are described as follows: **The Pistol Range Subarea** was used as a pistol range from 1976 until January 1, 2010; the southern half of the range was used exclusively since 2004. **The Former Pistol Range** was estimated to be in use from 1962 to 1964, based solely on historical aerial photographs. **The Detonation Area Near Concrete Pad Subarea.** The pad was primarily used for target assembly on the concrete pad and is noted in the subarea name only because it aids as a marker in locating the subarea. A one-time detonation event occurred in a small pit where a small depression area remains. The detonation occurred under the guidance of the Mayport Explosive Ordnance Disposal (EOD) Detachment in or around 2006. **The Rifle Range Subarea** was used for rifle practice from 1940 to January 1, 2010. **The Potential OB/OD Subarea** is suspected of OB/OD use solely based on historical aerial photographs that indicate potential activity (two bermed areas) as early as 1961 and ending sometime prior to 1985. There is also the possibility that landfilling activities may have occurred in this area. No other documentation is available. **The Potential Munitions Trench Subarea** is suspected of being used as a disposal area solely based on historical aerial photographs that indicated potential activity (trenches) sometime prior to 1958 (possibly as early as 1940) until October 1961. There is the possibility that landfilling activities may have occurred in the suspected trenches. No other documentation is available.
	Site Layout	SWMU 77-Small Arms Range is approximately 66 acres and is located on the peninsula at Punta Medio Mundo on the northeastern boundary of the facility. The SWMU 77 subareas of concern are situated as follows: **The Pistol Range Subarea** is located in a level area north of the entrance road to SWMU 77. **The Former Pistol Range Subarea** is located northeast of the current pistol range and southwest of the Detonation Area Near Concrete Pad Subarea. **The Detonation Area Near Concrete Pad Subarea** is located southeast of the Potential OB/OD Subarea between the 300- and 500-yard Rifle Range firing lines on the southern side of the unpaved road. **The Rifle Range Subarea** is a 500-yard narrow feature centrally located in SWMU 77 and orientated such that shots were fired toward the outer point of the peninsula.

Profile Type	Information Needs	Findings
		The Potential OB/OD Subarea is on the northern side of the unpaved road in the northwestern portion of the peninsula. **The Potential Munitions Trench Subarea** is between the 200- and 100-yard Rifle Range firing lines, south of the unpaved road.
	Range/Site Structures	SWMU 77 site structures are encompassed within the associated site subareas as described below. As observed during an August 2011 site visit, now that range operations have ceased, vegetation has become overgrown in areas where maintenance once occurred at the Pistol Range Subarea and Rifle Range Subarea, and the unpaved roads are now eroded and impassible. **The Pistol Range Subarea** was maintained via grass cutting until it was closed. An earthen berm that served as the bullet backstop is present just beyond the target area, and numerous bullets are visible on the surface. There are six firing lines (1.5-, 3-, 7-, 10-, 15-, and 25-yard) across two 50-foot-wide side-by-side ranges, and target markers remain. **The Former Pistol Range Subarea** is now overgrown with trees; the location of the former range berm/firing lines is unknown. **The Detonation Area Near Concrete Pad Subarea** has a concrete pad in the central portion of the subarea, and the area surrounding the pad is level, grassy, and not maintained. A small open depression was identified near the northern corner of the pad where a one-time detonation occurred. **Rifle Range Subarea** has 100-, 200-, 300-, and 500-yard elevated firing lines and a short-yardage range formerly used as a pistol range. The short-yardage range is located just in front of a fixed target berm. The target berm consists of a constructed earthen berm that served the short-yardage range, a concrete wall at the rear of the berm equipped with a target carrier mechanism to raise and lower targets, and a natural steep wooded hillside beyond the earthen berm/concrete wall that served as the backstop for these elevated targets. The range was maintained via grass and vegetation cutting until it was closed. **The Potential OB/OD Subarea** is flat and grass covered. A small depression is present in the middle of the grassy area, but there is no evidence of OB/OD operations. The terrain rises steeply beyond the level area, with scrubby brush and trees present on the northern hillside. **The Potential Munitions Trench Subarea** is heavily wooded and covered with overgrown grasses, except on the potential trenches.
	Range/Site Boundaries	SWMU 77 is bordered by the Atlantic Ocean on all sides excluding the southwestern portion, which connects the peninsula to NAPR.
	Range/Site Security	Security clearance is required for gated access to NAPR. Security patrols include SWMU 77; otherwise, SWMU 77 has been unsecured since the gate at the entrance of SWMU 77 was removed at or near the time of range closure on January 1, 2010. Also, access to the peninsula is unsecured from the water side.

Profile Type	Information Needs	Findings
Munitions/ Release Profile	Munitions Types	Expended items identified in available range records (from 2003 through 2009) included shotgun, ball, linked, and blank cartridges (more than 400,000), hand smoke grenades (six), and 40-millimeter (mm) training smoke grenades (55). MEC/MPPEH items added to the list after discovery during the Phase I RFI within the wooded embankment at the rear of the subarea included 40-mm CS M651 grenades (four), 37-mm CS grenade (one), Han-Ball CS 1902 grenade (one), and 40-mm practice grenades (two). Items discovered during the Phase I RFI were either left in place or were consolidated and detonated on site by Mayport EOD on August 19, 2010 (table of items discovered and resolution, including the EOD Report, are presented in Appendix B). In addition, two expended blasting caps were encountered in January 2010 during an archeological investigation near Site RR-9. Based on the results of the Phase 1 RFI, MEC/MPPEH are only a concern at the **Rifle Range Subarea**, **Potential OB/OD Subarea** and **Potential Munitions Trench Subarea**. (Tetra Tech, 2011, Phase I results are presented in Appendix B-3 of Volume I and Attachment 1-4 of Volume II)
	Maximum Probability Penetration Depth	MEC/MPPEH were identified during the Phase I RFI in the surface and are expected on the surface of areas not surveyed during the Phase I RFI at the **Rifle Range Subarea**. Subsurface anomalies encountered at this subarea during the analog detector-aided surveys are expected to be expended bullets or metallic debris and not MEC/MPPEH. Intrusive investigations need to be conducted at the **Rifle Range Subarea** to determine the source of the anomalies. At the **Potential OB/OD Subarea**, MEC/MPPEH may be present in the surface and/or subsurface at depths extending to 4 feet bgs. At the **Potential Munitions Trench Subarea**, MEC/MPPEH may be present in the surface and/or subsurface from approximately 1 foot bgs (assuming 1 foot of cover material over the trenches) extending up to 10 feet bgs (assuming typical backhoe reach). However, based on site-specific conditions as identified during the Phase I RFI (auger refusal was encountered at all of the soil boring locations at 0.5 foot bgs), actual burial depths are expected to be much less and are not anticipated to be greater than 4 feet bgs. During the Phase I RFI, weathered bedrock was exposed at the land surface in many areas of SWMU 77, particularly at steep embankments at the **Potential Munitions Trench Subarea**. Digital geophysical survey results during the Phase I RFI confirmed subsurface anomalies at the **Potential OB/OD Subarea** and **Potential Munitions Trench Subarea**. Additionally, analog survey results from the Phase I RFI indicated suspect subsurface anomalies at the **Rifle Range Subarea**. Because intrusive investigation of the subsurface was not included during the Phase I RFI, the anomaly sources are unknown and may be MEC/MPPEH and/or volcanic rock observed as outcrops and during soil boring refusal. Depths to any buried items are likely shallower than originally anticipated based on the shallow depth to bedrock during the Phase I RFI and remain unknown until subsurface intrusive investigation is conducted. During the Phase I RFI, MEC/MPPEH were not found on the surface nor were subsurface anomalies present within the depression area at the **Detonation Area Near Concrete Pad Subarea**. (Tetra Tech, 2011, Phase I results are presented in Appendix B-3 of Volume I and Attachment 1-4 of Volume II)
	MEC Density	At the ground surface, MEC/MPPEH were found at the **Rifle Range Subarea** only. Items previously encountered on the constructed earthen berm and grassy strip at the toe of the wooded embankment during site walks in support of Phase I RFI SAP planning were removed when SWMU 77 was closed in January 2010, and no known MEC/MPPEH items remain in this area. At the wooded embankment, eight MEC/MPPEH munitions items were encountered during the meandering path analog detector-aided survey conducted during the Phase I RFI. Three items warranting detonation were addressed by Mayport EOD on August 19, 2010 (see Appendix B). The survey did not cover 100 percent of the area, which was heavily wooded and difficult to traverse; therefore, there is a high probability that MEC/MPPEH items are still present in this area. MEC/MPPEH could be present in the **Potential OB/OD Subarea** and **Potential Munitions Trench Subarea** based on Phase I RFI geophysical surveys, and their potential presence remains unknown until subsurface intrusive investigation is conducted. (Tetra Tech, 2011, Phase I results are presented in Appendix B-3 of Volume I and Attachment 1-4 of Volume II)

Profile Type	Information Needs	Findings
	Munitions Scrap/ Fragments/ Material Documented as Safe (MDAS)	MDAS was only encountered at the **Rifle Range Subarea**, where training grenade fragments (blue pieces) at the earthen berm were observed, and several of the eight munitions items were identified as MDAS at the wooded embankment. In addition, two expended blasting caps were encountered in January 2010 during an archeological investigation near Site RR-9. At the **Pistol Range Subarea** berm and **Rifle Range Subarea** earthen constructed berm, a high density of expended bullets was observed during the Phase I RFI; moreover, high densities of bullets are suspected at the **Rifle Range Subarea** wooded embankment, where thick ground cover prevented visual observation. (Tetra Tech, 2011, Phase I results are presented in Appendix B-3 of Volume I and Attachment 1-4 of Volume II)
	Associated MC	**The Rifle Range Subarea**: NG, metals (antimony, arsenic, copper, lead, and zinc), and explosives were investigated during the Phase I RFI. Based on Phase I RFI results for surface soil samples from the firing lines and berm areas, NG concentrations exceeded screening criteria and were a potential risk concern at the 200-yard firing line for the Rifle Range. For the earthen constructed berm area/wooded embankment, metals, primarily lead, were present at elevated concentrations exceeding screening criteria. Maximum lead concentrations in samples from the constructed earthen berm and wooded embankment were 89,000 and 118,000 mg/kg, respectively. A high density of bullets was observed on the constructed earthen berm and is suspected on the wooded embankment. The only explosive detected, RDX, was at concentrations less than the PAL. **The Potential OB/OD Subarea**: NG, metals (antimony, arsenic, copper, lead, and zinc), and explosives were investigated. Based on Phase I RFI surface and subsurface soil results, only lead was of potential ecological concern based on evaluation of analytical results. The PAL for lead was the facility background concentration, and although lead was not highly elevated at the OB/OD Subarea (74 mg/kg maximum), it could present an ecological risk. The data are inconclusive until intrusive subsurface investigation is conducted. Even though there is no record or evidence of hazardous chemical disposal activity at this subarea, there is a possibility that hazardous materials may be present in the subsurface because of potential landfill activities. **The Potential Munitions Trench Subarea**: NG, metals (antimony, arsenic, copper, lead, and zinc), and explosives were investigated. Based on Phase I RFI results for the few surface soil samples collected, no PALs were exceeded. The data are inconclusive until intrusive subsurface investigation is conducted. Even though there is no record or evidence of hazardous chemical disposal activity at this subarea, there is a possibility that hazardous materials may be present in the subsurface because of potential landfill activities. **The Detonation Area Near Concrete Pad Subarea**: NG, metals (antimony, arsenic, copper, lead, and zinc), and explosives were investigated. Surface soil was investigated at two biased locations of anticipated maximum concentrations, the remaining depression area where the one-time detonation event occurred and the low-lying drainage area for the subarea. Results of the screening-level hazard/risk assessment indicate that human health risks are acceptable. Lead is a potential ecological concern based on exceedances of ecological screening criteria; however, the PAL for lead was the facility background concentration and subarea concentrations were not elevated (40.7 mg/kg maximum) in comparison to the background concentration. The subarea is small in size, and lead contamination may be anthropogenic, from vehicle traffic in and around the area, especially when considering that concentrations from the two sampling locations were very similar. **The Pistol Range Subarea**: NG and metals (antimony, arsenic, copper, lead, and zinc) were investigated in surface soil at the firing lines and berm area. Analytical results (NG) for the firing lines were evaluated, and NG was determined to be neither a human health nor ecological issue. For the berm, concentrations of metals, particularly lead, were elevated (maximum lead concentration of 58,400 mg/kg) and present both a human health and ecological risk issue. A high density of bullets and fragments was observed on the berm.

Profile Type	Information Needs	Findings
		The Former Pistol Range Subarea: NG and metals (antimony, arsenic, copper, lead, and zinc) were investigated. Surface soil was investigated at each side of the subarea to investigate potential historical berm locations and inside the estimated historical range boundaries to obtain data concerning NG at firing lines. NG concentrations did not exceed the PAL. For the berm, concentrations of metals, particularly lead, were elevated [maximum fixed-base laboratory (FBL) lead concentration of 2,430 and maximum calculated FBL concentration from correlated x-ray fluorescence (XRF) lead data of 12,295 mg/kg], which present both a human health and ecological risk issue. The most highly contaminated area was encountered in the northwestern portion of the subarea. A low density of bullets and fragments was observed in the area. (Tetra Tech, 2011, Phase I results are presented in Appendix B-3 of Volume I and Attachment 1-4 of Volume II)
	Migration Routes/ Release Mechanisms	Soil at the SWMU 77 subareas is expected to be moderately well drained, and contaminants could migrate from surface to subsurface soil via infiltrating precipitation or could be released directly to subsurface soil and subsequently leach into groundwater, thus causing groundwater to become contaminated. The stormwater/erosion runoff migration pathway is not expected to be significant due to the well-vegetated terrain and lack of drainage ditches or surface water bodies at SWMU 77. Potentially complete exposure pathways are also present that could result in unacceptable adverse environmental impacts to ecological receptors (biota and/or critical habitat), either through contact with/ingestion of contaminated soil and/or contact with contaminants through the food chain when ingesting vegetation such as grass at the site. Direct ingestion of bullets or bullet fragments by birds may also present a concern because of lead toxicity. In addition, MC contaminants may bioaccumulate in animals over time.
Physical Profile	Climate	NAPR has a tropical-marine climate characterized by minimal temperature fluctuations, relatively moderate humidity, and frequent rain showers. The rainy season is typically defined as May through November. Hurricane season is from June 1 through November 30.
	Topography	Ground surface elevations within NAPR ranges from 0 to 131 feet above mean sea level. At SWMU 77, the access road entrance area is low lying, but otherwise SWMU 77 is hilly and vegetated, except where areas have been cleared and leveled for operational purposes. Vegetative cover limits the amount of erosion that occurs at the site.
	Geology	The underlying geology of NAPR is predominantly volcanic, composed of lava and tuff, as well as sedimentary rocks derived from discontinuous beds of limestone.
	Soil	Except for tidal swamp soils associated with the access road entrance area, SWMU 77 consists of Descalabrado and Guyana soils, which are shallow, well-drained, moderately permeable soils that formed in moderately fine-textured residuum derived from volcanic rock. Slopes are steep, ranging from 5 to 60 percent. These soils have no value as cropland and are suited only for low-intensity grazing or wildlife habitat.

Profile Type	Information Needs	Findings
	Hydrogeology	Although no groundwater information is available for SWMU 77, the nearby marine waters suggest that salt-water intrusion has occurred on the peninsula. No drinking water wells have been developed at SWMU 77.
	Hydrology	No floodplains or significant surface water features are present within SWMU 77; however, the site is a peninsula bordered on all sides but the southwest by water.
	Vegetation	Vegetative cover types at SWMU 77 includes largely upland forest (consisting of stands of relatively small trees with grasses and shrubs) where all of the subareas are located. As observed during an August 2011 site visit, now that range operations have ceased, vegetation has become overgrown in areas where maintenance once occurred at the Pistol Range Subarea and Rifle Range Subarea. A mangrove area exists, limited to the SWMU 77 access road entrance area, and beach strand associations are limited to the fringe areas of SWMU 77.
Land Use and Exposure Profile	Current Land Use	SWMU 77 is currently not in use.
	Current Human Receptors	Current human receptors include Navy personnel (military and civilians), contractors, and trespassers.
	Current Activities	SWMU 77 is currently not in use.
	Potential Future Land Use	The future use of the SWMU 77 site and the individual subareas is unknown at this time; however, according to the Supplemental Environmental Assessment, SWMU 77 is located in Zone 5, designated as an Environmental Retreat and the anticipated future use as an environmental retreat area includes hostels, cabanas and campsites (Navy, 2011).
	Potential Future Human Receptors	Potential future human receptors include Navy personnel (military and civilians), residents, contractors, trespassers, and recreations users (including potential ecotourists and hotel workers). These receptors would include construction workers (if intrusive work is necessary) and maintenance and operations workers.
	Potential Future Land Use-Related Activities	The future use of the SWMU 77 site and the individual subareas is unknown at this time; however, according to the Supplemental Environmental Assessment, SWMU 77 is located in Zone 5, designated as an Environmental Retreat and the anticipated future use as an environmental retreat area includes hostels, cabanas and campsites (Navy, 2011).
	Zoning/Land Use Restrictions	There are no site-specific restrictions at this time pending the outcome of the subject Full RFI.
	Demographics/ Zoning	Puerto Rico is the easternmost island in the Greater Antilles chain separating the Caribbean Sea from the Atlantic Ocean; the island is approximately 110 miles long by 35 miles wide. NAPR is bordered by the municipalities of Ceiba to the west and north and Naguabo to the southwest. The nearest major town, Fajardo, with a population of nearly 42,000, is approximately 8 miles north of NAPR.
	Beneficial Resources	Protected habitats and protected/endangered animals are present at NAPR, including the SWMU 77 location.
Ecological Profile	Habitat Type	There are three primary habitats located on SWMU 77, upland forest, mangrove, and beach strand types. SWMU 77 subareas are all identified as upland forest.
	Degree of Disturbance	Conservation zones were established to preserve critical habitats at NAPR. The only designated critical habitat associated with SWMU 77 is the mangrove stands (present at the entrance of SWMU 77) for the yellow-shouldered blackbird.

Profile Type	Information Needs	Findings
	Ecological Receptors and Species of Special Concern	The major mammal population in and near NAPR consists of introduced species such as stray dogs and cats, Norway and gray-bellied rats, mice, and mongooses. The reptile population (especially snakes) has been significantly reduced because of the large mongoose population. Thirteen species of bats, none listed under the Endangered Species Act, are known to occur on Puerto Rico, including fruit-eating, nectivorous, insectivorous, and piscivorous bats. The species observed at NAPR that are classified as endangered under federal law, any of which could be present within the overall boundaries of SWMU 77 include sea turtles (hawksbill [*Eretmochelys imbricate*] and leatherback [*Dermochelys coriacea*]) one snake (Puerto Rican boa constrictor [*Epicrates inornatus*]), birds (yellow-shouldered blackbird and brown pelican *[Pelecanus occidentalis occidentalis]*), and one mammal (West Indian Manatee [*Trichechus manatus*]). Three species of vegetation of concern include are the black (*Avicennia germinans*), red (*Rhizophora mangle)*, and white (*Laguncularia racemosa*) mangrove. The black mangrove (*Avicennia germinans)* is classified as threatened under federal law. Because the mangrove areas are considered wetlands, they are protected under federal law and are critical habitat for the yellow shouldered blackbird (*Agelaius xanthomus*). Of note, NAPR supports one plant (*Cobana negra*) classified as threatened in 1990 by USFWS.
General Exposure Profile	Relationship of MC Sources to Habitat and Potential Receptors	Uptake of MC sources, in particular elevated metals concentrations encountered at the **Pistol Range Subarea** berm and **Rifle Range Subarea** during the Phase I RFI, could result in unacceptable adverse impacts to ecological receptors (biota and/or critical habitat), either through contact with/ingestion of contaminated soil and/or contact with contaminants through the food chain when ingesting vegetation such as grass. In addition, MC contaminants may bioaccumulate in animals over time. Direct ingestion of bullets or bullet fragments by birds may also present a concern because of lead toxicity; high densities of expended bullets were encountered during the Phase I RFI at the **Pistol Range Subarea** berm and **Rifle Range Subarea** constructed earthen berm (and a high density of bullets is suspected at the **Rifle Range Subarea** wooded embankment where thick ground cover prevented visual observation). (Tetra Tech, 2011, results are presented in Appendix B-3 of Volume I and Attachment 1-4 of Volume II)

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

(UFP-QAPP Manual Section 2.6.1)

SWMU 77 contains six subareas that must be investigated for MC, which include the Pistol Range Subarea, Former Pistol Range Subarea, Detonation Area Near Concrete Pad Subarea, Rifle Range Subarea, Potential OB/OD Subarea, and the Potential Munitions Trench Subarea. The overall decision matrix Figure 11-1, and supporting Figure11-1A addressing sampling decision matrix if evidence of landfilling is encountered, provides the supporting decision trees for determining the scope of the Full RFI and the paths forward for all subareas upon evaluation of MC investigation results.

11.1 PROBLEM STATEMENT

Within each specific SWMU 77 subarea, surface and/or subsurface soil may be contaminated with a variety of constituents associated with site-specific munitions-related operations. The Potential OB/OD Subarea and Potential Munitions Trench Subarea may also be contaminated with constituents associated with landfilling activities. Previously collected soil data indicate there may be contamination present at the SWMU 77 subareas as a result of site uses. Therefore, defining the nature and extent of potential MC in surface and subsurface soil is an objective of the Full RFI investigation at SWMU 77. Potential MC include select metals, explosives, and NG, as applicable per subarea. If evidence of landfilling is noted at the Potential OB/OD Subarea or Potential Munitions Trench Subarea, potential contaminants at these subareas may also include NG and non-MC-related contaminants including volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), pesticides, herbicides, polychlorinated biphenyls (PCBs), and all metals. Contaminants may have migrated from soil to other environmental media; therefore, human and ecological receptors may be at risk from exposure to potentially contaminated environmental media, and additionally, birds may be at risk from direct ingestion of bullets or bullet fragments. An additional objective is to obtain data sufficient to evaluate whether groundwater may have been impacted about regulatory standards. Note that groundwater samples are not planned or the Full RFI. However, soil data can and will be evaluated for potential migration pathway to groundwater via comparison with site-specific developed dilution attenuation factors. Additionally, depth to bedrock will be established. These results will aid the Navy and regulators in determining whether monitoring wells are warranted for the installation as part of future investigation and/or whether interim measures for source soils are warranted. A Full RFI must be conducted to determine whether MC, and possibly non-MC-related contaminants present a risk to either human or ecological receptors, and if so, then appropriate corrective action may be recommended, as necessary. Data results collected from each of the following subareas will be used by the Project Team to determine the next steps for SWMU 77:

- Pistol Range Subarea:
  - Surface and subsurface soil in the natural embankment, range floor, and areas surrounding the site may be contaminated with MC in the form of select metals. Additionally, surface and subsurface soil at select firing lines may be contaminated with MC in the form of NG.

- Former Pistol Range Subarea:
  - Surface soil in the northwestern portion of the site may be contaminated with MC in the form of select metals.

- Detonation Area Near Concrete Pad Subarea:
  - Surface soil near the one-time detonation pit/depression area and surrounding impacted surface soil may be contaminated with MC in the form of select metals and subsurface soil, particularly at the one-time detonation pit area and low lying area, may be contaminated with MC in the form of NG.

- Rifle Range Subarea:
  - Surface and subsurface soil at the 200-yard firing line may be contaminated with MC in the form of select metals and NG. Subsurface soil at the remaining firing lines may be contaminated with MC in the form of NG.
  - The surface and subsurface soil of the constructed earthen berm and natural wooded embankment and surrounding area may be contaminated with MC in the form of select metals and explosives.

- Potential OB/OD Subarea and Potential Munitions Trench Subarea:
  - Surface and subsurface soil in these subareas may be contaminated with MC in the form of select metals and explosives.
  - If evidence of landfilling [e.g., suspect soils where visual, olfactory, or photoionization detector (PID) observations suggest that soil may be impacted by chemical releases in the past] is determined during intrusive investigations that will be conducted during the MEC phase of the investigation at these subareas (see Appendix A, Volume 2), then surface and subsurface soil in these subareas may also be contaminated with NG and non-MC-related contaminants including VOCs, SVOCs, pesticides, herbicides, PCBs, and metals.

11.2 INFORMATION INPUTS

Data required for making decisions will come from two sources: an MEC investigation (see Appendix A, Volume 2) and this MC investigation. Some of the data to be collected during this MC investigation depend on the findings of the MEC investigation. Data required for this MC investigation are as follows:

1. UXO Detector-aided Surface Survey and Geophysical Investigation (see Appendix A of the UFP-SAP for MEC):

   Surface: UXO detector-aided surface surveys must be performed over select previously surveyed portions of the Rifle Range Subarea and also along new transects located north-northeast of the Phase I RFI survey area (Tetra Tech, 2011, Phase I results are presented in Attachment 1-4 of Volume II). UXO Technicians must strive to locate metallic items on the surface and will determine if these items are suspect MEC, MPPEH, or non-munitions-related debris.

   Subsurface: Subsurface geophysical surveys will be conducted at the Potential OB/OD Subarea, and Potential Munitions Trench Subarea, and data collected will be used to locate suspect metal objects in subsurface soil.

2. Intrusive Investigations (see Appendix A of the UFP-SAP for MEC):
   Intrusive investigations will be conducted at the Rifle Range Subarea, Potential OB/OD Subarea, and Potential Munitions Trench Subarea. The locations of the intrusive investigations will guide locations of the soil sample at the Potential OB/OD Area and Potential Munitions Trench Subarea. At a minimum, at least one soil sample must be collected from each test pit at each subarea, where MEC/MPPEH is encountered or evidence of chemical contamination from landfilling is encountered; and depending on the results of the intrusive investigations, additional soil samples may be collected. Sample locations will be chosen in the field based on the results of the intrusive investigation and at the discretion of the FOL; if no evidence of contamination is present, a minimum of one sample will be collected from the center of the excavation. The locations of the intrusive investigations may also guide the locations of the discretionary soil sample at the Rifle Range.

3. Global Positioning System (GPS) (sub-meter accuracy) will be used for the collection of new data points in soil. The locations of previously collected soil data points are included in the project geographic information system (GIS). The previous data locations will serve as points of reference for new data collection points. Data collection point coordinates will be documented in accordance with SOPs in Appendix C.

4. Laboratory Target Analyte Data: Laboratory analyses are necessary to determine the concentrations of select MC metals of primary concern (antimony, arsenic, lead, copper, and zinc), NG, and explosives in soil, as applicable for a given subarea (see Figures 11-1 and 11-1A). Depending on the results of MEC intrusive investigations, soil samples may also be analyzed for Appendix IX VOCs, SVOCs, pesticides, herbicides, PCBs, metals and NG.

5. Previously collected Phase I RFI data will be used along with newly collected Full RFI chemical data, to assess risk to human and ecological receptors and to determine the nature and extent of contamination at the SWMU 77 subareas (note that all metals analytes detected during the Phase I RFI were carried forward for evaluation in the Full RFI) (Tetra Tech, 2011, Phase I results are presented in Appendix B-3 of Volume I). Risk assessments will be conducted in accordance with USEPA protocols for human health risk assessments (HHRAs) and ecological risk assessments (ERAs).

6. PALs: Chemical data that can be used to determine the nature and extent of contamination and to evaluate potential risk to site users is required for the Full RFI. To accomplish this goal, the laboratory quantitation limits must be low enough to measure analyte concentrations to regulatory or other stringent and conservative values known as PALs. For this Full RFI, the PAL sources are listed below and are presented in Worksheet #15 to ensure that laboratory sensitivity is sufficient to meet project goals. Backup tables supporting the selection of human health and ecological screening values are presented in Appendix B. The current version of all references used to generate the PALs will be used for comparison of reported data at the time the risk assessments are completed. For screening purposes, the lower of the risk-based or MCL-based soil screening level will be used.

   - USEPA Regional Screening Levels for Chemical Contaminants at Superfund Sites - Residential Soil Values (R-RSLs) and risk-based SSLs (RBSSLs) for protection of groundwater (May, 2012). Note a dilution attenuation factor of 1 was applied to USEPA soil screening levels, and migration to groundwater values for the purposes of developing PALs. Site-specific DAFs will be calculated in the report, as part of the evaluation of the fate and transport of COPCs.

   - Ecological Screening Values: Available ecological screening values were selected from a variety of resources and represent concentration level protection of representative ecological species.

- Background Data (Baker and CH2MHill, 2010): An evaluation of site-risk versus background-risk versus total-risk will be presented in the risk characterization component of the risk assessment to assess the potential of contamination being naturally occurring versus site related. Analytical data (metals in soil) from these sites will be compared to facility background to determine if potential contaminant concentration ranges are within or greater than background concentrations. It is Navy policy to consider chemicals detected at concentrations within the background concentration range as not representing contamination and further specifies that risk assessments should not be conducted for chemicals that are present at levels less than corresponding background concentrations. If a contaminant concentration exceeds the associated toxicity screening but is less than facility background (metals), then that contaminant will be evaluated as background risk in the risk characterization component of the site-specific risk assessment. Facility-wide background data will be based on the soil type for the site determined during the Full RFI Background concentration tables are included in Appendix B. Also refer to Figure 11-1.

- Analytical data reported by the laboratory will use the following reporting conventions: All results below the Detection Limit (DL) will be considered nondetects; positive results reported at concentrations between the DL and Limits of Quantitation (LOQ) will be reported with a “J” qualifier; and, analytes not found (not detected) in a sample will be reported as the Limit of Detection (LOD) with a “U” qualifier..

In cases where conventional test methods are not able to achieve LOQs that are lower than the PALs (such as for select SVOCs), decision rules must be in place for determining whether the constituents poses a potentially unacceptable risk. In the event that a target analyte has a PAL between the LOD and LOQ, the “J” flagged data will be accepted to achieve project goals. Nondetected results reported for analytes where the LOD is greater than the PAL will not be considered COPCs and will not be retained for the quantitative risk assessment. However, the impact of such “non-detected results” will be further evaluated (qualitatively) in the DQR and Uncertainty Analysis section of the Full RFI Report to determine if risk management decisions would be impacted by the fact that the LOD exceeds the PAL. DL values are presented to aid in the decision making process.

11.3 DEFINE THE BOUNDARIES OF THE STUDY

SWMU 77 is divided into six subareas, and each subarea has particular study areas of interest that are likely to be contaminated, such as earthen berms, firing lines, or potential trenches. The table below describes the study areas within each subarea of SWMU 77. The study areas within each subarea are

presented in Figures 17-1 through 17-7. The extent of each study area represents the specific location of the investigation within each subarea.

SWMU 77 Subarea	Study Area
Pistol Range (Figure 17-1)	- Natural embankment - Floor of the range including select firing lines - Area surrounding range
Former Pistol Range (Figure 17-2)	- Area north-northwest of the northwestern earthen berm within historical aerial footprint
Detonation Area Near Concrete Pad (Figure 17-3)	- Open area surrounding the one-time detonation pit/depression area
Rifle Range (Figures 17-4 and 17-5)	- Firing lines - Constructed earthen berm, wooded natural embankment, and surrounding area
Potential OB/OD (Figure 17-6)	- OB/OD berms identified in historical aerial photographs and potential former pits in open clearing adjacent to road
Potential Munitions Trench (Figure 17-7)	- Area of multiple apparent disposal trenches as shown in historical aerial photographs

For surface soil, the surficial vertical study boundary for the MC investigation at the subareas described above will be limited to the top 6 inches of surface soil because this is the interval that is expected to contain the maximum concentrations of MC; furthermore, agreement was reached on this site-specific identification of surface soil sample depth at the August 2009 planning meeting. Subsurface soil will be investigated to a maximum of 4 feet bgs at the Potential OB/OD Subarea and Potential Munitions Trench Subarea; exact depths will be determined based on the depths of the MEC intrusive investigations at these subareas. Subsurface soil will be investigated to a maximum of 2 feet bgs at the other subareas at which subsurface soil it to be collected. In addition to evaluating risks separately for surface soil and subsurface soil, risks associated with the combined data set will be presented.

If suspect surface or subsurface MEC/MPPEH are encountered during the MEC investigation (Rifle Range Subarea, Potential OB/OD Subarea, and Potential Munitions Trench Subarea), sampling will be biased to locations near and/or under the MEC/MPPEH item after it is removed from the site. The presence of MEC/MPPEH may affect the vertical or horizontal boundaries of the investigation area. Any alterations to the proposed subarea boundaries will be recorded and documented in an FTMR.

11.4 DEVELOP THE ANALYTIC APPROACH

Fixed-base analytical laboratory data will be used to characterize potential MC contamination at the SWMU 77 subareas. The rationale for the sample collection program at each of the subareas is included in Worksheet #17. The MC decisions to be made for each subarea are presented on Figure 11-1.

As appropriate for each subarea, individual chemical concentrations will be determined in surface and subsurface soil, as appropriate, for each of the MC select metals, explosives, and NG, and possibly Appendix IX VOCs, SVOCs, pesticides, herbicides, PCBs, metals through fixed-base laboratory analysis, and these concentrations will be compared to the PALs listed in Worksheet #15, which were developed considering human health and ecological risk-based screening criteria and background metals concentrations. Appendix B presents all human health and ecological screening criteria used to determine PALs. The lesser of the screening values for each parameter was chosen as the PAL to prompt the fixed-base analytical laboratory to attain low detection limits necessary for data evaluation. The USEPA migration-to-groundwater SSLs are included as part of the screening criteria for soils.

Navy policy relating to the use of background data specifies that risk assessments should not be conducted for chemicals that are present at levels less than corresponding background concentrations. However, during the Full RFI, two risk assessments will be conducted, a site-specific risk assessment with only chemicals identified as COPCs and a cumulative risk assessment to aid in risk management decisions that includes chemicals (metals) screened out at the COPC selection phase of the site-specific risk assessment based on comparison with facility background concentrations. Furthermore, data from samples collected during the Phase I RFI and Full RFI will be combined for use in the cumulative baseline risk assessment (Tetra Tech, 2011, results are presented in Appendix B-3 of Volume I). All metals analytes that were detected during the Phase I RFI were carried forward for evaluation in the Full RFI. Any risk that may be present because of chemicals (metals) that are detected at levels greater than screening criteria but less than corresponding facility background concentrations will be discussed in the uncertainty evaluation of the Full RFI risk assessment.

During the Full RFI, duplicate sample results will not be averaged for use in COPC selection; the greater of the two results will be used for COPC selection and during risk evaluation. Rejected data will not be used for the achievement of project objectives.

11.5 SPECIFY PERFORMANCE OR ACCEPTANCE CRITERIA

Performance criteria for laboratory-generated data are normal laboratory QA limits and pre-established DLs for MC and non-MC target analytes, as listed in Worksheet #15. Data quality will be evaluated as part of the verification/validation and data usability processes described in Worksheet #37. All analytical data will be analyzed by Katahdin Analytical Services or TestAmerica and certified by a third-party Puerto Rico-certified chemist. Validation of the certified data will be performed by Tetra Tech data validation chemists. Failure to meet validation targets or limitations on data use identified during data usability

assessment will be described in the Full RFI Report. Data validation reports will be included as an appendix to the Full RFI Report.

If all data are collected as planned and no data points are missing or rejected for quality reasons, then the investigation completeness will be considered satisfactory. If any data gaps are identified, including missing or rejected data, the Project Team will assess whether a claim of having obtained project objectives is reasonable, based on the quantity and types of data gaps. All Project Team members will be involved in rendering the final conclusion by consensus regarding adequacy of the data.

11.6 DEVELOP THE PLAN FOR OBTAINING DATA

The sampling plan and rationale for the MC investigations of the subareas are presented in Worksheet #17.

SAP Worksheet #12 -- Measurement Performance Criteria Table – Field Quality Control Samples

(UFP-QAPP Manual Section 2.6.2)

QC Sample	Analytical Group	Frequency	Data Quality Indicators (DQIs)	Measurement Performance Criteria (MPCs)	QC Sample Assesses Error for Sampling (S), Analytical (A) or Both (S&A)
Trip Blank	VOCs only	One per cooler containing VOC samples.	Bias/ Contamination	No analytes ≥ ½ LOQ.	S & A
Equipment Rinsate Blank	All analytical groups	One per 20 field samples per matrix per sampling equipment [1].	Accuracy/Bias/ Contamination	No analytes ≥ ½ LOQ, except common laboratory contaminants, which must be < LOQ.	S & A
Field Duplicate	All analytical groups	One per 20 field samples collected per matrix.	Precision	Values > 5X LOQ: Relative Percent Difference (RPD) must be ≤30[2,3] (aqueous), ≤50[2,3] (solid).	S & A
Cooler Temperature Indicator	All analytical groups	One per cooler.	Representativeness	Temperature must be between 0 and 6 degrees Celsius (°C).	S

1 Equipment rinsate blanks will be collected if non-dedicated sampling equipment is used. For disposable equipment, one sample per batch of disposable equipment will be collected.
2 If duplicate values for non-metals are less than five times the LOQ, the absolute difference should be less than two times the LOQ.
3 If duplicate values for metals are less than five times the LOQ, the absolute difference should be less than four times the LOQ.

Note: Completeness will be calculated in two ways, on a per sample basis and a per analyte basis in order to determine how many samples were actually collected and how many total results were received from the laboratory per analyte based on validation (rejected or blank contamination) results, respectively. Completeness will be determined using the following equation:

$$\%C = (V/T) \times 100$$

where %C = percent completeness
V = number of samples taken or results determined to be valid
T = total number of planned samples or results

The project completeness goal for samples collected and valid, usable analytical results (i.e., not rejected) is 95%.

SAP Worksheet #13 – Secondary Use of Data Criteria and Limitations Table

(UFP-QAPP Manual Section 2.7)

Secondary Data	Data Source (originating organization, report title and date)	Data Generator(s) (originating organization, data types, data generation/collection dates)	How Data Will Be Used	Limitations on Data Use
Phase I RCRA Facility Investigation	Phase I RCRA Facility Investigation for SWMU 77 – Small Arms Range, Naval Activity Puerto Rico, Ceiba, Puerto Rico. April 2011	Tetra Tech	Data will be used as the basis of UFP-SAP for Full RFI. The information is quantitative and site specific. The information will be used to establish the field work program and identify data gaps.	Refer to Appendix H of the Phase I RFI Report for a summary of rejected data.

SAP Worksheet #14 -- Summary of Project Tasks

Full RFI project activities consist of the following tasks:

- Field tasks including:
  - Mobilization/demobilization and utility clearance
  - Soil sample collection
  - QC sample collection and other QC tasks
  - Equipment decontamination
  - Investigation-derived waste (IDW) management
  - GPS locating
  - Analytical tasks
- Data management
- Assessment and oversight
- Data review
- Project report

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

FIELD TASKS

Mobilization/Demobilization: Mobilization/demobilization activities include field equipment procurement and transport to the work site, subcontractor procurement and coordination, utility awareness and clearance, location and setup of areas for decontamination and waste storage, acquisition of vehicles, and establishment of an on-site staging area. These tasks will be reviewed by the Project Team and Tetra Tech PM. The FOL will be responsible for receiving and unpacking the equipment and ensuring that all equipment is operable and calibrated.

Equipment requirements will be finalized by the FOL following acceptance of the UFP-SAP. The FOL will review the scope of work and assemble equipment (e.g., vehicles and sampling, personal protection, and decontamination equipment) to implement the field investigations.

The FOL will be responsible for tracking equipment used in the field and for coordinating associated field activities with the Empirical and TestAmerica PMs. The Tetra Tech Project Chemist will be responsible for coordinating the analytical services and for acquisition and delivery of sample containers to the site.

Prior to commencing any work at NAPR, constraints in the work area, such as the planned nominal vegetation cutting/clearing (permit required) that may affect work at the site and other requirements that must be met prior to commencing work, such as locating underground utilities at each of the investigative areas, will be addressed.

Prior to mobilization, the FOL will review the roles and responsibilities of each field team member and review the requirements of the various field activities. A series of meetings will be conducted to review the sampling and analytical requirements. Upon mobilization, the FOL/SSO will ensure that all field personnel have read and understand this UFP-SAP and the associated HASP and will ensure that all non-health and safety-related equipment is available and operational. In addition the FOL/SSO will ensure that all health and safety-related equipment is available and operational. Daily safety meetings will be held each morning by Tetra Tech to briefly address the planned activities for that day.

Upon completion of all site investigation activities, the FOL and field crew will demobilize from the site and transport field equipment back to the Tetra Tech Pittsburgh, Pennsylvania, office or third-party vendor, as necessary. All sample location pin flags will be removed from the sites, work areas will be thoroughly checked, and trash will be bagged and disposed of in a dumpster designated by the NAPR POC.

Soil Sample Collection: Surface (0 to 6 inches bgs) and subsurface (minimum of 0.5 to 2 feet bgs) soil samples will be collected in accordance with SOPs-05 and -06. The sample numbering scheme is provided in SOP-04. Methods for recording data are included in each of the above SOPs and SOP-01. Sample labeling will be in accordance with SOP-02, and selection of sample containers, sample preservation, packaging, and shipping will be in accordance with SOP-03.

The numbers and types of samples to be collected at each site along with associated analytical programs are presented in Worksheets #18, Sections 18.1 through 18.6. At some sites, sampling locations will be determined by the results of the intrusive investigations to be conducted during the MEC portion of the investigation.

Quality Control Tasks: Equipment rinsate blanks and field duplicates will be collected at the frequencies listed in Worksheet #12, matrix spike and matrix spike duplicate (MS/MSD) samples and laboratory duplicates will be collected at the frequencies listed in Worksheet #28.

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

Equipment Decontamination: All reusable sampling equipment (e.g., hand augers, etc.) will be decontaminated prior to sampling and between samples, in accordance SOP-07 (Decontamination of Field Sampling Equipment) included in Appendix C. Decontamination fluid will be containerized as described in SOP-08.

IDW: It is anticipated that soil, decontamination water waste, used personal protective equipment (PPE), and miscellaneous paper/rubbish will be generated during the field investigation. The PPE and miscellaneous paper/rubbish will be properly bagged and disposed of in NAPR facility dumpsters. Excess soil from the surface/subsurface soil sample collection effort will be returned to the subarea location from which it was collected. Decontamination water waste will be containerized. The containers will be labeled by Tetra Tech as soon as possible after they are filled. The drums will be arranged into rows for easy access; additional guidance is provided in SOP-08. Composite samples will be collected from drums of IDW. IDW sample nomenclature is provided in SOP-04

GPS Locating: A hand-held GPS unit capable of sub-meter accuracy (e.g., Trimble GeoXM or Trimble GeoHX) will be used to locate the proposed sampling points according to SOP-09. The GPS coordinate system will be set up so that all data points are collected relative to the North American Datum of 1983 (NAD83), Puerto Rico and Virgin Island Coordinate System 83 in US survey feet. If poor satellite reception in an area prohibits GPS use, then data will not be collected until more satellites are available and the accuracy criteria are met, or an alternative positioning technique will be employed and documented in the field logbook (e.g., tape-measured grid or fiducial; a fiducial is a fixed reference point(s) to which other points can be related).

ADDITIONAL PROJECT-RELATED TASKS

Analytical Tasks - Chemical analyses for will be performed by Empirical and TestAmerica Savannah, which are both DoD Environmental Laboratory Approval Program (ELAP)-accredited laboratories and employ the certification services of an independent Puerto Rico chemist. Copies of the laboratory accreditations are included in Appendix D. Analyses will be performed in accordance with the analytical methods identified in Worksheet #30. Empirical and TestAmerica will perform the chemical analyses following laboratory-specific SOPs (see Worksheet #s 19 and 23) developed based on the methods listed in Worksheet #s 19 and 30.

All soil results will be reported by the laboratory on an adjusted dry-weight basis. Results of percent moisture will be reported in each analytical data package and associated electronic data files. This information will also be captured in the project database, which will eventually be uploaded to the Naval Installation Restoration Information Solution (NIRIS) database. Percent moisture information will also be captured in the RFI Report.

The analytical data packages provided by Empirical and TestAmerica will be in a Contract Laboratory Program-like format and will be fully validatable and contain raw data, summary forms for all sample and laboratory method blank data, and summary forms containing all method-specific QC (results, recoveries, RPDs, relative standard deviations [RSDs], and/or percent differences etc.).

Data Generation Procedures - Project documentation and records include the following:

- Field sample collection and field measurement records as described in Worksheet #29.
- Data assessment documents and records as listed in Worksheet #29.

Data recording formats are described in Worksheet #27.

Assessment and Oversight: Refer to Worksheet #32 for assessment findings and CAs and to Worksheet #33 for QA management reports.

Data Review: Data verification is described in Worksheet #34, data validation is described in Worksheets #35 and #36, and usability assessment is described in Worksheet #37.

Project Report: USEPA requested an interim report/memorandum so that the Project Team can address the need for groundwater investigation at SWMU 77 and munitions characterization of the hillside at the Rifle Range Subarea. The interim report/memorandum will include a brief description of the field investigation conducted, including any field modifications. Maps showing sampling locations and detector-aided surface survey and geophysical survey areas (see Appendix A, Volume 2 for MEC investigation) will also be presented in the interim report/memorandum. The interim report/memorandum will include a preliminary review of results but will not include a munitions hazard assessment (HA), HHRA, or ERA. The CSM will be refined to assess exposure pathways, and preliminary recommendations will be included

Draft and final versions of Full RFI report will be prepared and submitted to the Navy, USEPA, and PREQB for review. The report will include the following sections:

- Executive Summary – will include a brief description of the work conducted and the associated findings.

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

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

- Data Quality – will include a summary of quantitative analytical performance indicators such as completeness, precision, bias, and sensitivity, as well as qualitative indicators such as representativeness and comparability. This action will include a reconciliation of project data with the DQOs and an identification of deviations from this UFP-SAP.

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

- Nature and Extent of Contamination – will include a discussion of the extent of the contaminated soil that requires removal.

- Human Health Risk Assessment – will include a discussion of the risk assessment for the cumulative data set with and without COPCs screened out based on the facility background.

- Ecological Risk Assessment – will include a discussion of the risk assessment for the cumulative data set with and without COPCs eliminated based on comparisons to facility background concentrations.

- Conclusions and Recommendations – will include a discussion of the changes to the CSM and a discussion of the path forward for each decision unit associated with the site.

SAP Worksheet #15 – Reference Limits and Evaluation Table

(UFP-QAPP Manual Section 2.8.1)

Matrix: Soil
Parameter: Empirical Appendix IX VOCs

Analyte	Chemical Abstract Service (CAS) No.	Human Health (HH) PAL (mg/kg)	HH PAL Reference (1, 2, 3)	Ecological PAL (mg/kg)	Ecological PAL Reference (6, 7, 8, 9)	Project Quantitation Limit Goal (PQLG) (mg/kg)	Empirical		
							LOQ (mg/kg)	LOD (mg/kg)	DL (mg/kg)
1,1,1-Trichloroethane	71-55-6	2.6	RBSSL	29.8	Region 5 SSL	0.87	0.005	0.0025	0.00125
1,1,1,2-Tetrachloroethane	630-20-6	**0.00019**	**RBSSL**	225	Region 5 SSL	6.33E-05	0.005	0.0025	0.00125
1,1,2,2-Tetrachloroethane	79-34-5	**0.000026**	**RBSSL**	0.127	Region 5 SSL	8.67E-06	0.005	0.0025	0.00125
1,1,2-Trichloroethane	79-00-5	**0.000077**	**RBSSL**	28.6	Region 5 SSL	2.57E-05	0.005	0.0025	0.00125
1,1-Dichloroethane	75-34-3	**0.00068**	**RBSSL**	20.1	Region 5 SSL	2.27E-04	0.005	0.0025	0.00125
1,1-Dichloroethene	75-35-4	0.093	RBSSL	8.28	Region 5 SSL	0.031	0.005	0.0025	0.00125
1,2,3-Trichloropropane	96-18-4	**0.00000028**	**RBSSL**	3.36	Region 5 SSL	9.33E-08	0.005	0.0025	0.00125
1,2,4-Trichlorobenzene	120-82-1	0.0029	RBSSL	0.51	LANL ESL	9.67E-04	0.005	0.0025	0.00125
1,2-Dibromo-3-chloropropane	96-12-8	**0.00000014**	**RBSSL**	0.0352	Region 5 SSL	4.67E-08	0.01	0.005	0.0025
1,2-Dibromethane	106-93-4	**0.0000018**	**RBSSL**	1.23	Region 5 SSL	6E-06	0.005	0.0025	0.00125
1,2-Dichlorobenzene	95-50-1	0.27	RBSSL	1.5	LANL ESL	0.09	0.005	0.0025	0.00125
1,2-Dichloroethane	107-06-2	**0.000042**	**RBSSL**	0.85	LANL ESL	1.4E-05	0.005	0.0025	0.00125
1,2-Dichloropropane	78-87-5	**0.00013**	**RBSSL**	32.7	Region 5 SSL	4.33E-05	0.005	0.0025	0.00125
1,3-Dichlorobenzene	541-73-1	**0.0004** (4)	**RBSSL**	1.3	LANL ESL	1.33E-04	0.005	0.0025	0.00125
1,4-Dichlorobenzene	106-46-7	**0.0004**	**RBSSL**	0.546	Region 5 SSL	1.33E-04	0.005	0.0025	0.00125
1,4-Dioxane	123-91-1	**0.00014**	**RBSSL**	2.05	Region 5 SSL	4.67E-05	0.0667	0.0333	0.0167
2-Butanone	78-93-3	1	RBSSL	89.6	Region 5 SSL	0.33	0.01	0.005	0.0025
2-Hexanone	591-78-6	0.0079	RBSSL	0.36	LANL ESL	2.63E-03	0.005	0.0025	0.00125

Analyte	Chemical Abstract Service (CAS) No.	Human Health (HH) PAL (mg/kg)	HH PAL Reference (1, 2, 3)	Ecological PAL (mg/kg)	Ecological PAL Reference (6, 7, 8, 9)	Project Quantitation Limit Goal (PQLG) (mg/kg)	Empirical		
							LOQ (mg/kg)	LOD (mg/kg)	DL (mg/kg)
4-Methyl-2-pentanone	108-10-1	0.23	RBSSL	9.8	LANL ESL	7.67E-02	0.005	0.0025	0.00125
Acetone	67-64-1	2.4	RBSSL	1.2	LANL ESL	0.8	0.02	0.01	0.005
Acrylonitrile	107-13-1	**0.0000098**	**RBSSL**	0.0239	Region 5 SSL	3.27E-06	0.02	0.01	0.005
Acrolein	107-02-8	**0.0000084**	**RBSSL**	5.27	Region 5 SSL	2.8E-06	0.02	0.01	0.005
Acetonitrile	75-05-8	**0.026**	**RBSSL**	1.37	Region 5 SSL	8.67E-03	0.05	0.025	0.01
Allyl Chloride	107-05-1	**0.0002**	**RBSSL**	0.0134	Region 5 SSL	6.67E-05	0.005	0.0025	0.00125
Benzene	71-43-2	**0.0002**	**RBSSL**	0.255	Region 5 SSL	6.67E-05	0.005	0.0025	0.00125
Bromodichloromethane	75-27-4	**0.000032**	**RBSSL**	0.54	Region 5 SSL	1.07E-05	0.005	0.0025	0.00125
Bromoform	75-25-2	**0.0021**	**RBSSL**	15.9	Region 5 SSL	7E-04	0.005	0.0025	0.00125
Bromomethane	74-83-9	**0.0018**	**RBSSL**	0.235	Region 5 SSL	6E-04	0.01	0.005	0.0025
Carbon Disulfide	75-15-0	0.21	RBSSL	0.0941	Region 5 SSL	0.03	0.005	0.0025	0.00125
Carbon Tetrachloride	56-23-5	**0.00015**	**RBSSL**	2.98	Region 5 SSL	5E-04	0.005	0.0025	0.00125
Chlorobenzene	108-90-7	0.049	RBSSL	2.4	LANL ESL	0.016	0.005	0.0025	0.00125
Chloroethane	75-00-3	**0.0021**	**RBSSL**	NC	NC	7E-04	0.01	0.005	0.0025
Chloroform	67-66-3	**0.000053**	**RBSSL**	1.19	Region 5 SSL	1.77E-05	0.005	0.0025	0.00125
Chloromethane	74-87-3	0.049	RBSSL	10.4	Region 5 SSL	0.016	0.01	0.005	0.0025
Chloroprene	126-99-8	**0.0000085**	**RBSSL**	**0.0029**	**Region 5 SSL**	2.83E-06	0.005	0.0025	0.00125
cis-1,3-Dichloropropene	542-75-6	**0.00015** (5)	**RBSSL**	0.398	Region 5 SSL	5E-04	0.005	0.0025	0.00125
Dibromomethane	74-95-3	**0.0019**	**RBSSL**	65	Region 5 SSL	6.33E-04	0.005	0.0025	0.00125
Dibromochloromethane	124-48-1	**0.000039**	**RBSSL**	2.05	Region 5 SSL	1.3E-05	0.005	0.0025	0.00125
Dichlorodifluoromethane	75-71-8	0.3	RBSSL	39.5	Region 5 SSL	0.1	0.01	0.005	0.0025
Ethylbenzene	100-41-4	**0.0015**	**RBSSL**	5.16	Region 5 SSL	5E-04	0.005	0.0025	0.00125
Ethyl Methacrylate	97-63-2	0.099	RBSSL	30	Region 5 SSL	0.033	0.005	0.0025	0.00125
Isobutyl alcohol	78-83-1	0.95	RBSSL	20.8	Region 5 SSL	0.32	0.1	0.04	0.02

Analyte	Chemical Abstract Service (CAS) No.	Human Health (HH) PAL (mg/kg)	HH PAL Reference (1, 2, 3)	Ecological PAL (mg/kg)	Ecological PAL Reference (6, 7, 8, 9)	Project Quantitation Limit Goal (PQLG) (mg/kg)	Empirical		
							LOQ (mg/kg)	LOD (mg/kg)	DL (mg/kg)
Methyl Iodide	74-88-4	NC	NC	0.038	LANL ESL	0.013	0.01	0.005	0.0025
Methyl Methacrylate	80-62-6	0.3	RBSSL	984	Region 5 SSL	0.1	0.005	0.0025	0.00125
Methacrylonitrile	126-98-7	**0.00017**	**RBSSL**	0.057	Region 5 SSL	5.67E-05	0.05	0.025	0.01
Methylene Chloride	75-09-2	**0.0025**	**RBSSL**	2.6	LANL ESL	8E-04	0.01	0.005	0.0025
Methylene Bromide (dibromomethane)	74-95-3	**0.0019**	**RBSSL**	65	Region 5 SSL	6.33E-04	0.005	0.0025	0.00125
Pentachloroethane	76-01-7	**0.00027**	**RBSSL**	10.7	Region 5 SSL	9E-05	0.05	0.025	0.025 (10)
Propionitrile	107-12-0	NC	NC	**0.0498**	**Region 5 SSL**	0.02	0.05	0.025	0.01
Styrene	100-42-5	1.2	RBSSL	1.2	LANL ESL	0.40	0.005	0.0025	0.00125
Tetrachloroethene	127-18-4	**0.0044**	**RBSSL**	0.36	LANL ESL	0.0015	0.005	0.0025	0.00125
Toluene	108-88-3	0.59	RBSSL	5.45	Region 5 SSL	0.2	0.005	0.0025	0.00125
trans-1,2-Dichloroethene	156-60-5	0.025	RBSSL	0.784	Region 5 SSL	8.33E-03	0.005	0.0025	0.00125
trans-1,3-Dichloropropene	542-75-6	**0.00015 (5)**	**RBSSL**	0.398	Region 5 SSL	5E-05	0.005	0.0025	0.00125
trans-1,4-Dichloro-2-butene	110-57-6	**0.00000054**	**RBSSL**	NC	NC	1.8E-07	0.005	0.0025	0.00125
Trichloroethene	79-01-6	**0.00016**	**RBSSL**	12.4	Region 5 SSL	5.33E-05	0.005	0.0025	0.00125
Trichlorofluoromethane	75-69-4	0.69	RBSSL	16.4	Region 5 SSL	0.23	0.01	0.005	0.0025
Vinyl Acetate	108-05-4	0.087	RBSSL	12.7	Region 5 SSL	0.029	0.01	0.005	0.0025
Vinyl Chloride	75-01-4	**0.0000053**	**RBSSL**	0.13	LANL ESL	1.77E-06	0.005	0.0025	0.00125
Xylenes (Total)	1330-20-7	0.19	RBSSL	2	LANL ESL	0.06	0.015	0.0075	0.00375

NC - No criterion available.

Human Health Notes:

1 The residential direct contact RSLs (R-RSLs) and risk-based migration to groundwater soil screening levels (RBSSLs) were taken from USEPA's Regional Screening Levels for Chemical Contaminants at Superfund Sites, May, 2012, available online at http://epa-prgs.ornl.gov/chemicals/index.shtml. The RBSSLs are based on a target hazard quotient (HQ) of 1 for non-carcinogens (denoted with an "N" flag) in the EPA table or an incremental lifetime cancer risk (ILCR) of 1E-6 for carcinogens (denoted with a "C" flag) in the EPA table.

2 USEPA R-RSLs (May, 2012) for non-carcinogens were adjusted by dividing by 10, yielding a concentration equivalent to a HQ of 0.1. The residential soil screening level for carcinogens (not adjusted) is equivalent to an ILCR of 1E-6.
3 A dilution attenuation factor of 1 was applied to USEPA RBSSLs, site-specific values will be determined based on information collected during the Full RFI.
4 Value is for 1,4-dichlorobenzene.
5 Value is for 1,3-dichloropropene.

Ecological Notes:
6 USEPA Ecological Soil Screening Levels (Eco-SSLs) available online: http://www.epa.gov/ecotox/ecossl/. The minimum of plant, invertebrate, avian, and herbivorous mammalian screening values is presented.
7 USEPA Region 5 Ecological SSLs (Region 5 SSLs) (USEPA, August 2003).
8 Los Alamos National Laboratory (LANL) Ecological Screening Levels (ESLs), Ecorisk Database, Release 3.0, October 2011. The minimum of plant, earthworm, avian, and mammalian (desert cottontail and deer mouse) screening values presented.
9 Ecological screening criteria were selected in the following order of preference:
a. USEPA Eco-SSL.
b. Lesser of Region 5 SSL and LANL ESL.

Laboratory Notes:
10 Estimated value. Laboratory will report results for this compound but is not accredited to perform this evaluation under DoD ELAP. The project team accepts this limitation because the laboratory is accredited to perform analyses for similar compounds.

Bolded rows indicate that the PAL is between the laboratory LOQ and LOD. The Project Team has agreed to accept this data for decision making as long as results below the LOQ are "J" qualified. Nondetected results reported for analytes where the LOD is greater than the PAL will not be considered COPCs and will not be retained for the quantitative risk assessment. However the impact of such "non-detected results" will be further evaluated (qualitatively) in the DQR and in the uncertainties analysis section of the Full RFI Report to determine if risk management decisions would be impacted by the fact that LOD exceeds the PAL.

Shaded and Bold row indicate the PAL is less than the LOD. The Project Team has agreed to accept this data for decision making as long as results below the LOQ are "J" qualified. Nondetected results reported for analytes where the LOD is greater than the PAL will not be considered COPCs and will not be retained for the quantitative risk assessment. However the impact of such "non-detected results" will be further evaluated (qualitatively) in the uncertainties analysis section of the Full RFI Report to determine if risk management decisions would be impacted by the fact that LOD exceeds the PAL. DL values are presented to aid in the decision making process.

Matrix: Soil
Parameter: TestAmerica Appendix IX SVOCs

Analyte	CAS No.	HH PAL (mg/kg)	HH PAL Reference (1, 2, 3)	Ecological PAL (mg/kg)	Ecological PAL Reference (4, 5, 6, 7)	PQLG (mg/kg)	TestAmerica		
							LOQ (mg/kg)	LOD (9) (mg/kg)	DL (9) (mg/kg)
1,4-Naphthoquinone	130-15-4	NC	NC	1.67	Region 5 SSL	0.56	0.033	0.0033	0.0033
1,2,4,5-Tetrachlorobenzene	95-94-3	**0.0058**	**RBSSL**	2.02	Region 5 SSL	1.9E-03	0.033	0.0033	0.0033
2,3,4,6-Tetrachlorophenol	58-90-2	1.1	RBSSL	0.199	Region 5 SSL	0.07	0.033	0.0033	0.0033
2,4,5-Trichlorophenol	95-95-4	3.3	RBSSL	14.1	Region 5 SSL	1.1	0.033	0.0076	0.0076
2,4,6-Trichlorophenol	88-06-2	**0.013**	**RBSSL**	9.94	Region 5 SSL	4.3E-03	0.033	0.0079	0.0079
2,4-Dichlorophenol	120-83-2	0.041	RBSSL	87.5	Region 5 SSL	0.014	0.033	0.0072	0.0072
2,4-Dimethylphenol	105-67-9	0.32	RBSSL	**0.01**	**Region 5 SSL**	3.33E-03	0.066	0.0076	0.0076
2,4-Dinitrophenol	51-28-5	**0.034**	**RBSSL**	**0.0609**	**Region 5 SSL**	0.01	0.33	0.042	0.017
2,4-Dinitrotoluene	121-14-2	**0.0056**	**RBSSL**	0.00028	Region 5 SSL	9.33E-05	0.033	0.0075	0.0075
2,6-Dinitrotoluene	606-20-2	**0.02**	**RBSSL**	**0.0328**	**Region 5 SSL**	6.67E-03	0.033	0.0079	0.0079
2,6-Dichlorophenol	87-65-0	NC	NC	1.17	Region 5 SSL	0.39	0.033	0.0033	0.0033
2-Chloronapthalene	91-58-7	2.9	RBSSL	**0.0122**	**Region 5 SSL**	4.07E-03	0.033	0.006	0.006
2-Chlorophenol	95-57-8	0.057	RBSSL	0.243	Region 5 SSL	0.019	0.033	0.0053	0.0053
2-Methylphenol	95-48-7	1.1	RBSSL	0.67	LANL ESL	0.22	0.033	0.0063	0.0063
2-Nitroaniline	88-74-4	**0.062**	**RBSSL**	5.4	LANL ESL	0.02	0.17	0.007	0.007
2-Nitrophenol	88-75-5	NC	None	1.6	Region 5 SSL	0.53	0.033	0.0058	0.0058
3,3'-Dichlorobenzidine	91-94-1	**0.00071**	**RBSSL**	**0.646**	**Region 5 SSL**	2.37E-04	0.066	0.017	0.017

Analyte	CAS No.	HH PAL (mg/kg)	HH PAL Reference (1, 2, 3)	Ecological PAL (mg/kg)	Ecological PAL Reference (4, 5, 6, 7)	PQLG (mg/kg)	TestAmerica		
							LOQ (mg/kg)	LOD (9) (mg/kg)	DL (9) (mg/kg)
3-Nitroaniline	99-09-2	NC	NC	3.16	Region 5 SSL	1.05	0.17	0.0067	0.0067
3&4-Methylphenol	NA	1.1	RBSSL	0.69	LANL ESL	0.23	0.033	0.0073	0.0073
4,6-Dinitro-2-methylphenol	534-52-1	**0.002**	**RBSSL**	**0.144**	**Region 5 SSL**	6.67E-04	0.17	0.017	0.017
4-Bromophenyl-phenylether	101-55-3	NC	NC	NC	NC	NC	0.033	0.0069	0.0069
4-Chloro-3-methylphenol	59-50-7	1.3	RBSSL	7.95	Region 5 SSL	0.43	0.033	0.007	0.007
4-Chloroaniline	106-47-8	**0.00013**	**RBSSL**	1	LANL ESL	4.33E-05	0.066	0.0052	0.0052
4-Chlorophenyl-phenylether	7005-72-3	NC	NC	NC	NC	NC	0.033	0.0064	0.0064
4-Nitroaniline	100-01-6	**0.0014**	**RBSSL**	21.9	Region 5 SSL	4.67E-04	0.17	0.017	0.0083
4-Nitrophenol	100-02-7	NC	NC	5.12	Region 5 SSL	1.71	0.17	0.073	0.073
Acetophenone	98-86-2	0.45	RBSSL	300	Region 5 SSL	0.15	0.033	0.0068	0.0068
bis(2-Chloroethoxy) methane	111-91-1	**0.011**	**RBSSL**	0.302	Region 5 SSL	3.67E-04	0.033	0.0065	0.0065
bis(2-Chloroethyl) ether	111-44-4	**0.0000031**	**RBSSL**	23.7	Region 5 SSL	1.03E-06	0.033	0.0065	0.0065
bis(2-Chloro-1-methylethyl) ether	108-60-1	**0.00011**	**RBSSL**	19.9	Region 5 SSL	3.67E-05	0.033	0.0072	0.0072
bis-(2-Ethylhexyl) phthalate	117-81-7	**0.017**	**RBSSL**	**0.02**	**LANL ESL**	5.67E-03	0.066	0.006	0.006
Butylbenzylphthalate	85-68-7	0.2	RBSSL	0.239	Region 5 SSL	0.08	0.033	0.0067	0.0055
Dibenzofuran	132-64-9	0.11	RBSSL	6.1	LANL ESL	0.037	0.033	0.0067	0.0067
Diethylphthalate	84-66-2	4.7	RBSSL	24.8	Region 5 SSL	1.57	0.033	0.0074	0.0074
Dimethylphthalate	131-11-3	NC	NC	10	LANL ESL	3.33	0.033	0.0075	0.0075
Dinoseb	88-85-7	0.098	RBSSL	**0.0218**	**Region 5 SSL**	7.3E-03	0.066	0.0067	0.0062
Di-n-butylphthalate	84-74-2	**0.000039**	**RBSSL**	**0.011**	**LANL ESL**	1.3E-05	0.17	0.017	0.017

Analyte	CAS No.	HH PAL (mg/kg)	HH PAL Reference (1, 2, 3)	Ecological PAL (mg/kg)	Ecological PAL Reference (4, 5, 6, 7)	PQLG (mg/kg)	TestAmerica		
							LOQ (mg/kg)	LOD (9) (mg/kg)	DL (9) (mg/kg)
Di-n-octylphthalate	117-84-0	NC	NC	1.8	LANL ESL	0.6	0.033	0.0067	0.0036
Hexachlorobenzene	118-74-1	**0.00053**	**RBSSL**	0.079	LANL ESL	1.77E-04	0.033	0.0076	0.0076
Hexachlorobutadiene	87-68-3	**0.0005**	**RBSSL**	0.0398	Region 5 SSL	1.67E-04	0.033	0.0068	0.0068
Hexachlorocyclopentadiene	77-47-4	0.07	RBSSL	0.755	Region 5 SSL	0.023	0.066	0.0037	0.0037
Hexachloroethane	67-72-1	**0.00048**	**RBSSL**	0.596	Region 5 SSL	1.6E-04	0.033	0.0058	0.0058
Hexachlorophene	70-30-4	1.8	R-RSL	0.199	Region 5 SSL	0.07	17	2.4	2.4
Isophorone	78-59-1	**0.022**	**RBSSL**	139	Region 5 SSL	7.33E-03	0.033	0.007	0.007
Nitrobenzene	98-95-3	**0.000079**	**RBSSL**	1.31	Region 5 SSL	2.63E-05	0.033	0.0066	0.0066
N-Nitroso-di-n-propylamine	621-64-7	**0.000007**	**RBSSL**	0.544	Region 5 SSL	2.33E-06	0.033	0.0074	0.0075
N-Nitrosodiphenylamine	86-30-6	0.057	RBSSL	0.545	Region 5 SSL	0.019	0.033	0.0061	0.0061
Pentachlorophenol	87-86-5	**0.0017**	**RBSSL**	2.1	Eco SSL	5.67E-04	0.17	0.017	0.017
Phenol	108-95-2	2.6	RBSSL	0.79	LANL ESL	0.26	0.033	0.0065	0.0065
Pyridine	110-86-1	**0.0053**	**RBSSL**	1.03	Region 5 SSL	1.77E-03	0.033	0.02	0.02
Safrole	94-59-7	**0.000038**	**RBSSL**	0.404	Region 5 SSL	1.27E-05	0.033	0.0033	0.0033
o-Toluidine	95-53-4	NC	NC	2.97	Region 5 SSL	0.99	0.033	0.0033	0.0033
O,O,O-Triethylphosphorothioate	126-68-1	NC	NC	0.818	Region 5 SSL	0.27	0.066	0.0067	0.0044
1,3,5-trinitrobenzene	99-35-4	1.7	RBSSL	0.376	Region 5 SSL	0.13	0.066	0.017	0.017
1,3 Dinitrobenzene	99-65-0	**0.0014**	**RBSSL**	0.073	LANL ESL	4.67E-04	0.033	0.017	0.017
1-Naphthylamine	134-32-7	NC	None	9.34	Region 5 SSL	3.11	0.066	0.017	0.017

Analyte	CAS No.	HH PAL (mg/kg)	HH PAL Reference (1, 2, 3)	Ecological PAL (mg/kg)	Ecological PAL Reference (4, 5, 6, 7)	PQLG (mg/kg)	TestAmerica		
							LOQ (mg/kg)	LOD (9) (mg/kg)	DL (9) (mg/kg)
2-Acetylaminofluorene	53-96-3	**0.000065**	**RBSSL**	0.596	Region 5 SSL	2.17E-05	0.033	0.006	0.006
2-Naphthylamine	91-59-8	**0.00017**	**RBSSL**	3.03	Region 5 SSL	5.67E-05	0.066	0.017	0.017
2-Picoline	109-06-8	NC	NC	9.9	Region 5 SSL	3.30	0.066	0.0033	0.0033
3,3'-dimethylbenzidine	119-93-7	**0.000037**	**RBSSL**	NC	NC	1.23E-05	0.066	0.066	0.066
3-Methylcholanthrene	56-49-5	**0.0019**	**RBSS**	0.0779	Region 5 SSL	6.33E-04	0.033	0.042	0.042
4-Aminobiphenyl	92-67-1	**0.000013**	**RBSSL**	**0.00305**	**Region 5 SSL**	4.33E-06	0.066	0.017	0.017
4-Nitroquinoline-1-Oxide	56-57-5	NC	NC	**0.122**	**Region 5 SSL**	0.04	0.33	0.042	0.042
5-Nitro-O-Toluidine	99-55-8	**0.0039**	**RBSSL**	8.73	Region 5 SSL	1.3E-03	0.033	0.017	0.017
7,12-Dimethylbenz(a)Anthracene	57-97-6	**0.000085**	**RBSSL**	16.3	Region 5 SSL	2.83E-05	0.033	0.017	0.017
a,a-Dimethylphenethylamine	122-09-8	NC	NC	**0.3**	**Region 5 SSL**	0.10	6.7	0.33	0.33
Aniline	62-53-3	**0.0039**	**RBSSL**	**0.0568**	**Region 5 SSL**	1.3E-03	0.066	0.0082	0.0082
Aramite	140-57-8	**0.03**	**RBSSL**	166	Region 5 SSL	0.01	0.066	0.0048	0.0048
Benzyl Alcohol	100-51-6	0.37	RBSSL	65.8	Region 5 SSL	0.12	0.033	0.0061	0.0061
Diallate	2303-16-4	**0.00068**	**RBSSL**	0.452	Region 5 SSL	2.27E-04	0.033	0.0056	0.0056
Diphenylamine	122-39-4	0.44	RBSSL	1.01	Region 5 SSL	0.15	(8)	(8)	(8)
Ethyl Methanesulfonate	62-50-5	NC	NC	NC	NC	NC	0.066	0.0078	0.0078
Hexachloropropene	1888-71-7	NC	NC	NC	NC	NC	0.033	0.0053	0.0053
Isosafrole	120-58-1	NC	NC	9.94	Region 5 SSL	3.31	0.033	0.0033	0.0033

Analyte	CAS No.	HH PAL (mg/kg)	HH PAL Reference (1, 2, 3)	Ecological PAL (mg/kg)	Ecological PAL Reference (4, 5, 6, 7)	PQLG (mg/kg)	TestAmerica		
							LOQ (mg/kg)	LOD (9) (mg/kg)	DL (9) (mg/kg)
Methapyrilene	91-80-5	NC	NC	**2.78**	**Region 5 SSL**	0.93	6.7	0.067	0.033
Methyl Methanesulfonate	66-27-3	**0.00014**	**RBSSL**	0.315	Region 5 SSL	4.67E-05	0.033	0.0038	0.0038
N-Nitrosodiethylamine	55-18-5	**5.0E-08**	**RBSSL**	0.0693	Region 5 SSL	1.67E-08	0.066	0.0033	0.0033
N-Nitrosodimethylamine	62-75-9	**1.0E-07**	**RBSSL**	**0.0000321**	**Region 5 SSL**	3.33E-08	0.033	0.019	0.019
N-Nitroso-Di-n-Butylamine	924-16-3	**4.8E-06**	**RBSSL**	0.267	Region 5 SSL	1.6E-06	0.033	0.017	0.017
N-Nitrosomethylethylamine	10595-95-6	**8.7E-07**	**RBSSL**	**0.00166**	**Region 5 SSL**	2.9E-07	0.033	0.0033	0.0033
N-Nitrosomorpholine	59-89-2	**0.0000025**	**RBSSL**	0.0706	Region 5 SSL	8.33E-07	0.033	0.0045	0.0045
N-Nitrosopiperidine	100-75-4	**7.6.0E-05**	**RBSSL**	**0.00665**	**Region 5 SSL**	2.53E-05	0.033	0.0034	0.0034
N-Nitrosopyrrolidine	930-55-2	**0.000012**	**RBSSL**	**0.0126**	**Region 5 SSL**	4.00E-06	0.033	0.0036	0.0036
p-Dimethylaminoazobenzene	60-11-7	**0.000018**	**RBSSL**	0.04	Region 5 SSL	6E-06	0.033	0.017	0.017
Pentachlorobenzene	608-93-5	**0.017**	**RBSSL**	0.497	Region 5 SSL	5.67E-03	0.033	0.0033	0.0033
Pentachloronitrobenzene	82-68-8	**0.0013**	**RBSSL**	0.7	LANL ESL	4.33E-04	0.033	0.017	0.017
Phenacetin	62-44-2	**0.0083**	**RBSSL**	11.7	Region 5 SSL	2.77E-03	0.033	0.017	0.017
p-Phenylenediamine	106-50-3	0.79	RBSSL	6.16	Region 5 SSL	0.26	0.83	0.83	0.36
Pronamide	23950-58-5	0.91	RBSSL	**0.0136**	**Region 5 SSL**	4.53E-03	0.033	0.0042	0.0042
Thionazin (O,O-diethyl phosphorothioate)	297-97-2	NC	NC	0.799	Region 5 SSL	0.27	0.033	0.017	0.017
Dimethoate	60-51-5	**0.0007**	**RBSSL**	0.218	Region 5 SSL	2.33E-04	0.033	0.017	0.017

Analyte	CAS No.	HH PAL (mg/kg)	HH PAL Reference (1, 2, 3)	Ecological PAL (mg/kg)	Ecological PAL Reference (4, 5, 6, 7)	PQLG (mg/kg)	TestAmerica		
							LOQ (mg/kg)	LOD (9) (mg/kg)	DL (9) (mg/kg)
Disulfoton	298-04-4	**0.00071**	**RBSSL**	**0.0199**	**Region 5 SSL**	2.37E-04	0.033	0.017	0.017
Famphur	52-85-7	NC	NC	0.0497	Region 5 SSL	0.02	0.033	0.017	0.017
Methyl parathion	298-00-0	**0.0057**	**RBSSL**	**0.000292**	**Region 5 SSL**	9.73E-05	0.033	0.017	0.017
Ethyl parathion (parathion)	56-38-2	0.33	RBSSL	**0.00034**	**Region 5 SSL**	1.13E-04	0.033	0.042	0.042
Phorate	298-02-2	**0.0026**	**RBSSL**	**0.000496**	**Region 5 SSL**	1.65E-04	0.033	0.017	0.0059
Sulfotepp (tetraethyl dithiopyrophosphate)	3689-24-5	**0.0039**	**RBSSL**	0.596	Region 5 SSL	1.3E-03	0.033	0.017	0.0065

NC - No criterion available.

Human Health Notes:

1 The R-RSLs and RBSSLs were taken from USEPA's Regional Screening Levels for Chemical Contaminants at Superfund Sites, May, 2012, available online at http://epa-prgs.ornl.gov/chemicals/index.shtml. The RBSSLs are based on a target HQ of 1 for non-carcinogens (denoted with an "N" flag) in the EPA table or an ILCR of 1E-6 for carcinogens (denoted with a "C" flag) in the EPA table.

2 USEPA R-RSLs (May, 2012) for non-carcinogens were adjusted by dividing by 10, yielding a concentration equivalent to a HQ of 0.1. The residential soil screening level for carcinogens (not adjusted) is equivalent to an ILCR of 1E-6.

3 A dilution attenuation factor of 1 was applied to USEPA RBSSLs, site-specific values will be determined based on information collected during the Full RFI.

Ecological Notes:

4 USEPA Eco-SSLs available online: http://www.epa.gov/ecotox/ecossl/. The minimum of plant, invertebrate, avian, and herbivorous mammalian screening values presented.

5 USEPA Region 5 SSLs (August 2003).

6 LANL ESLs, Ecorisk Database, Release 3.0, October 2011. The minimum of plant, earthworm, avian, and mammalian (desert cottontail and deer mouse) screening values presented.

7 Ecological screen criteria were selected in the following order of preference:
a. USEPA Eco-SSL.
b. Lesser of Region 5 SSL and LANL ESL.

Laboratory Notes:

8 N-nitrosodiphenylamine decomposes in the gas chromatographic inlet and cannot be separated from diphenylamine. Since n-nitrosodiphenylamine is a default target analyte for analytical method SW-8468270, diphenlyamine is not listed.

9 The LOD is typically 2 to 3 times the DL, however, in some circumstances the this relationship cannot be verified, please see Appendix D for further explanation for these LODs values that do not meet this criteria.

Bolded rows indicate that the PAL is between the laboratory LOQ and LOD. The Project Team has agreed to accept this data for decision making as long as results below the LOQ are "J" qualified. Nondetected results reported for analytes where the LOD is greater than the PAL will not be considered COPCs and will not be retained for the quantitative risk assessment. However the impact of such "non-detected results" will be further evaluated (qualitatively) in the DQR and in the uncertainties analysis section of the Full RFI Report to determine if risk management decisions would be impacted by the fact that LOD exceeds the PAL

Shaded and Bold row indicate the PAL is less than the LOD. The Project Team has agreed to accept this data for decision making as long as results below the LOQ are "J" qualified. Nondetected results reported for analytes where the LOD is greater than the PAL will not be considered COPCs and will not be retained for the quantitative risk assessment. However the impact of such "non-detected results" will be further evaluated (qualitatively) in the uncertainties analysis section of the Full RFI Report to determine if risk management decisions would be impacted by the fact that LOD exceeds the PAL DL values are presented to aid in the decision making process.

Matrix: Soil
Parameter: Empirical Appendix IX SVOCs (Low-Level Scan)

Analyte	CAS No.	HH PAL (mg/kg)	HH PAL Reference (1, 2, 3)	Ecological PAL (mg/kg)	Ecological PAL Reference (6, 7, 8, 9)	PQLG (mg/kg)	Empirical		
							LOQ (mg/kg)	LOD (mg/kg)	DL (mg/kg)
2-Methylnaphthalene	91-57-6	0.14	RBSSL	29	Eco SSL	0.05	0.00667	0.00333	0.00167
Acenaphthene	83-32-9	4.1	RBSSL	29	Eco SSL	1.37	0.00667	0.00333	0.00167
Acenaphthylene	208-96-8	4.1 (4)	RBSSL	29	Eco SSL	1.37	0.00667	0.00333	0.00167
Anthracene	120-12-7	20	RSSSL	29	Eco SSL	6.67	0.00667	0.00333	0.00167
Benzo(a)anthracene	56-55-3	0.01	RBSSL	18	Eco SSL	0.003	0.00667	0.00333	0.00167
Benzo(a)pyrene	50-32-8	**0.0035**	**RBSSL**	18	Eco SSL	0.001	0.00667	0.00333	0.00167
Benzo(b)fluoranthene	205-99-2	0.035	RBSSL	18	Eco SSL	0.01	0.00667	0.00333	0.00167
Benzo(g,h,i)perylene	191-24-2	9.5(5)	RBSSL	18	Eco SSL	3.17	0.00667	0.00333	0.00167
Benzo(k)fluoranthene	207-08-9	0.35	RBSSL	18	Eco SSL	0.12	0.00667	0.00333	0.00167
Chrysene	218-01-9	1.1	R-RSL	18	Eco SSL	0.37	0.00667	0.00333	0.00167
Dibenzo(a,h)anthracene	53-70-3	**0.011**	**R-RSL**	18	Eco SSL	0.004	0.00667	0.00333	0.00167
Fluoranthene	206-44-0	70	RBSS	29	Eco SSL	9.67	0.00667	0.00333	0.00167
Fluorene	86-73-7	0.14	RBSS	29	Eco SSL	0.05	0.00667	0.00333	0.00167
Indeno(1,2,3-cd)pyrene	193-39-5	0.12	RBSS	18	Eco SSL	0.04	0.00667	0.00333	0.00167
Naphthalene	91-20-3	**0.00047**	**RBSSL**	29	Eco SSL	1.57E-04	0.00667	0.00333	0.00167
Phenanthrene	85-01-8	9.5 (5)	RBSS	29	Eco SSL	3.17	0.00667	0.00333	0.00167
Pyrene	129-00-0	9.5	RBSS	18	Eco SSL	3.17	0.00667	0.00333	0.00167

NC - No criterion available.

Human Health Notes:

1 The R-RSLs and RBSSLs were taken from USEPA's Regional Screening Levels for Chemical Contaminants at Superfund Sites, May, 2012, available online at http://epa-prgs.ornl.gov/chemicals/index.shtml. The RBSSLs are based on a target HQ of 1 for non-carcinogens (denoted with an "N" flag) in the EPA table or an ILCR of 1E-6 for carcinogens (denoted with a "C" flag) in the EPA table.

2 USEPA R-RSLs (May, 2012) for non-carcinogens were adjusted by dividing by 10, yielding a concentration equivalent to a HQ of 0.1. The residential soil screening level for carcinogens (not adjusted) is equivalent to an ILCR of 1E-6.

3 A dilution attenuation factor of 1 was applied to USEPA RBSSLs, site-specific values will be determined based on information collected during the Full RFI.
4 Value is for acenaphthene.
5 Value is for pyrene.

Ecological Notes:

6 USEPA Eco-SSLs available online: http://www.epa.gov/ecotox/ecossl/. The minimum of plant, invertebrate, avian, and herbivorous mammalian screening values presented.
7 USEPA Region 5 SSLs (, August 2003).
8 LANL ESLs, Ecorisk Database, Release 3.0, October 2011. The minimum of plant, earthworm, avian, and mammalian (desert cottontail and deer mouse) screening values presented.
9 Ecological screen criteria were selected in the following order of preference:
a. USEPA Eco-SSL.
b. Lesser of Region 5 SSL and LANL ESL.

DL values are presented to aid in the decision making process.

Matrix: Soil
Parameter: Empirical Appendix IX PCBs

Analyte	CAS No.	HHRA PAL (mg/kg)	HH PAL Reference (1, 2, 3)	Ecological PAL (mg/kg)	Ecological PAL Reference (4, 5, 6, 7)	PQLG (mg/kg)	Empirical		
							LOQ (mg/kg)	LOD (mg/kg)	DL (mg/kg)
Aroclor-1016	12674-11-2	0.092	RBSSL	**0.000332**	**Region 5 SSL**	1.11E-04	0.0167	0.00833	0.00417
Aroclor-1221	11104-28-2	**0.000074**	**RBSSL**	**0.000332**	**Region 5 SSL**	1.11E-04	0.0167	0.00833	0.00417
Aroclor-1232	11141-16-5	**0.000074**	**RBSSL**	**0.000332**	**Region 5 SSL**	1.11E-04	0.0167	0.00833	0.00417
Aroclor-1242	53469-21-9	**0.0053**	**RBSSL**	**0.000332**	**Region 5 SSL**	1.11E-04	0.0167	0.00833	0.00417
Aroclor-1248	12672-29-6	**0.0052**	**RBSSL**	**0.000332**	**Region 5 SSL**	1.11E-04	0.0167	0.00833	0.00417
Aroclor-1254	11097-69-1	0.0088	RBSSL	**0.000332**	**Region 5 SSL**	1.11E-04	0.0167	0.00833	0.00417
Aroclor-1260	11096-82-5	0.024	RBSSL	**0.000332**	**Region 5 SSL**	1.11E-04	0.0167	0.00833	0.00417

NC - No criterion available.

Human Health Notes:

1 The R-RSLs and RBSSLs were taken from USEPA's Regional Screening Levels for Chemical Contaminants at Superfund Sites, May, 2012, available online at http://epa-prgs.ornl.gov/chemicals/index.shtml. The RBSSLs are based on a target HQ of 1 for non-carcinogens (denoted with an "N" flag) in the EPA table or an ILCR of 1E-6 for carcinogens (denoted with a "C" flag) in the EPA table.

2 USEPA R-RSLs (May, 2012) for non-carcinogens were adjusted by dividing by 10, yielding a concentration equivalent to a HQ of 0.1. The residential soil screening level for carcinogens (not adjusted) is equivalent to an ILCR of 1E-6.

3 A dilution attenuation factor of 1 was applied to USEPA RBSSLs, site-specific values will be determined based on information collected during the Full RFI.

Ecological Notes:

4 USEPA Eco-SSLs available online: http://www.epa.gov/ecotox/ecossl/. The minimum of plant, invertebrate, avian, and herbivorous mammalian screening values presented.

5 USEPA Region 5 SSLs (August 2003).

6 LANL ESLs, Ecorisk Database, Release 3.0, October 2011. The minimum of plant, earthworm, avian, and mammalian (desert cottontail and deer mouse) screening values presented.

7 Ecological screen criteria were selected in the following order of preference:
a. USEPA Eco SSL.
b. Lesser of Region 5 SSL and LANL ESL.

Shaded and Bold row indicate the PAL is less than the LOD. The Project Team has agreed to accept this data for decision making as long as results below the LOQ are "J" qualified. Nondetected results reported for analytes where the LOD is greater than the PAL will not be considered COPCs and will not be retained for the quantitative risk assessment. However the impact of such "non-detected results" will be further evaluated (qualitatively) in the DQR and in the uncertainties analysis section of the Full RFI Report to determine if risk management decisions would be impacted by the fact that LOD exceeds the PALDL values are presented to aid in the decision making process.

Matrix: Soil
Parameter: Empirical Metals and Select Metals*

Analyte	CAS No.	HHRA PAL (mg/kg)	HH PAL Reference[1, 2, 3]	Ecological PAL (mg/kg)	Ecological PAL Reference[4, 5, 6, 7]	PQLG (mg/kg)	Empirical		
							LOQ (mg/kg)	LOD (mg/kg)	DL (mg/kg)
Antimony*	7440-36-0	**0.027**	**RBSSL**	10	Eco SSL	0.09	0.50	0.4	0.25
Arsenic*	7440-38-2	**0.0013**	**RBSSL**	18	Eco SSL	4.33E-04	0.5	0.3	0.15
Barium	7440-39-9	120	RBSSL	330	Eco SSL	40	2	0.5	0.25
Beryllium	7440-41-7	13	RBSSL	21	Eco SSL	4.33	0.25	0.1	0.05
Cadmium	7440-43-9	0.52	RBSSL	0.77	Eco SSL	0.17	0.25	0.1	0.05
Chromium (total)	77440-47-3	NC	None	26 [8]	Eco SSL	8.67	0.5	0.2	0.1
Cobalt	7440-48-4	**0.21**	**RBSSL**	0.07	Eco SSL	0.77	0.625	0.5	0.25
Copper*	7440-50-8	22	RBSSL	7.33	Eco SSL	9.33	0.5	0.4	0.2
Lead*	7439-92-1	14	RBSSL	11	Eco SSL	3.67	0.25	0.15	0.075
Mercury	7439-97-6	0.033	RBSSL	**0.013** [9]	**LANL ESL**	4.33E-03	0.033	0.033	0.0130
Nickel	7440-02-0	20	RBSSL	38	Eco SSL	6.67	0.5	0.3	0.15
Selenium	7782-49-2	**0.4**	**RBSSL**	0.52	Eco SSL	0.13	0.5	0.25	0.15
Silver	7440-22-4	0.6	RBSSL	4.2	Eco SSL	0.2	0.5	0.1	0.05
Thallium	7440-28-0	**0.011**	**RBSSL**	**0.0569**	**Region 5 SSL**	3.67E-03	0.4	0.2	0.15
Tin	7440-31-5	2300	RBSSL	7.62	Region 5 SSL	2.54	10	2.5	0.5
Vanadium	7440-62-2	39	R-RSL	7.8	Eco SSL	2.60	0.625	0.5	0.25
Zinc*	7440-66-6	290	RBSSL	46	Eco SSL	15.33	1	0.5	0.25
Cyanide	57-12-5	**0.094**	**RBSSL**	**0.1**	**LANL ESL**	0.03	0.75	0.25	0.125
Sulfide	18496-25-8	NC	NC	**3.58E-03**	**Region 5 SSL**	1.19E-03	116	58	50

NC - No criterion available.
*annotates the select metals

Human Health Notes:

1 The R-RSLs and RBSSLs were taken from USEPA's Regional Screening Levels for Chemical Contaminants at Superfund Sites, May, 2012, available online at http://epa-prgs.ornl.gov/chemicals/index.shtml. The RBSSLs are based on a target HQ of 1 for non-carcinogens (denoted with an "N" flag) in the EPA table or an ILCR of 1E-6 for carcinogens (denoted with a "C" flag) in the EPA table.

2 USEPA R-RSLs (May, 2012) for non-carcinogens were adjusted by dividing by 10, yielding a concentration equivalent to a HQ of 0.1. The residential soil screening level for carcinogens (not adjusted) is equivalent to an ILCR of 1E-6.

3 A dilution attenuation factor of 1 was applied to USEPA RBSSLs, site-specific values will be determined based on information collected during the Full RFI.

Ecological Notes:

4 USEPA Eco-SSLs available online: http://www.epa.gov/ecotox/ecossl/. The minimum of plant, invertebrate, avian, and herbivorous mammalian screening values presented.

5 USEPA Region 5 SSLs (August 2003).

6 LANL ESLs) Ecorisk Database, Release 3.0, October 2011. The minimum of plant, earthworm, avian, and mammalian (desert cottontail and deer mouse) screening values presented.

7 Ecological screen criteria were selected in the following order of preference:
a. USEPA Eco-SSL.
b. Lesser of Region 5 SSL and LANL ESL.

8 Value is for trivalent chromium.

9 Value is for inorganic mercury.

Shaded and Bold row indicate the PAL is less than the LOD. The Project Team has agreed to accept this data for decision making as long as results below the LOQ are "J" qualified. Nondetected results reported for analytes where the LOD is greater than the PAL will not be considered COPCs and will not be retained for the quantitative risk assessment. However the impact of such "non-detected results" will be further evaluated (qualitatively) in the DQR and in the uncertainties analysis section of the Full RFI Report to determine if risk management decisions would be impacted by the fact that LOD exceeds the PAL DL values are presented to aid in the decision making process.

Matrix: Soil
Parameter: TestAmerica Appendix IX Pesticides

Analyte	CAS No.	HHRA PAL (mg/kg)	HH PAL Reference(1, 2, 3)	Ecological PAL (mg/kg)	Ecological PAL Reference(4, 5, 6, 7)	PQLG (mg/kg)	TestAmerica		
							LOQ (mg/kg)	LOD (8) (mg/kg)	DL (8) (mg/kg)
Kepone	143-50-0	**0.00011**	**RBSSL**	0.03272	Region 5 SSL	3.67E-05	0.17	0.17	0.17
Chlorobenzilate	510-15-6	NC	NC	5.05	Region 5 SSL	1.68	0.017	0.017	0.017
Isodrin	465-73-6	NC	NC	0.00332	Region 5 SSL	1.11E-03	0.0033	0.0033	0.0033

NC - No criterion available.

HH Notes:
1 The R-RSLs and RBSSLs were taken from USEPA's Regional Screening Levels for Chemical Contaminants at Superfund Sites, May, 2012, available online at http://epa-prgs.ornl.gov/chemicals/index.shtml. The RBSSLs are based on a target HQ of 1 for non-carcinogens (denoted with an "N" flag) in the EPA table or an ILCR of 1E-6 for carcinogens (denoted with a "C" flag) in the EPA table.
2 USEPA R-RSLs (May, 2012) for non-carcinogens were adjusted by dividing by 10, yielding a concentration equivalent to a HQ of 0.1. The residential soil screening level for carcinogens (not adjusted) is equivalent to an ILCR of 1E-6.
3 A dilution attenuation factor of 1 was applied to USEPA RBSSLs, site-specific values will be determined based on information collected during the Full RFI.

Ecological Notes:
4 USEPA Eco SSLs available online: http://www.epa.gov/ecotox/ecossl/. The minimum of plant, invertebrate, avian, and herbivorous mammalian screening value presented.
5 USEPA Region 5 SSLs (USEPA, August 2003).
6 LANL ESLs, Ecorisk Database release 3.0, October 2011. The minimum of plant, earthworm, avian, and mammalian (Desert Cottontail and Deer Mouse) screening value presented.
7 Ecological Screen Criterion was selected in the following order of preference:
a. USEPA Eco SSL.
b. Lower of Region 5 SSL or LANL ESL.

Laboratory Notes:
8 The LOD is typically 2 to 3 times the DL, however, in some circumstances the this relationship cannot be verified, please see Appendix D for further explanation for these LODs values that do not meet this criteria.

Shaded and Bold row indicate the PAL is less than the LOD. The Project Team has agreed to accept this data for decision making as long as results below the LOQ are "J" qualified. Nondetected results reported for analytes where the LOD is greater than the PAL will not be considered COPCs and will not be retained for the quantitative risk assessment. However the impact of such "non-detected results" will be further evaluated (qualitatively) in the DQR and in the uncertainties analysis section of the Full RFI Report to determine if risk management decisions would be impacted by the fact that LOD exceeds the PAL DL values are presented to aid in the decision making process.

Matrix: Soil
Parameter: Empirical Appendix IX Pesticides

Analyte	CAS No.	HHRA PAL (mg/kg)	HH PAL Reference(1, 2, 3)	Ecological PAL (mg/kg)	Ecological PAL Reference(7, 8, 9, 10)	PQLG (mg/kg)	Empirical		
							LOQ (mg/kg)	LOD (mg/kg)	DL (mg/kg)
Aldrin	309-00-2	**0.000034**	**RBSSL**	0.00332	Region 5 SSL	1.13E-05	0.00067	0.00034	0.00011
alpha-BHC	319-84-6	**0.000036**	**RBSSL**	0.0994	Region 5 SSL	1.2E-05	0.00067	0.00034	0.00011
beta-BHC	319-85-7	**0.00013**	**RBSSL**	0.00398	Region 5 SSL	4.33E-05	0.00067	0.00034	0.00011
delta-BHC	319-86-8	**0.000036** (4)	**RBSSL**	9.94	Region 5 SSL	1.2E-05	0.00067	0.00034	0.00011
gamma-BHC	58-89-9	**0.00021**	**RBSSL**	0.005	Region 5 SSL	7E-05	0.00067	0.00034	0.00011
Chlordane	12789-03-6	**0.0018**	**RBSSL**	0.224	Region 5 SSL	0.0006	0.0034	0.0017	0.00114
4,4'-DDD	72-54-8	0.066	RBSSL	0.093	Eco SSL	0.022	0.00067	0.00034	0.00017
4,4'-DDE	72-55-9	0.046	RBSSL	0.093	Eco SSL	0.015	0.00067	0.00034	0.00017
4,4'-DDT	50-29-3	0.067	RBSSL	0.093	Eco SSL	0.02	0.00067	0.00034	0.00017
Dieldrin	60-57-1	**0.000061**	**RBSSL**	0.022	Eco SSL	2.03E-05	0.00067	0.00034	0.00017
Endosulfan I	115-29-7	1.1 (5)	RBSSL	0.119	Region 5 SSL	0.04	0.00067	0.00034	0.00011
Endosulfan II	33213-65-9	1.1 (5)	RBSSL	0.119	Region 5 SSL	0.04	0.00067	0.00034	0.00017
Endosulfan sulfate	1031-07-8	1.1 (5)	RBSSL	0.0358	Region 5 SSL	0.01	0.00067	0.00034	0.00017
Endrin	72-20-8	0.068	RBSSL	0.0014	LANL ESL	4.67E-04	0.00067	0.00034	0.00017
Endrin aldehyde	7421-93-4	0.068 (6)	RBSSL	0.0105	Region 5 SSL	3.50E-03	0.00067	0.00034	0.00017
Heptachlor	76-44-8	**0.00014**	**RBSSL**	0.00598	Region 5 SSL	4.67E-05	0.00067	0.00034	0.00011
Heptachlor epoxide	1024-57-3	**0.000068**	**RBSSL**	0.152	Region 5 SSL	2.27E-05	0.00067	0.00034	0.00011
Methoxychlor	72-43-5	1.5	RBSSL	0.0199	Region 5 SSL	0.007	0.00067	0.00034	0.00011
Toxaphene	8001-35-2	**0.0021**	**RBSSL**	0.119	Region 5 SSL	0.0007	0.033	0.022	0.011

NC - No criterion available.

Human Health Notes:

1 The R-RSLs and BSSLs were taken from USEPA's Regional Screening Levels for Chemical Contaminants at Superfund Sites, May, 2012, available online at http://epa-prgs.ornl.gov/chemicals/index.shtml. The RBSSLs are based on a target HQ of 1 for non-carcinogens (denoted with an "N" flag) in the EPA table or an ILCR of 1E-6 for carcinogens (denoted with a "C" flag) in the EPA table.

2 USEPA R-RSLs (May, 2012) for non-carcinogens were adjusted by dividing by 10, yielding a concentration equivalent to a HQ of 0.1. The residential soil screening level for carcinogens (not adjusted) is equivalent to an ILCR of 1E-6.

3 A dilution attenuation factor of 1 was applied to USEPA RBSSLs, site-specific values will be determined based on information collected during the Full RFI.

4 - Value is for alpha-BHC.

5 - Value is for Endosulfan.

6 - Value is for Endrin.

Ecological Notes:

7 - USEPA Eco SSLs available online: http://www.epa.gov/ecotox/ecossl/. The minimum of plant, invertebrate, avian, and herbivorous mammalian screening value presented.

8 - USEPA Region 5 SSLs (USEPA, August 2003).

9 - LANL ESLs, Ecorisk Database release 3.0, October 2011. The minimum of plant, earthworm, avian, and mammalian (Desert Cottontail and Deer Mouse) screening value presented.

10 - Ecological Screen Criterion was selected in the following order of preference:

a. USEPA Eco SSL.

b. Lower of Region 5 SSL or LANL ESL.

DL values are presented to aid in the decision making process.

Matrix: Soil
Parameter: Empirical Explosives plus NG

Analyte	CAS No.	HHRA PAL (mg/kg)	HH PAL Reference (1, 2, 3)	Ecological PAL (mg/kg)	Ecological PAL Reference (4, 5, 6, 7)	PQLG (mg/kg)	Empirical		
							LOQ (mg/kg)	LOD (mg/kg)	DL (mg/kg)
Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)	2691-41-0	0.99	RBSSL	27	LANL ESL	0.33	0.400	0.200	0.100
Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX)	121-82-4	**0.00023**	**RBSSL**	7.5	LANL ESL	7.67E-05	0.400	0.200	0.100
1,3,5-Trinitrobenzene	99-35-4	1.7	RBSSL	**0.376**	**Region 5 SSL**	0.13	0.400	0.200	0.100
1,3-Dinitrobenzene	99-65-0	**0.0014**	**RBSSL**	0.655	Region 5 SSL	4.67E-04	0.400	0.200	0.100
Methyl-2,4,6-trinitrophenylnitramine (Tetryl)	479-45-8	0.59	RBSSL	0.073	LANL ESL	0.024	0.400	0.200	0.100
Nitrobenzene	98-95-3	**0.000079**	**RBSSL**	1.31	Region 5 SSL	2.6E-05	0.400	0.200	0.100
2,4,6-Trinitrotoluene	118-96-7	**0.013**	**RBSSL**	6.4	LANL ESL	0.004	0.400	0.200	0.100
4-Amino-2,6-dinitrotoluene	19406-51-0	**0.023**	**RBSSL**	3.6	LANL ESL	0.008	0.400	0.200	0.100
2-Amino-4,6-dinitrotoluene	35572-78-2	**0.023**	**RBSSL**	10	LANL ESL	0.008	0.400	0.200	0.100
2,4-Dinitrotoluene	121-14-2	**0.00028**	**RBSSL**	1.28	Region 5 SSL	9.33E-05	0.400	0.200	0.100
2,6-Dinitrotoluene	606-20-2	**0.02**	**RBSSL**	**0.0328**	**Region 5 SSL**	0.007	0.400	0.200	0.100
2-Nitrotoluene	88-72-2	**0.00025**	**RBSSL**	9.9	LANL ESL	8.33E-05	0.400	0.200	0.100
3-Nitrotoluene	99-08-1	**0.0012**	**RBSSL**	12	LANL ESL	0.0004	0.400	0.200	0.100
4-Nitrotoluene	99-99-0	**0.0034**	**RBSSL**	22	LANL ESL	0.001	0.400	0.200	0.100
Nitroglycerin	55-63-0	**0.00066**	**RBSSL**	71	LANL ESL	0.0002	1.00	0.500	0.250

NC - No criterion available.

Human Health Notes:

1 The R-RSLs and RBSSLs were taken from USEPA's Regional Screening Levels for Chemical Contaminants at Superfund Sites, May, 2012, available online at http://epa-prgs.ornl.gov/chemicals/index.shtml. The RBSSLs are based on a target HQ of 1 for non-carcinogens (denoted with an "N" flag) in the EPA table or ILCR of 1E-6 for carcinogens (denoted with a "C" flag) in the EPA table.

2 USEPA R-RSLs (May, 2012) for non-carcinogens were adjusted by dividing by 10, yielding a concentration equivalent to a HQ of 0.1. The residential soil screening level for carcinogens (not adjusted) is equivalent to an ILCR of 1E-6.
3 A dilution attenuation factor of 1 was applied to USEPA RBSSLs, site-specific values will be determined based on information collected during the Full RFI.

Ecological Notes:
4 - USEPA Eco SSLs available online: http://www.epa.gov/ecotox/ecossl/. The minimum of plant, invertebrate, avian, and herbivorous mammalian screening value presented.
5 - USEPA Region 5 SSLs (USEPA, August 2003).
6 - LANL ESLs, Ecorisk Database release 3.0, October 2011. The minimum of plant, earthworm, avian, and mammalian (Desert Cottontail and Deer Mouse) screening value presented.
7 - Ecological Screen Criterion was selected in the following order of preference:
a. USEPA Eco SSL.
b. Lower of Region 5 SSL or LANL ESL.

Bolded rows indicate that the PAL is between the laboratory LOQ and LOD. The Project Team has agreed to accept this data for decision making as long as results below the LOQ are "J" qualified. Nondetected results reported for analytes where the LOD is greater than the PAL will not be considered COPCs and will not be retained for the quantitative risk assessment. However the impact of such "non-detected results" will be further evaluated (qualitatively) in the uncertainties analysis section of the Full RFI Report to determine if risk management decisions would be impacted by the fact that LOD exceeds the PAL

Shaded and Bold row indicate the PAL is less than the LOD. The Project Team has agreed to accept this data for decision making as long as results below the LOQ are "J" qualified. Nondetected results reported for analytes where the LOD is greater than the PAL will not be considered COPCs and will not be retained for the quantitative risk assessment. However the impact of such "non-detected results" will be further evaluated (qualitatively) in the DQR and in the uncertainties analysis section of the Full RFI Report to determine if risk management decisions would be impacted by the fact that LOD exceeds the PAL DL values are presented to aid in the decision making process.

Matrix: Soil
Parameter: Empirical Appendix IX Herbicides

Analyte	CAS No.	HHRA PAL (mg/kg)	HH PAL Reference (1, 2, 3)	Ecological PAL (mg/kg)	Ecological PAL Reference (4, 5, 6, 7)	PQLG (mg/kg)	Empirical		
							LOQ (mg/kg)	LOD (mg/kg)	DL (mg/kg)
2,4-D	94-75-7	**0.035**	**RBSSL**	**0.0272**	**Region 5 SSL**	0.01	0.1	0.05	0.025
Silvex (2,4,5-TP)	93-72-1	0.046	RBSSL	0.109	Region 5 SSL	0.015	0.01	0.005	0.0025
2,4,5-T	93-76-5	0.052	RBSSL	0.596	Region 5 SSL	0.017	0.01	0.005	0.0025

HH Notes:
1 The R-RSLs and RBSSLs were taken from USEPA's Regional Screening Levels for Chemical Contaminants at Superfund Sites, May, 2012, available online at http://epa-prgs.ornl.gov/chemicals/index.shtml. The RBSSLs are based on a target HQ of 1 for non-carcinogens (denoted with an "N" flag) in the EPA table or an ILCR of 1E-6 for carcinogens (denoted with a "C" flag) in the EPA table.
2 USEPA R-RSLs (May, 2012) for non-carcinogens were adjusted by dividing by 10, yielding a concentration equivalent to a HQ of 0.1. The residential soil screening level for carcinogens (not adjusted) is equivalent to an ILCR of 1E-6.
3 A dilution attenuation factor of 1 was applied to USEPA RBSSLs, site-specific values will be determined based on information collected during the Full RFI.

Ecological Notes:
4 - USEPA Eco SSLs available online: http://www.epa.gov/ecotox/ecossl/. The minimum of plant, invertebrate, avian, and herbivorous mammalian screening value presented.
5 - USEPA Region 5 SSLs (USEPA, August 2003).
6 - LANL ESLs, Ecorisk Database release 3.0, October 2011. The minimum of plant, earthworm, avian, and mammalian (Desert Cottontail and Deer Mouse) screening value presented.
7 - Ecological Screen Criterion was selected in the following order of preference:
a. USEPA Eco SSL.
b. Lower of Region 5 SSL or LANL ESL.

Shaded and Bold row indicate the PAL is less than the LOD. The Project Team has agreed to accept this data for decision making as long as results below the LOQ are "J" qualified. Nondetected results reported for analytes where the LOD is greater than the PAL will not be considered COPCs and will not be retained for the quantitative risk assessment. However the impact of such "non-detected results" will be further evaluated (qualitatively) in the DQR and in the uncertainties analysis section of the Full RFI Report to determine if risk management decisions would be impacted by the fact that LOD exceeds the PAL DL values are presented to aid in the decision making process.

Matrix: IDW
Parameter: TCLP Regulatory

Analyte	CAS No.	PAL (mg/L)	PAL Reference	PQLG (mg/L)	Empirical Quantitation Limit (mg/L)
IDW - TCLP Regulatory List Compounds					
Benzene	71-43-2	0.5	REG	0.1	0.01
Carbon Tetrachloride	56-23-5	0.5	REG	0.1	0.01
Chlorobenzene	108-90-7	100	REG	5	0.01
Chloroform	67-66-3	6	REG	2	0.01
1,2-Dichloroethane	107-06-2	0.5	REG	0.1	0.01
1,1-Dichloroethene	75-35-4	0.7	REG	0.1	0.01
2-Butanone	78-93-3	200	REG	0.5	0.1
Tetrachloroethene	127-18-4	0.7	REG	0.1	0.01
Trichloroethene	79-01-6	0.5	REG	0.1	0.01
Vinyl Chloride	75-01-4	0.2	REG	0.04	0.01
O-Cresol	95-48-7	200	REG	0.5	0.05
M-Cresol	95-48-7	200	REG	0.5	0.05
P-Cresol	106-44-5	200	REG	0.5	0.05
1,4-Dichlorobenzene	106-46-7	7.5	REG	0.2	0.01
2,4-Dinitrotoluene	121-14-2	0.13	REG	0.02	0.05
Hexachlorobenzene	118-74-1	0.13	REG	0.02	0.05
Hexachloro-1,3-Butadiene	87-68-3	0.5	REG	0.1	0.05
Hexachloroethane	67-72-1	3	REG	0.2	0.05
Nitrobenzene	98-95-3	2	REG	0.2	0.05
Pentachlorophenol	87-86-5	100	REG	0.5	0.2
Pyridine	110-86-1	5	REG	0.2	0.10
2,4,5-Trichlorophenol	95-95-4	400	REG	0.5	0.05
2,4,6-Trichlorophenol	88-06-2	2	REG	0.2	0.05
Chlordane	57-74-9	0.03	REG	0.001	0.001
Endrin	72-20-8	0.02	REG	0.001	0.0002

Analyte	CAS No.	PAL (mg/L)	PAL Reference	PQLG (mg/L)	Empirical Quantitation Limit (mg/L)
IDW - TCLP Regulatory List Compounds					
Heptachloro	76-44-8	0.008	REG	0.001	0.0002
Heptachlor Epoxide	1024-57-3	0.008	REG	0.001	0.0002
Lindane	58-89-9	0.4	REG	0.05	0.0002
Methoxychlor	72-43-5	10	REG	0.5	0.0002
Toxaphene	8001-35-2	0.5	REG	0.1	0.01
2,4-D	94-75-7	10	REG	0.5	0.1
2,4,5-TP (Silvex)	93-72-1	1	REG	0.1	0.01
Arsenic	7440-38-2	5	REG	1	0.1
Barium	7440-39-3	100	REG	20	0.4
Cadmium	7440-43-9	1	REG	0.2	0.05
Chromium	7440-47-3	5	REG	1	0.1
Lead	7439-92-1	5	REG	1	0.03
Mercury	7439-97-6	0.2	REG	0.05	0.002
Selenium	7782-49-2	1	REG	0.2	0.1
Silver	7440-22-4	5	REG	1	0.1

IDW - Investigative Derived Waste
TCLP - Toxicity Characteristic Leaching procedure
REG = The project action limit is the TCLP regulatory level.
All IDW results will be reported to the Laboratory Quantitation Limit.

SAP Worksheet #16 – Project Schedule/Timeline Table

(UFP-QAPP Manual Section 2.8.2)

Activity	Organization	Dates (MM/YYYY)	
		Anticipated Date(s) of Initiation	Anticipated Date of Completion
Prepare Draft Full RFI SAP	Tetra Tech, Navy	08/2011	12/2011
Submit Draft Full RFI SAP	Tetra Tech	12/2011	12/2011
Review	USEPA, PREQB	12/2011	02/2012
Receive Comments/Resolve Comments	Tetra Tech, Navy, USEPA, PREQB	02/2012	03/2012
Prepare Final Full RFI SAP	Tetra Tech	02/2012	08/2012
Submit Final RI/RFI SAP	Tetra Tech	08/2012	08/2012
Field Investigation	Tetra Tech	09/2012	09/2012
Prepare Pre-Draft Full RFI Report	Tetra Tech	10/2012	03/2013
Submit Pre-Draft Full RFI Report	Tetra Tech	03/2013	03/2013
Review	Navy	03/2013	04/2013
Receive Comments/Resolve Comments	Tetra Tech, Navy	04/2013	05/2013
Prepare Draft Full RFI Report	Tetra Tech	04/2013	05/2013
Submit Draft Full RFI Report	Tetra Tech	05/2013	05/2013
Review	USEPA, PREQB	05/2013	07/2013
Receive Comments/Resolve Comments	Tetra Tech, Navy, USEPA, PREQB	07/2013	08/2013
Prepare Final Full RFI Report	Tetra Tech	07/2013	09/2013
Submit Final Full RFI Report	Tetra Tech	09/2013	09/2013

SAP Worksheet #17 – Sampling Design and Rationale

(UFP-QAPP Manual Section 3.1.1)

17.1 INTRODUCTION

This section describes sampling locations, methods, and rationales for the Full RFI field effort to be conducted at the following six subareas at SWMU 77:

- Pistol Range Subarea
- Former Pistol Range Subarea
- Detonation Area Near Concrete Pad Subarea
- Rifle Range Subarea
- Potential OB/OD Subarea
- Potential Munitions Trench Subarea

The Full RFI is focused on determining the lateral and vertical extent of MC contamination, as applicable per subarea, and possibly non-MC-related contamination and to determine if soil contamination is present that may impact groundwater. The Full RFI will also address data gaps identified during the Phase I RFI review process (Tetra Tech, 2011, Phase I results are presented in Appendix B-3 of Volume I and Attachment 1-4 of Volume II). Evaluation of SWMU 77 groundwater will be deferred to a later phase of investigation, after the MEC investigation and soil results are known, if warranted based on evaluation of these results.

General sampling rationale and programs for each of the six subareas are discussed in Sections 17.3.1 through 17.3.6 and details are presented in Worksheets #18.1 through #18.7.

17.2 GENERAL SAMPLING DESIGN AND RATIONALE

Archeological items, if any encountered during SWMU 77 fieldwork (e.g., fragments of pottery), will be flagged and recorded via GPS. The item(s) will be left in place and the location(s) will be avoided until direction is received from the project Navy archeologist at NAVFAC SE, Darrell Gundrum, phone 904-542-6844, e-mail darrell.gundrum@navy.mil.

All referenced field SOPs are presented in Appendix C. Each soil sample location will be marked with a brightly colored pin flag. Additional brightly colored flagging may be tied to an adjacent tree or shrub to identify a sample location. Sample locations may be adjusted due to field observations and conditions

(vegetation). There will be clearing/cutting of vegetation in support of MC sample collection activities at the Pistol Range Subarea and Former Pistol Range Subarea. Coordinates for the actual soil sample locations will be determined by a sub-meter accuracy GPS, which will allow for future studies or guide in any removal action. Pre-determined GIS-grade sample coordinates may be used in locating proposed sample locations. All sample location markers will be removed prior to final demobilization.

All field visual observations, including physical observation of bullets, MEC/MPPEH, drums, etc., will be recorded on the sample log sheets and in daily field records. Any encounters with metallic objects or other objects that indicate a potential contaminant source or hazard will be documented in the field notes and reported to the FOL/SSO and/or UXO Technician, and appropriate actions will be taken as specified in this UFP-SAP and associated HASP and ESS (provided to the field team under separate cover.), along with additional guidance provided in the final MEC UFP-SAP.

For the Pistol Range Subarea, Former Pistol Range Subarea, and Rifle Range Subarea (both Target Area Earthen Berm and Wooded Embankment), a bucket evaluation will be conducted to quantify lead impacts from bullets (slugs or casings), in order to evaluate potential exposures and consider future actions at these subareas. The bucket evaluation for a given subarea will be conducted after the soil sampling effort such that the location of the bucket evaluation can be determined based on field observation of biased high bullet density. Approximately five pounds of soil will be collected and placed into a clean container (e.g., single-use bucket) for this evaluation. The Tetra Tech field geologist will classify the soils in the bucket and collect a soil sample for pH analysis. The total weight of the soil will be determined and a soil sample collected for pH analysis, then the entire sample screened using a 0.25-inch wire screen, and then the residual items (i.e., bullets) weighed such that the relative percent by weight of bullets vs. soil may be determined.

At the Rifle Range Subarea, Potential OB/OD Subarea, and Potential Munitions Trench Subarea, MEC investigations will take place, including brush cutting/vegetation management, detector-aided surface surveys, geophysical surveys, and intrusive investigation to further delineate subsurface anomalies and to relocate the anomaly areas identified during the Phase I RFI (Tetra Tech, 2011, Phase I results are presented in Appendix B-3 of Volume I). Intrusive activities will be conducted to determine the sources of the subsurface anomalies. Following/during the MEC investigation field event, the data will be interpreted and will be used to guide the MC investigation. Complete details regarding the MEC investigation is provided in the MEC UFP-SAP (Appendix A, Volume 2).

17.3 DATA COLLECTION PLAN FOR SWMU 77

Sampling details for each individual subarea are provided in the following subsections below. Details regarding soil sampling procedures are provided in Worksheet #14 and applicable SOPs provided in Appendix C. QA/QC samples will be collected at the frequencies listed in Worksheet #12.

17.3.1 Pistol Range Subarea

The Pistol Range Subarea consists of two adjacent 25-yard 10-firing-point pistol ranges, with an earthen berm located behind the targets and used as a bullet stop (see Figure 17-1).

Up to 22 discrete surface (0 to 6 inches bgs) soil samples will be collected from the Pistol Range Subarea, as shown on Figure 17-1, to determine the lateral extent of contamination found during the Phase I RFI (Tetra Tech, 2011, results are presented in Appendix B-3). Six of the 22 samples (locations 77PRSB037 through 77PRSB042) will be collected from above the natural embankment, six samples (locations 77PRSB043 through 77PRSB048), which will also have co-located subsurface soil samples (0.5 to 2 feet bgs), will be collected from the toe of the natural embankment, and up to 10 samples (77PRSB049 through 77PRSB058) will be collected from locations scattered around the range and between the firing lines. Twelve discrete subsurface (0.5 to 2 feet bgs) soil samples (locations 77PRSB059 through 77PRSB070) will be collected from samples distributed throughout the natural embankment to determine the vertical extent into the berm of contamination found during the Phase I RFI (Tetra Tech, 2011, results are presented in Appendix B-3). Two discrete subsurface (0.5 to 2 feet bgs) soil samples (locations 77PRSB071 and 77PRSB072) will be collected at the firing lines which has the two highest detections of NG during the Phase I RFI to determine if NG is present and if it is migrating to the subsurface. In addition, up to four discretionary samples (77PRSB073 through 77PRSB076) may be collected at locations to be determined in the field to better characterize surface and/or subsurface soil. All of the soil samples will be submitted to the laboratory for select metals (antimony, arsenic, copper, lead, and zinc) analysis with the exception of the firing line samples which will be analyzed for NG.

17.3.2 Former Pistol Range Subarea

The Former Pistol Range Subarea consists of a pistol range of unknown size and presumably, at one time, a target area with an earthen berm that was used as a bullet stop.

Eight discrete surface (0 to 6 inches bgs) soil samples (locations 77FPSB033 through 77FPSB040) will be collected from the Former Pistol Range, as shown on Figure 17-2, to determine the lateral extent of contamination found during the Phase I RFI (Tetra Tech, 2011, results are presented in Appendix B-3).

The samples are located approximately 30 and 60 feet northwest and west of the samples collected during the Phase I RFI. In addition, up to four discretionary surface soil samples (77FPSB041 through 77FPSB044) may be collected at locations to be determined in the field to better characterize surface soil. All of the soil samples will be analyzed for select metals (antimony, arsenic, copper, lead, and zinc).

17.3.3 Detonation Area Near Concrete Pad Subarea

The Detonation Area Near Concrete Pad Subarea has limited evidence of munitions-related activities on the soil surface; however, detonation activity is known to have occurred during a one-time event in the surface depression off the northern corner of the concrete pad. Nine discrete surface (0 to 6 inches bgs) soil samples (locations 77DASB003 through 77DASB011) will be collected from across the site, as illustrated on Figure 17-3. The samples are located largely based on topography to target contamination migration pathway via overland flow. Four of the Full RFI samples are located around the detonation area, one is in between the detonation area and the low-draining area, two are within the low-draining area (east and west side), and two samples are just outside of the low-draining area (to the south and east side). The sample results will be combined with the Phase I RFI results to complete risk assessments and to better characterize site soil (Tetra Tech, 2011, results are presented in Appendix B-3 of Volume I) and in order to have an adequate number of samples to conduct risk assessment. In addition, up to four discretionally samples (77DASB015 through 77DASB017) may be collected at locations to be determined by the field personnel base on site specific observations. These samples will be used to fully characterize site soil. All of the surface soil samples will be analyzed for select metals (antimony, arsenic, copper, lead, and zinc) and NG. Two subsurface soil samples (77DASB012 and 77DASB013), for NG analysis, will be collected at the location of the two surface soil samples collected during the Phase I RFI to determine if NG may be migrating to the subsurface.

17.3.4 Rifle Range Subarea

The Rifle Range Subarea consists of a 500-yard range with elevated firing lines (100-yard, 200-yard, 300-yard, and 500-yard) and a short-yardage range with firing lines (7-yard, 15-yard, and 25-yard) located just in front of a constructed earthen berm at the northeastern end of the Rifle Range. The earthen berm served the short-yardage range and low-hitting shots from the Rifle Range, and fired bullets are visible on the berm. The berm is backed by a concrete wall with elevated targets serving the Rifle Range, and a natural, steep, wooded embankment beyond the earthen berm/concrete wall serves as the backstop for these elevated targets.

Target Area Earthen Berm and Wooded Embankment

MEC investigation is proposed for the Rifle Range Subareas (earthen berm and wooded embankment) because munitions items were observed on the land surface, and subsurface anomalies were detected during the Phase I RFI (Tetra Tech, 2011, results are presented in Attachment 1-4 of Volume II). UXO Technicians will conduct a detector-aided surface survey and intrusive investigations of the areas surrounding the embankment during the first phase of the investigation, and these results will guide the samplers to the sampling locations. Details regarding MEC field investigation activities are provided in the MEC SAP (Appendix A, Volume 2).

MC sampling will include surface (0 to 6 inches bgs) and subsurface (0.5 to 2 feet bgs) soil collected at locations within the subarea, and locations outside of and surrounding the subarea (see Figure 17-5). A UXO Technician will be required for sampling at the Rifle Range Subarea earthen berm and wooded embankment beyond the berm, and UXO avoidance will be practiced during MC sampling.

Ten discrete subsurface soil samples (locations 77RRSB058 through 77RRSB067) will be collected into the face of the constructed earthen berm, and discrete subsurface soil samples (locations 77RRSB068 through 77RRSB077) will be collected from into the wooded embankment (see Figure 17-5). These samples are intended to determine the vertical extent of contamination detected in surface soil during the Phase I RFI. The locations were selected to provide data throughout the constructed earthen berm and wooded embankment areas where Phase I RFI samples were collected (Tetra Tech, 2011, results are presented in Appendix B-3). The samples will be submitted to the laboratory for select metals (antimony, arsenic, copper, lead, and zinc) analysis.

Five soil boring locations (77RRSB078 through 77RRSB082) are proposed for the flat area just behind the target stands (between the earthen berm and wooded embankment), and five soil borings (77RRSB083 through 77RRSB087) are proposed in the short-yardage target stands area. At each soil boring location, discrete surface and subsurface soil samples will be collected to determine the nature and vertical and lateral extent of the soil contamination. The samples will be submitted to the laboratory for select metals (antimony, arsenic, copper, lead, and zinc) and explosives analysis.

Up to 14 surface soil samples (locations 77RRSB088 through 77RRSB101) are proposed for collection outside of the study area to define the lateral extent of the contamination (see Figure 17-5). The samples will be submitted to the laboratory for select metals (antimony, arsenic, copper, lead, and zinc) analysis.

In addition, up to four discretionary samples (77RRSB113 through 77RRSB116) are proposed for collection at locations based on field observations at the discretion of the FOL and in consultation with the UXO Technician and Tetra Tech PM. The analytical group for the discretionary samples will be based on the sample collection area, i.e., firing lines, earthen berm, and will match the analysis for those areas as discussed in this section.

Firing Lines

Five discrete surface (0 to 6 inches bgs) and subsurface (0.6 to 2 feet bgs) soil samples (locations 77RRSB102 through 77RRSB106) will be collected and analyzed for NG from the Rifle Range 200-yard firing line to further investigate and confirm the detections of NG in the composite sample collected during the Phase I RFI (see Figure 17-4 for Full RFI sampling locations). Samples collected from the 200-yard firing line will also be analyzed for select metals (antimony, arsenic, copper, lead, and zinc) to better define the nature of contamination; samples collected during the Phase I RFI did not include metals analysis. (Tetra Tech, 2011, results are presented in Appendix B-3)

Phase I RFI composite samples collected and analyzed for NG at the other firing lines had concentrations less than human health risk-based screening levels. However, because NG was detected, and to confirm that NG has not migrated to the subsurface, a subsurface soil sample (77RRSB107 through 77RRSB112) will be collected from the mid-point of each of the remaining six firing lines for NG analysis (Tetra Tech, 2011, results are presented in Appendix B-3).

17.3.5 Potential OB/OD Subarea

The Potential OB/OD Subarea has no visible evidence of munitions-related activities; however, historical aerial photographs that appear to show constructed semi-circular berms support the potential for OB/OD activities to have taken place in this area. It is also possible that landfilling activities took place in this area. Due to the unknown nature of past activities in this area, a UXO Technician will be required during MC sampling, and UXO avoidance procedures will be practiced.

Intrusive activities (excavations) will be conducted during the MEC phase of investigation (detailed in Volume II of the UFP-SAP). A minimum of 9 samples including one sample per test pit and up to a maximum of 12 discrete soil samples (depths and locations to be determined based on MEC excavation results) (locations 77OBSB011 through 77OBSB022) will be collected at the areas of test pit and hand dig excavations (see Volume II for locations of test pits and hand dig excavations). Regardless of whether MEC and/or landfill debris are encountered, soil samples will be collected to provide adequate analytical

data to conduct a risk assessment for this subarea, although the suite of analytes will vary depending on the source of the anomalies. If no evidence of contamination is present, a minimum of one sample will be collected from the center of the given excavation. All of the soil samples collected will be submitted to the laboratory, at a minimum, for explosives and select metals (antimony, arsenic, copper, lead, and zinc) analysis. However, if during the intrusive MEC activities, evidence of landfilling is found (see Figure 11-1A), the sample(s) will also be submitted to the laboratory for NG and Appendix IX VOC, SVOC, pesticide, herbicide, PCB, and metals analysis, as applicable. If encountered, the FOL will document the extent of landfill debris and the locations of any drums or other potentially hazardous waste source containing items using a GPS unit. In addition, photographs of the various types of debris found onsite will be taken and item descriptions and photograph numbers will be documented in the field log book. This information in conjunction with associated analytical results (MC scope) and extent of geophysical survey anomalies (MEC scope) determined during the Phase I RFI and Full RFI, will be used to determine nature and extent of contamination. If contamination is identifiable, e.g., drum of solvent, the Project Team will be consulted to determine if a reduced analyte set is appropriate. If unidentifiable, then samples will be analyzed for all analytes as listed.

The MC sampling at the Potential OB/OD Subarea will also include collection of four discrete surface (0 to 6 inches bgs) soil samples (locations 77OBSB007 through 77OBSB010) located across the site as shown on Figure 17-6 to better characterize the surface soil and in order to have an adequate number of samples to conduct risk assessment. In addition, up to four discretionary surface or subsurface soil samples (77OBSB023 through 77OBSB026) may be collected at locations to be determined in the field to fully characterize surface and subsurface soil.

17.3.6 Potential Munitions Trench Subarea

The Potential Munitions Trench Subarea has no visible evidence of munitions-related activities on the land surface; however, MEC disposal is suspected in this area based on historical aerial photographs that appear to show multiple linear features. It is also possible that landfilling activities took place in this area. Due to the unknown nature of past activities in this area, a UXO Technician will be required for MC sampling, and UXO avoidance procedures will be practiced.

Intrusive activities (excavations) will be conducted during the MEC phase of investigation (detailed in Volume II of the UFP-SAP). Ten discrete soil samples (depths and locations to be determined based on MEC excavation results) (locations 77MTSB011 through 77MTSB020) will be collected at the areas of excavation (see Volume II for locations of the excavations). Regardless of whether MEC and/or landfill

debris are encountered, a minimum of 10 subsurface soil samples will be collected to provide sufficient data to conduct a risk assessment for this subarea.

The MC sampling will also include collection of seven discrete surface (0 to 6 inches bgs) soil samples (locations 77MTSB004 through 77MTSB010) located across the site as shown on Figure 17-7, to better characterize the surface soil and in order to have an adequate number of samples to conduct risk assessment.

All of the soil samples collected will be submitted to the laboratory for explosives and select metals (antimony, arsenic, copper, lead, and zinc) analysis. However, if during intrusive MEC activities, landfill debris (see Figure 11-1A) is encountered the soil sample(s) will be collected and analyzed for NG and Appendix IX VOCs, SVOCs, pesticides, herbicides, PCBs, and metals, as applicable. If encountered, the FOL will document the extent of landfill debris and the locations of any drums or other potentially hazardous waste source containing items using a GPS unit. In addition, photographs of the various types of debris found onsite will be taken and item descriptions and photograph numbers will be documented in the field log book. This information, in conjunction with associated analytical results (MC scope) and extent of geophysical survey anomalies (MEC scope) determined during the Phase I RFI and Full RFI, will be used to determine nature and extent of contamination. If contamination is identifiable, e.g., drum of solvent, the Project Team will be consulted to determine if a reduced analyte set is appropriate. If unidentifiable, then samples will be analyzed for all analytes as listed.

In addition, up to four discretionary surface or subsurface soil samples (77MTSB021 through 77MTSB024) may be collected at locations to be determined in the field to fully characterize the surface and subsurface soil.

SAP Worksheet #18.1 – Pistol Range Subarea Sampling Locations and Methods/SOP Requirements Table

Sampling Location	ID Number	Matrix	Depth (feet bgs)	Analytical Group	Number of Samples Per Location (identify field duplicates)	Sampling SOP Reference	Sample Rationale
ABOVE NATURAL EMBANKMENT (six samples)							
77PRSB037	77PR-SS037G-00.5 77PR-FDmmddyy-01	Surface Soil	0 – 0.5	Select metals; antimony, arsenic, copper, lead, and zinc	2 (duplicate)	SOP-01, SOP-02, SOP-03, SOP-04, SOP-05, SOP-06, SOP-07, SOP-08, and SOP-09	To determine the lateral extent of MC (selecte metals) contamination above and around the natural embankment (found during the Phase I RFI; Tetra Tech, 2011, results presented in Appendix B-3).
77PRSB038	77PR-SS038G-00.5	Surface Soil	0 – 0.5	Select metals; antimony, arsenic, copper, lead, and zinc	1	SOP-01, SOP-02, SOP-03, SOP-04, SOP-05, SOP-06, SOP-07, SOP-08, and SOP-09	To determine the lateral extent of MC (selecte metals) contamination above and around the natural embankment (found during the Phase I RFI; Tetra Tech, 2011, results presented in Appendix B-3).
77PRSB039	77PR-SS039G-00.5	Surface Soil	0 – 0.5	Select metals; antimony, arsenic, copper, lead, and zinc	1	SOP-01, SOP-02, SOP-03, SOP-04, SOP-05, SOP-06, SOP-07, SOP-08, and SOP-09	To determine the lateral extent of MC (selecte metals) contamination above and around the natural embankment (found during the Phase I RFI; Tetra Tech, 2011, results presented in Appendix B-3).
77PRSB040	77PR-SS040G-00.5	Surface Soil	0 – 0.5	Select metals; antimony, arsenic, copper, lead, and zinc	1	SOP-01, SOP-02, SOP-03, SOP-04, SOP-05, SOP-06, SOP-07, SOP-08, and SOP-09	To determine the lateral extent of MC (selecte metals) contamination above and around the natural embankment (found during the Phase I RFI; Tetra Tech, 2011, results presented in Appendix B-3).
77PRSB041	77PR-SS041G-00.5	Surface Soil	0 – 0.5	Select metals; antimony, arsenic, copper, lead, and zinc	1	SOP-01, SOP-02, SOP-03, SOP-04, SOP-05, SOP-06, SOP-07, SOP-08, and SOP-09	To determine the lateral extent of MC (selecte metals) contamination above and around the natural embankment (found during the Phase I RFI; Tetra Tech, 2011, results presented in Appendix B-3).
77PRSB042	77PR-SS042G-00.5	Surface Soil	0 – 0.5	Select metals; antimony, arsenic, copper, lead, and zinc	1	SOP-01, SOP-02, SOP-03, SOP-04, SOP-05, SOP-06, SOP-07, SOP-08, and SOP-09	To determine the lateral extent of MC (selecte metals) contamination above and around the natural embankment (found during the Phase I RFI; Tetra Tech, 2011, results presented in Appendix B-3).
NATURAL EMBANKMENT (12 samples)							
77PRSB043	77PR-SS043G-00.5	Surface Soil	0 – 0.5	Select metals; antimony, arsenic, copper, lead, and zinc	1	SOP-01, SOP-02, SOP-03, SOP-04, SOP-05, SOP-06, SOP-07, SOP-08, and SOP-09	To determine the lateral extent of MC (select metals) contamination below and at the natural embankment (found during the Phase I RFI; Tetra Tech, 2011, results presented in Appendix B-3).
77PRSB043	77PR-SB043G-0.502 77PR-FDmmddyy-04	Subsurface Soil	0.5 – 2	Select metals; antimony, arsenic, copper, lead, and zinc	2 (duplicate)	SOP-01, SOP-02, SOP-03, SOP-04, SOP-05, SOP-06, SOP-07, SOP-08, and SOP-09	To determine the vertical extent of MC (select metals) contamination below and at the natural embankment (found during the Phase I RFI; Tetra Tech, 2011, results presented in Appendix B-3).
77PRSB044	77PR-SS044G-00.5	Surface Soil	0 – 0.5	Select metals; antimony, arsenic, copper, lead, and zinc	1	SOP-01, SOP-02, SOP-03, SOP-04, SOP-05, SOP-06, SOP-07, SOP-08, and SOP-09	To determine the lateral extent of MC (select metals) contamination below and at the natural embankment (found during the Phase I RFI; Tetra Tech, 2011, results presented in Appendix B-3).

Sampling Location	ID Number	Matrix	Depth (feet bgs)	Analytical Group	Number of Samples Per Location (identify field duplicates)	Sampling SOP Reference	Sample Rationale
77PRSB044	77PR-SB044G-0.502	Subsurface Soil	0.5 – 2	Select metals; antimony, arsenic, copper, lead, and zinc	1	SOP-01, SOP-02, SOP-03, SOP-04, SOP-05, SOP-06, SOP-07, SOP-08, and SOP-09	To determine the vertical extent of MC (select metals) contamination below and at the natural embankment (found during the Phase I RFI; Tetra Tech, 2011, results presented in Appendix B-3).
77PRSB045	77PR-SS045G-00.5	Surface Soil	0 – 0.5	Select metals; antimony, arsenic, copper, lead, and zinc	1	SOP-01, SOP-02, SOP-03, SOP-04, SOP-05, SOP-06, SOP-07, SOP-08, and SOP-09	To determine the lateral extent of MC (select metals) contamination below and at the natural embankment (found during the Phase I RFI; Tetra Tech, 2011, results presented in Appendix B-3).
77PRSB045	77PR-SB045G-0.502	Subsurface Soil	0.5 – 2	Select metals; antimony, arsenic, copper, lead, and zinc	1	SOP-01, SOP-02, SOP-03, SOP-04, SOP-05, SOP-06, SOP-07, SOP-08, and SOP-09	To determine the vertical extent of MC (select metals) contamination below and at the natural embankment (found during the Phase I RFI; Tetra Tech, 2011, results presented in Appendix B-3).
77PRSB046	77PR-SS046G-00.5	Surface Soil	0 – 0.5	Select metals; antimony, arsenic, copper, lead, and zinc	1	SOP-01, SOP-02, SOP-03, SOP-04, SOP-05, SOP-06, SOP-07, SOP-08, and SOP-09	To determine the lateral extent of MC (select metals) contamination below and at the natural embankment (found during the Phase I RFI; Tetra Tech, 2011, results presented in Appendix B-3).
77PRSB046	77PR-SB046G-0.502	Subsurface Soil	0.5 – 2	Select metals; antimony, arsenic, copper, lead, and zinc	1	SOP-01, SOP-02, SOP-03, SOP-04, SOP-05, SOP-06, SOP-07, SOP-08, and SOP-09	To determine the vertical extent of MC (select metals) contamination below and at the natural embankment (found during the Phase I RFI; Tetra Tech, 2011, results presented in Appendix B-3).
77PRSB047	77PR-SS047G-00.5	Surface Soil	0 – 0.5	Select metals; antimony, arsenic, copper, lead, and zinc	1	SOP-01, SOP-02, SOP-03, SOP-04, SOP-05, SOP-06, SOP-07, SOP-08, and SOP-09	To determine the lateral extent of MC (select metals) contamination below and at the natural embankment (found during the Phase I RFI; Tetra Tech, 2011, results presented in Appendix B-3).
77PRSB047	77PR-SB047G-0.502	Subsurface Soil	0.5 – 2	Select metals; antimony, arsenic, copper, lead, and zinc	1	SOP-01, SOP-02, SOP-03, SOP-04, SOP-05, SOP-06, SOP-07, SOP-08, and SOP-09	To determine the vertical extent of MC (select metals) contamination below and at the natural embankment (found during the Phase I RFI; Tetra Tech, 2011, results presented in Appendix B-3).
77PRSB048	77PR-SS048G-00.5	Surface Soil	0 – 0.5	Select metals; antimony, arsenic, copper, lead, and zinc	1	SOP-01, SOP-02, SOP-03, SOP-04, SOP-05, SOP-06, SOP-07, SOP-08, and SOP-09	To determine the lateral extent of MC (select metals) contamination below and at the natural embankment (found during the Phase I RFI; Tetra Tech, 2011, results presented in Appendix B-3).
77PRSB048	77PR-SB048G-0.502	Subsurface Soil	0.5 – 2	Select metals; antimony, arsenic, copper, lead, and zinc	1	SOP-01, SOP-02, SOP-03, SOP-04, SOP-05, SOP-06, SOP-07, SOP-08, and SOP-09	To determine the vertical extent of MC (select metals) contamination below and at the natural embankment (found during the Phase I RFI; Tetra Tech, 2011, results presented in Appendix B-3).
GENERAL FIRING RANGE AREAS (10 samples)							
77PRSB049	77PR-SS049G-00.5	Surface Soil	0 – 0.5	Select metals; antimony, arsenic, copper, lead, and zinc	1	SOP-01, SOP-02, SOP-03, SOP-04, SOP-05, SOP-06, SOP-07, SOP-08, and SOP-09	To determine the lateral extent of MC (selecte metals) contamination around the natural embankment, including the firing lines (found during the Phase I RFI; Tetra Tech, 2011, results presented in Appendix B-3).

Sampling Location	ID Number	Matrix	Depth (feet bgs)	Analytical Group	Number of Samples Per Location (identify field duplicates)	Sampling SOP Reference	Sample Rationale
77PRSB050	77PR-SS050G-00.5	Surface Soil	0 – 0.5	Select metals; antimony, arsenic, copper, lead, and zinc	1	SOP-01, SOP-02, SOP-03, SOP-04, SOP-05, SOP-06, SOP-07, SOP-08, and SOP-09	To determine the lateral extent of MC (selecte metals) contamination around the natural embankment, including the firing lines (found during the Phase I RFI; Tetra Tech, 2011, results presented in Appendix B-3).
77PRSB051	77PR-SS051G-00.5	Surface Soil	0 – 0.5	Select metals; antimony, arsenic, copper, lead, and zinc	1	SOP-01, SOP-02, SOP-03, SOP-04, SOP-05, SOP-06, SOP-07, SOP-08, and SOP-09	To determine the lateral extent of MC (selecte metals) contamination around the natural embankment, including the firing lines (found during the Phase I RFI; Tetra Tech, 2011, results presented in Appendix B-3).
77PRSB052	77PR-SS052G-00.5	Surface Soil	0 – 0.5	Select metals; antimony, arsenic, copper, lead, and zinc	1	SOP-01, SOP-02, SOP-03, SOP-04, SOP-05, SOP-06, SOP-07, SOP-08, and SOP-09	To determine the lateral extent of MC (selecte metals) contamination around the natural embankment, including the firing lines (found during the Phase I RFI; Tetra Tech, 2011, results presented in Appendix B-3).
77PRSB053	77PR-SS053G-00.5	Surface Soil	0 – 0.5	Select metals; antimony, arsenic, copper, lead, and zinc	1	SOP-01, SOP-02, SOP-03, SOP-04, SOP-05, SOP-06, SOP-07, SOP-08, and SOP-09	To determine the lateral extent of MC (selecte metals) contamination around the natural embankment, including the firing lines (found during the Phase I RFI; Tetra Tech, 2011, results presented in Appendix B-3).
77PRSB054	77PR-SS054G-00.5	Surface Soil	0 – 0.5	Select metals; antimony, arsenic, copper, lead, and zinc	1	SOP-01, SOP-02, SOP-03, SOP-04, SOP-05, SOP-06, SOP-07, SOP-08, and SOP-09	To determine the lateral extent of MC (selecte metals) contamination around the natural embankment, including the firing lines (found during the Phase I RFI; Tetra Tech, 2011, results presented in Appendix B-3).
77PRSB055	77PR-SS055G-00.5	Surface Soil	0 – 0.5	Select metals; antimony, arsenic, copper, lead, and zinc	1	SOP-01, SOP-02, SOP-03, SOP-04, SOP-05, SOP-06, SOP-07, SOP-08, and SOP-09	To determine the lateral extent of MC (selecte metals) contamination around the natural embankment, including the firing lines (found during the Phase I RFI; Tetra Tech, 2011, results presented in Appendix B-3).
77PRSB056	77PR-SS056G-00.5	Surface Soil	0 – 0.5	Select metals; antimony, arsenic, copper, lead, and zinc	1	SOP-01, SOP-02, SOP-03, SOP-04, SOP-05, SOP-06, SOP-07, SOP-08, and SOP-09	To determine the lateral extent of MC (selecte metals) contamination around the natural embankment, including the firing lines (found during the Phase I RFI; Tetra Tech, 2011, results presented in Appendix B-3).
77PRSB057	77PR-SS057G-00.5	Surface Soil	0 – 0.5	Select metals; antimony, arsenic, copper, lead, and zinc	1	SOP-01, SOP-02, SOP-03, SOP-04, SOP-05, SOP-06, SOP-07, SOP-08, and SOP-09	To determine the lateral extent of MC (selecte metals) contamination around the natural embankment, including the firing lines (found during the Phase I RFI; Tetra Tech, 2011, results presented in Appendix B-3).
77PRSB058	77PR-SS058G-00.5 77PR-FDmmddyy-02	Surface Soil	0 – 0.5	Select metals; antimony, arsenic, copper, lead, and zinc	2 (duplicate)	SOP-01, SOP-02, SOP-03, SOP-04, SOP-05, SOP-06, SOP-07, SOP-08, and SOP-09	To determine the lateral extent of MC (selecte metals) contamination around the natural embankment, including the firing lines (found during the Phase I RFI; Tetra Tech, 2011, results presented in Appendix B-3).
NATURAL EMBANKMENT (12 samples)							
77PRSB059	77PR-SB059G-0.502 77PR-FDmmddyy-03	Subsurface Soil	0.5 – 2	Select metals; antimony, arsenic, copper, lead, and zinc	2 (duplicate)	SOP-01, SOP-02, SOP-03, SOP-04, SOP-05, SOP-06, SOP-07, SOP-08, and SOP-09	To determine the vertical extent of MC (select metals) contamination, at the natural embankment (found duirng the Phase I RFI; Tetra Tech, 2011, results presented in Appendix B-3).

Sampling Location	ID Number	Matrix	Depth (feet bgs)	Analytical Group	Number of Samples Per Location (identify field duplicates)	Sampling SOP Reference	Sample Rationale
77PRSB060	77PR-SB060G-0.502	Subsurface Soil	0.5 – 2	Select metals; antimony, arsenic, copper, lead, and zinc	1	SOP-01, SOP-02, SOP-03, SOP-04, SOP-05, SOP-06, SOP-07, SOP-08, and SOP-09	To determine the vertical extent of MC (select metals) contamination, at the natural embankment (found duirng the Phase I RFI; Tetra Tech, 2011, results presented in Appendix B-3).
77PRSB061	77PR-SB061G-0.502	Subsurface Soil	0.5 – 2	Select metals; antimony, arsenic, copper, lead, and zinc	1	SOP-01, SOP-02, SOP-03, SOP-04, SOP-05, SOP-06, SOP-07, SOP-08, and SOP-09	To determine the vertical extent of MC (select metals) contamination, at the natural embankment (found duirng the Phase I RFI; Tetra Tech, 2011, results presented in Appendix B-3).
77PRSB062	77PR-SB062G-0.502	Subsurface Soil	0.5 – 2	Select metals; antimony, arsenic, copper, lead, and zinc	1	SOP-01, SOP-02, SOP-03, SOP-04, SOP-05, SOP-06, SOP-07, SOP-08, and SOP-09	To determine the vertical extent of MC (select metals) contamination, at the natural embankment (found duirng the Phase I RFI; Tetra Tech, 2011, results presented in Appendix B-3).
77PRSB063	77PR-SB063G-0.502	Subsurface Soil	0.5 – 2	Select metals; antimony, arsenic, copper, lead, and zinc	1	SOP-01, SOP-02, SOP-03, SOP-04, SOP-05, SOP-06, SOP-07, SOP-08, and SOP-09	To determine the vertical extent of MC (select metals) contamination, at the natural embankment (found duirng the Phase I RFI; Tetra Tech, 2011, results presented in Appendix B-3).
77PRSB064	77PR-SB064G-0.502	Subsurface Soil	0.5 – 2	Select metals; antimony, arsenic, copper, lead, and zinc	1	SOP-01, SOP-02, SOP-03, SOP-04, SOP-05, SOP-06, SOP-07, SOP-08, and SOP-09	To determine the vertical extent of MC (select metals) contamination, at the natural embankment (found duirng the Phase I RFI; Tetra Tech, 2011, results presented in Appendix B-3).
77PRSB065	77PR-SB065G-0.502	Subsurface Soil	0.5 – 2	Select metals; antimony, arsenic, copper, lead, and zinc	1	SOP-01, SOP-02, SOP-03, SOP-04, SOP-05, SOP-06, SOP-07, SOP-08, and SOP-09	To determine the vertical extent of MC (select metals) contamination, at the natural embankment (found duirng the Phase I RFI; Tetra Tech, 2011, results presented in Appendix B-3).
77PRSB066	77PR-SB066G-0.502	Subsurface Soil	0.5 – 2	Select metals; antimony, arsenic, copper, lead, and zinc	1	SOP-01, SOP-02, SOP-03, SOP-04, SOP-05, SOP-06, SOP-07, SOP-08, and SOP-09	To determine the vertical extent of MC (select metals) contamination, at the natural embankment (found duirng the Phase I RFI; Tetra Tech, 2011, results presented in Appendix B-3).
77PRSB067	77PR-SB067G-0.502	Subsurface Soil	0.5 – 2	Select metals; antimony, arsenic, copper, lead, and zinc	1	SOP-01, SOP-02, SOP-03, SOP-04, SOP-05, SOP-06, SOP-07, SOP-08, and SOP-09	To determine the vertical extent of MC (select metals) contamination, at the natural embankment (found duirng the Phase I RFI; Tetra Tech, 2011, results presented in Appendix B-3).
77PRSB068	77PR-SB068G-0.502	Subsurface Soil	0.5 – 2	Select metals; antimony, arsenic, copper, lead, and zinc	1	SOP-01, SOP-02, SOP-03, SOP-04, SOP-05, SOP-06, SOP-07, SOP-08, and SOP-09	To determine the vertical extent of MC (select metals) contamination, at the natural embankment (found duirng the Phase I RFI; Tetra Tech, 2011, results presented in Appendix B-3).
77PRSB069	77PR-SB069G-0.502	Subsurface Soil	0.5 – 2	Select metals; antimony, arsenic, copper, lead, and zinc	1	SOP-01, SOP-02, SOP-03, SOP-04, SOP-05, SOP-06, SOP-07, SOP-08, and SOP-09	To determine the vertical extent of MC (select metals) contamination, at the natural embankment (found duirng the Phase I RFI; Tetra Tech, 2011, results presented in Appendix B-3).
77PRSB070	77PR-SB070G-0.502	Subsurface Soil	0.5 – 2	Select metals; antimony, arsenic, copper, lead, and zinc	1	SOP-01, SOP-02, SOP-03, SOP-04, SOP-05, SOP-06, SOP-07, SOP-08, and SOP-09	To determine the vertical extent of MC (select metals) contamination, at the natural embankment (found duirng the Phase I RFI; Tetra Tech, 2011, results presented in Appendix B-3).

Sampling Location	ID Number	Matrix	Depth (feet bgs)	Analytical Group	Number of Samples Per Location (identify field duplicates)	Sampling SOP Reference	Sample Rationale
FIRING LINES (2 samples)							
77PRSB071	77PR-SS071G-0.502	Subsurface Soil	0.5 – 2	NG	1	SOP-01, SOP-02, SOP-03, SOP-04, SOP-05, SOP-06, SOP-07, SOP-08, and SOP-09	To determine if NG is present and may have migrated to subsurface soil.
77PRSB072	77PR-SS072G-0.502	Subsurface Soil	0.5 - 2	NG	1	SOP-01, SOP-02, SOP-03, SOP-04, SOP-05, SOP-06, SOP-07, SOP-08, and SOP-09	To determine if NG is present and may have migrated to subsurface soil.
DISCRETIONARY SAMPLES							
77PRSB073(1)	77PR-SS073G-XXXX	TBD	TBD	Select metals; antimony, arsenic, copper, lead, and zinc	1	SOP-01, SOP-02, SOP-03, SOP-04, SOP-05, SOP-06, SOP-07, SOP-08, and SOP-09	To be collected at locations to be determined in the field to better characterize surface and/or subsurface soil and at the discretion of the FOL.
77PRSB074(1)	77PR-SS074G-XXXX	TBD	TBD	Select metals; antimony, arsenic, copper, lead, and zinc	1	SOP-01, SOP-02, SOP-03, SOP-04, SOP-05, SOP-06, SOP-07, SOP-08, and SOP-09	To be collected at locations to be determined in the field to better characterize surface and/or subsurface soil and at the discretion of the FOL.
77PRSB075(1)	77PR-SB075G-XXXX	TBD	TBD	Select metals; antimony, arsenic, copper, lead, and zinc	1	SOP-01, SOP-02, SOP-03, SOP-04, SOP-05, SOP-06, SOP-07, SOP-08, and SOP-09	To be collected at locations to be determined in the field to better characterize surface and/or subsurface soil and at the discretion of the FOL.
77PRSB076(1)	77PR-SB076G-XXXX	TBD	TBD	Select metals; antimony, arsenic, copper, lead, and zinc	1	SOP-01, SOP-02, SOP-03, SOP-04, SOP-05, SOP-06, SOP-07, SOP-08, and SOP-09	To be collected at locations to be determined in the field to better characterize surface and/or subsurface soil and at the discretion of the FOL.
BUCKET EVALUATION							
77PRSB077 (2)	77PRSS077G-XXXX	TBD	TBD	pH	1	SOP-01, SOP-02, SOP-03, SOP-04 ; SOP-07, and SOP-08	To be collected during bucket evaluation.

1 – Up to four discretionary samples; actual locations, depths, and number collected will be determined during the field investigation.
2 – A bucket evaluation will be conducted to quantify lead impacts from bullets (slugs or casings). The bucket evaluation for a given subarea will be conducted after the soil sampling efforts such that they location of the bucket evaluation can be determined based on field observation of biased high bullet density. Approximately five pounds of soil will be collected and placed into a clean container (e.g., single-use bucket) for this evaluation. The Tetra Tech field geologist will classify the soil and collecte a soil sample for pH analysis. The total weight of the soil will be determined, then the entire sample screened using a 0.25-inch wire screen, and then the residual items (i.e., bullets) weighed such that the relative percent tby weight of bullets vs. soil may be determined.
TBD – To be determined.

SAP Worksheet #18.2 – Former Pistol Range Subarea Sampling Locations and Methods/SOP Requirements Table

Sampling Location	ID Number	Matrix	Depth (feet bgs)	Analytical Group	Number of Samples Per Location (identify field duplicates)	Sampling SOP Reference	Sample Rationale
NORTHWEST AREA (16 samples)							
77FPSB033	77FP-SS033G-00.5 77FP-FDmmddyy-01	Surface Soil	0 – 0.5	Select metals; antimony, arsenic, copper, lead, and zinc	2 (duplicate)	SOP-01, SOP-02, SOP-03, SOP-04, SOP-05, SOP-06, SOP-07, SOP-08, and SOP-09	To determine the lateral extent of MC (select metals) contamination (found during the Phase I RFI; Tetra Tech, 2011, results presented in Appendix B-3). The most highly contaminated area was encountered in the northwestern area of the site, therefore, samples will be collected from locations northwest of the site.
77FPSB033	77FP-SB033G-0.502 77FP-FDmmddyy-02	Subsurface Soil	0.5 – 2	Select metals; antimony, arsenic, copper, lead, and zinc	2 (duplicate)	SOP-01, SOP-02, SOP-03, SOP-04, SOP-05, SOP-06, SOP-07, SOP-08, and SOP-09	To determine the vertical extend ot potential MC (selecte metals) contamination (found during the Phase I RFI; Tetra Tech, 2011, results presented in Appendix B-3). The most highly contaminated area was encountered in the northwestern area of the site, therefore, samples will be collected from locations northwest of the site.
77FPSB034	77FP-SS034G-00.5	Surface Soil	0 – 0.5	Select metals; antimony, arsenic, copper, lead, and zinc	1	SOP-01, SOP-02, SOP-03, SOP-04, SOP-05, SOP-06, SOP-07, SOP-08, and SOP-09	To determine the lateral extent of MC (select metals) contamination (found during the Phase I RFI; Tetra Tech, 2011, results presented in Appendix B-3). The most highly contaminated area was encountered in the northwestern area of the site, therefore, samples will be collected from locations northwest of the site.
77FPSB034	77FP-SB034G-0.502	Subsurface Soil	0.5 – 2	Select metals; antimony, arsenic, copper, lead, and zinc	1	SOP-01, SOP-02, SOP-03, SOP-04, SOP-05, SOP-06, SOP-07, SOP-08, and SOP-09	To determine the vertical extend ot potential MC (selecte metals) contamination (found during the Phase I RFI; Tetra Tech, 2011, results presented in Appendix B-3). The most highly contaminated area was encountered in the northwestern area of the site, therefore, samples will be collected from locations northwest of the site.
77FPSB035	77FP-SS035G-00.5	Surface Soil	0 – 0.5	Select metals; antimony, arsenic, copper, lead, and zinc	1	SOP-01, SOP-02, SOP-03, SOP-04, SOP-05, SOP-06, SOP-07, SOP-08, and SOP-09	To determine the lateral extent of MC (select metals) contamination (found during the Phase I RFI; Tetra Tech, 2011, results presented in Appendix B-3). The most highly contaminated area was encountered in the northwestern area of the site, therefore, samples will be collected from locations northwest of the site.
77FPSB035	77FP-SB035G-0.502	Subsurface Soil	0.5 – 2	Select metals; antimony, arsenic, copper, lead, and zinc	1	SOP-01, SOP-02, SOP-03, SOP-04, SOP-05, SOP-06, SOP-07, SOP-08, and SOP-09	To determine the vertical extend ot potential MC (selecte metals) contamination (found during the Phase I RFI; Tetra Tech, 2011, results presented in Appendix B-3). The most highly contaminated area was encountered in the northwestern area of the site, therefore, samples will be collected from locations northwest of the site.

Sampling Location	ID Number	Matrix	Depth (feet bgs)	Analytical Group	Number of Samples Per Location (identify field duplicates)	Sampling SOP Reference	Sample Rationale
77FPSB036	77FP-SS036G-00.5	Surface Soil	0 – 0.5	Select metals; antimony, arsenic, copper, lead, and zinc	1	SOP-01, SOP-02, SOP-03, SOP-04, SOP-05, SOP-06, SOP-07, SOP-08, and SOP-09	To determine the lateral extent of MC (select metals) contamination (found during the Phase I RFI; Tetra Tech, 2011, results presented in Appendix B-3). The most highly contaminated area was encountered in the northwestern area of the site, therefore, samples will be collected from locations northwest of the site.
77FPSB036	77FP-SB036G-0.502	Subsurface Soil	0.5 – 2	Select metals; antimony, arsenic, copper, lead, and zinc	1	SOP-01, SOP-02, SOP-03, SOP-04, SOP-05, SOP-06, SOP-07, SOP-08, and SOP-09	To determine the vertical extend ot potential MC (selecte metals) contamination (found during the Phase I RFI; Tetra Tech, 2011, results presented in Appendix B-3). The most highly contaminated area was encountered in the northwestern area of the site, therefore, samples will be collected from locations northwest of the site.
77FPSB037	77FP-SS037G-00.5	Surface Soil	0 – 0.5	Select metals; antimony, arsenic, copper, lead, and zinc	1	SOP-01, SOP-02, SOP-03, SOP-04, SOP-05, SOP-06, SOP-07, SOP-08, and SOP-09	To determine the lateral extent of MC (select metals) contamination (found during the Phase I RFI; Tetra Tech, 2011, results presented in Appendix B-3). The most highly contaminated area was encountered in the northwestern area of the site, therefore, samples will be collected from locations northwest of the site.
77FPSB037	77FP-SB037G-0.502	Subsurface Soil	0.5 – 2	Select metals; antimony, arsenic, copper, lead, and zinc	1	SOP-01, SOP-02, SOP-03, SOP-04, SOP-05, SOP-06, SOP-07, SOP-08, and SOP-09	To determine the vertical extend ot potential MC (selecte metals) contamination (found during the Phase I RFI; Tetra Tech, 2011, results presented in Appendix B-3). The most highly contaminated area was encountered in the northwestern area of the site, therefore, samples will be collected from locations northwest of the site.
77FPSB038	77FP-SS038G-00.5	Surface Soil	0 – 0.5	Select metals; antimony, arsenic, copper, lead, and zinc	1	SOP-01, SOP-02, SOP-03, SOP-04, SOP-05, SOP-06, SOP-07, SOP-08, and SOP-09	To determine the lateral extent of MC (select metals) contamination (found during the Phase I RFI; Tetra Tech, 2011, results presented in Appendix B-3). The most highly contaminated area was encountered in the northwestern area of the site, therefore, samples will be collected from locations northwest of the site.
77FPSB038	77FP-SB038G-0.502	Subsurface Soil	0.5 – 2	Select metals; antimony, arsenic, copper, lead, and zinc	1	SOP-01, SOP-02, SOP-03, SOP-04, SOP-05, SOP-06, SOP-07, SOP-08, and SOP-09	To determine the vertical extend ot potential MC (selecte metals) contamination (found during the Phase I RFI; Tetra Tech, 2011, results presented in Appendix B-3). The most highly contaminated area was encountered in the northwestern area of the site, therefore, samples will be collected from locations northwest of the site.
77FPSB039	77FP-SS039G-00.5	Surface Soil	0 – 0.5	Select metals; antimony, arsenic, copper, lead, and zinc	1	SOP-01, SOP-02, SOP-03, SOP-04, SOP-05, SOP-06, SOP-07, SOP-08, and SOP-09	To determine the lateral extent of MC (select metals) contamination (found during the Phase I RFI; Tetra Tech, 2011, results presented in Appendix B-3). The most highly contaminated area was encountered in the northwestern area of the site, therefore, samples will be collected from locations northwest of the site.

Sampling Location	ID Number	Matrix	Depth (feet bgs)	Analytical Group	Number of Samples Per Location (identify field duplicates)	Sampling SOP Reference	Sample Rationale
77FPSB039	77FP-SB039G-0.502	Subsurface Soil	0.5 – 2	Select metals; antimony, arsenic, copper, lead, and zinc	1	SOP-01, SOP-02, SOP-03, SOP-04, SOP-05, SOP-06, SOP-07, SOP-08, and SOP-09	To determine the vertical extend ot potential MC (selecte metals) contamination (found during the Phase I RFI; Tetra Tech, 2011, results presented in Appendix B-3). The most highly contaminated area was encountered in the northwestern area of the site, therefore, samples will be collected from locations northwest of the site.
77FPSB040	77FP-SS040G-00.5	Surface Soil	0 – 0.5	Select metals; antimony, arsenic, copper, lead, and zinc	1	SOP-01, SOP-02, SOP-03, SOP-04, SOP-05, SOP-06, SOP-07, SOP-08, and SOP-09	To determine the lateral extent of MC (select metals) contamination (found during the Phase I RFI; Tetra Tech, 2011, results presented in Appendix B-3). The most highly contaminated area was encountered in the northwestern area of the site, therefore, samples will be collected from locations northwest of the site.
77FPSB040	77FP-SB040G-0.502	Subsurface Soil	0.5 – 2	Select metals; antimony, arsenic, copper, lead, and zinc	1	SOP-01, SOP-02, SOP-03, SOP-04, SOP-05, SOP-06, SOP-07, SOP-08, and SOP-09	To determine the vertical extend ot potential MC (selecte metals) contamination (found during the Phase I RFI; Tetra Tech, 2011, results presented in Appendix B-3). The most highly contaminated area was encountered in the northwestern area of the site, therefore, samples will be collected from locations northwest of the site.
DISCRETIONARY SAMPLES							
77FPSB041[(1)]	77FP-SS041G-00.5	Surface Soil	0 – 0.5	Select metals; antimony, arsenic, copper, lead, and zinc	1	SOP-01, SOP-02, SOP-03, SOP-04, SOP-05, SOP-06, SOP-07, SOP-08, and SOP-09	To be collected at locations to be determined in the field to better characterize surface soil and at the discretion of the FOL.
77FPSB042[(1)]	77FP-SS042G-00.5	Surface Soil	0 – 0.5	Select metals; antimony, arsenic, copper, lead, and zinc	1	SOP-01, SOP-02, SOP-03, SOP-04, SOP-05, SOP-06, SOP-07, SOP-08, and SOP-09	To be collected at locations to be determined in the field to better characterize surface soil and at the discretion of the FOL.
77FPSB043[(1)]	77FP-SS043G-00.5	Surface Soil	0 – 0.5	Select metals; antimony, arsenic, copper, lead, and zinc	1	SOP-01, SOP-02, SOP-03, SOP-04, SOP-05, SOP-06, SOP-07, SOP-08, and SOP-09	To be collected at locations to be determined in the field to better characterize surface soil and at the discretion of the FOL.
77FPSB044[(1)]	77FP-SS044G-00.5	Surface Soil	0 – 0.5	Select metals; antimony, arsenic, copper, lead, and zinc	1	SOP-01, SOP-02, SOP-03, SOP-04, SOP-05, SOP-06, SOP-07, SOP-08, and SOP-09	To be collected at locations to be determined in the field to better characterize surface soil and at the discretion of the FOL.
BUCKET EVALUATION							
77FPSB045 [(2)]	77FPSS045G-XXXX	TBD	TBD	pH	1	SOP-01, SOP-02, SOP-03, SOP-04 ; SOP-07, and SOP-08	To be collected during bucket evaluation.

1 – Up to four discretionary samples; actual locations and number collected will be determined during the field investigation.
2 – A bucket evaluation will be conducted to quantify lead impacts from bullets (slugs or casings). The bucket evaluation for a given subarea will be conducted after the soil sampling efforts such that they location of the bucket evaluation can be determined based on field observation of biased high bullet density. Approximately five pounds of soil will be collected and placed into a clean container (e.g., single-use bucket) for this evaluation. The Tetra Tech field geologist will classify the soil and collecte a soil sample for pH analysis. The total weight of the soil will be determined, then the entire sample screened using a 0.25-inch wire screen, and then the residual items (i.e., bullets) weighed such that the relative percent tby weight of bullets vs. soil may be determined.

SAP Worksheet #18.3 – Detonation Area Near Concrete Pad Subarea Sampling Locations and Methods/SOP Requirements Table

Sampling Location	ID Number	Matrix	Depth (feet bgs)	Analytical Group	Number of Samples Per Location (identify field duplicates)	Sampling SOP Reference	Sample Rationale
THROUGHOUT SITE (eleven samples)							
77DASB003	77DA-SS003G-00.5 77DA-FDmmddyy-01	Surface Soil	0 – 0.5	Select metals; antimony, arsenic, copper, lead, and zinc; and NG	2 (duplicate)	SOP-01, SOP-02, SOP-03, SOP-04, SOP-05, SOP-06, SOP-07, SOP-08, and SOP-09	To characterize soil at the site. To collect additional samples to add to Phase I RFI data (Tetra Tech, 2011, results presented in Appendix B-3) in order to have adequate number of samples to conduct risk assessment.
77DASB004	77DA-SS004G-00.5	Surface Soil	0 – 0.5	Select metals; antimony, arsenic, copper, lead, and zinc; and NG	1	SOP-01, SOP-02, SOP-03, SOP-04, SOP-05, SOP-06, SOP-07, SOP-08, and SOP-09	To characterize soil at the site. To collect additional samples to add to Phase I RFI data (Tetra Tech, 2011, results presented in Appendix B-3) in order to have adequate number of samples to conduct risk assessment.
77DASB005	77DA-SS005G-00.5	Surface Soil	0 – 0.5	Select metals; antimony, arsenic, copper, lead, and zinc; and NG	1	SOP-01, SOP-02, SOP-03, SOP-04, SOP-05, SOP-06, SOP-07, SOP-08, and SOP-09	To characterize soil at the site. To collect additional samples to add to Phase I RFI data (Tetra Tech, 2011, results presented in Appendix B-3) in order to have adequate number of samples to conduct risk assessment.
77DASB006	77DA-SS006G-00.5	Surface Soil	0 – 0.5	Select metals; antimony, arsenic, copper, lead, and zinc; and NG	1	SOP-01, SOP-02, SOP-03, SOP-04, SOP-05, SOP-06, SOP-07, SOP-08, and SOP-09	To characterize soil at the site. To collect additional samples to add to Phase I RFI data (Tetra Tech, 2011, results presented in Appendix B-3) in order to have adequate number of samples to conduct risk assessment.
77DASB007	77DA-SS007G-00.5	Surface Soil	0 – 0.5	Select metals; antimony, arsenic, copper, lead, and zinc; and NG	1	SOP-01, SOP-02, SOP-03, SOP-04, SOP-05, SOP-06, SOP-07, SOP-08, and SOP-09	To characterize soil at the site. To collect additional samples to add to Phase I RFI data (Tetra Tech, 2011, results presented in Appendix B-3) in order to have adequate number of samples to conduct risk assessment.
77DASB008	77DA-SS008G-00.5	Surface Soil	0 – 0.5	Select metals; antimony, arsenic, copper, lead, and zinc; and NG	1	SOP-01, SOP-02, SOP-03, SOP-04, SOP-05, SOP-06, SOP-07, SOP-08, and SOP-09	To characterize soil at the site. To collect additional samples to add to Phase I RFI data (Tetra Tech, 2011, results presented in Appendix B-3) in order to have adequate number of samples to conduct risk assessment.
77DASB009	77DA-SS009G-00.5	Surface Soil	0 – 0.5	Select metals; antimony, arsenic, copper, lead, and zinc; and NG	1	SOP-01, SOP-02, SOP-03, SOP-04, SOP-05, SOP-06, SOP-07, SOP-08, and SOP-09	To characterize soil at the site. To collect additional samples to add to Phase I RFI data (Tetra Tech, 2011, results presented in Appendix B-3) in order to have adequate number of samples to conduct risk assessment.

Sampling Location	ID Number	Matrix	Depth (feet bgs)	Analytical Group	Number of Samples Per Location (identify field duplicates)	Sampling SOP Reference	Sample Rationale
77DASB010	77DA-SS010G-00.5	Surface Soil	0 – 0.5	Select metals; antimony, arsenic, copper, lead, and zinc; and NG	1	SOP-01, SOP-02, SOP-03, SOP-04, SOP-05, SOP-06, SOP-07, SOP-08, and SOP-09	To characterize soil at the site. To collect additional samples to add to Phase I RFI data (Tetra Tech, 2011, results presented in Appendix B-3) in order to have adequate number of samples to conduct risk assessment.
77DASB011	77DA-SS011G-00.5	Surface Soil	0 – 0.5	Select metals; antimony, arsenic, copper, lead, and zinc; and NG	1	SOP-01, SOP-02, SOP-03, SOP-04, SOP-05, SOP-06, SOP-07, SOP-08, and SOP-09	To characterize soil at the site. To collect additional samples to add to Phase I RFI data (Tetra Tech, 2011, results presented in Appendix B-3) in order to have adequate number of samples to conduct risk assessment.
77DASB012	77DA-SB012G-0.502	Subsurface Soil	0.5 – 2	NG	1	SOP-01, SOP-02, SOP-03, SOP-04, SOP-05, SOP-06, SOP-07, SOP-08, and SOP-09	To determine if NG may be present in site subsurface soil.
77DASB013	77DA-SB013G-0.502	Subsurface Soil	0.5 - 2	NG	1	SOP-01, SOP-02, SOP-03, SOP-04, SOP-05, SOP-06, SOP-07, SOP-08, and SOP-09	To determine if NG may be present in site subsurface soil.
DISCRETIONARY SAMPLES							
77DASB014(1)	77DA-SS014G-00.5	Surface Soil	0 – 0.5	Select metals; antimony, arsenic, copper, lead, and zinc; and NG	1	SOP-01, SOP-02, SOP-03, SOP-04, SOP-05, SOP-06, SOP-07, SOP-08, and SOP-09	To be collected at locations to be determined in the field to better characterize site soil and at the discretion of the FOL.
77DASB015(1)	77DA-SS015G-00.5	Surface Soil	0 – 0.5	Select metals; antimony, arsenic, copper, lead, and zinc; and NG	1	SOP-01, SOP-02, SOP-03, SOP-04, SOP-05, SOP-06, SOP-07, SOP-08, and SOP-09	To be collected at locations to be determined in the field to better characterize site soil and at the discretion of the FOL.
77DASB016(1)	77DA-SS016G-00.5	Surface Soil	0 – 0.5	Select metals; antimony, arsenic, copper, lead, and zinc; and NG	1	SOP-01, SOP-02, SOP-03, SOP-04, SOP-05, SOP-06, SOP-07, SOP-08, and SOP-09	To be collected at locations to be determined in the field to better characterize site soil and at the discretion of the FOL.
77DASB017(1)	77DA-SS017G-00.5	Surface Soil	0 – 0.5	Select metals; antimony, arsenic, copper, lead, and zinc; and NG	1	SOP-01, SOP-02, SOP-03, SOP-04, SOP-05, SOP-06, SOP-07, SOP-08, and SOP-09	To be collected at locations to be determined in the field to better characterize site soil and at the discretion of the FOL.

1 – Up to four discretionary samples; actual locations and number collected will be determined in the field based on field observations.

SAP Worksheet #18.4 – Rifle Range Subarea Sampling Locations and Methods/SOP Requirements Table

Sampling Locations	ID Number	Matrix	Depth (feet bgs)	Analytical Group	Number of Samples Per Location (identify field duplicates)	Sampling SOP Reference	Sample Rationale
EARTHEN BERM AREA (10 samples)							
77RRSB058	77RR-SB058G-0.502 77RR-FDmmddyy-01	Subsurface Soil	0.5 - 2	Select metals; antimony, arsenic, copper, lead, and zinc	2 (duplicate)	SOP-01, SOP-02, SOP-03, SOP-04, SOP-05, SOP-06, SOP-07, SOP-08, and SOP-09	To determine the vertical extent of MC (select metals) contamination at the earthen berm (found during the Phase I RFI; Tetra Tech, 2011, results presented in Appendix B-3).
77RRSB059	77RR-SB059G-0.502	Subsurface Soil	0.5 - 2	Select metals; antimony, arsenic, copper, lead, and zinc	1	SOP-01, SOP-02, SOP-03, SOP-04, SOP-05, SOP-06, SOP-07, SOP-08, and SOP-09	To determine the vertical extent of MC (select metals) contamination at the earthen berm (found during the Phase I RFI; Tetra Tech, 2011, results presented in Appendix B-3).
77RRSB060	77RR-SB060G-0.502	Subsurface Soil	0.5 - 2	Select metals; antimony, arsenic, copper, lead, and zinc	1	SOP-01, SOP-02, SOP-03, SOP-04, SOP-05, SOP-06, SOP-07, SOP-08, and SOP-09	To determine the vertical extent of MC (select metals) contamination at the earthen berm (found during the Phase I RFI; Tetra Tech, 2011, results presented in Appendix B-3).
77RRSB061	77RR-SB061G-0.502	Subsurface Soil	0.5 - 2	Select metals; antimony, arsenic, copper, lead, and zinc	1	SOP-01, SOP-02, SOP-03, SOP-04, SOP-05, SOP-06, SOP-07, SOP-08, and SOP-09	To determine the vertical extent of MC (select metals) contamination at the earthen berm (found during the Phase I RFI; Tetra Tech, 2011, results presented in Appendix B-3).
77RRSB062	77RR-SB062G-0.502	Subsurface Soil	0.5 - 2	Select metals; antimony, arsenic, copper, lead, and zinc	1	SOP-01, SOP-02, SOP-03, SOP-04, SOP-05, SOP-06, SOP-07, SOP-08, and SOP-09	To determine the vertical extent of MC (select metals) contamination at the earthen berm (found during the Phase I RFI; Tetra Tech, 2011, results presented in Appendix B-3).
77RRSB063	77RR-SB063G-0.502	Subsurface Soil	0.5 - 2	Select metals; antimony, arsenic, copper, lead, and zinc	1	SOP-01, SOP-02, SOP-03, SOP-04, SOP-05, SOP-06, SOP-07, SOP-08, and SOP-09	To determine the vertical extent of MC (select metals) contamination at the earthen berm (found during the Phase I RFI; Tetra Tech, 2011, results presented in Appendix B-3).
77RRSB064	77RR-SB064G-0.502	Subsurface Soil	0.5 - 2	Select metals; antimony, arsenic, copper, lead, and zinc	1	SOP-01, SOP-02, SOP-03, SOP-04, SOP-05, SOP-06, SOP-07, SOP-08, and SOP-09	To determine the vertical extent of MC (select metals) contamination at the earthen berm (found during the Phase I RFI; Tetra Tech, 2011, results presented in Appendix B-3).
77RRSB065	77RR-SB065G-0.502	Subsurface Soil	0.5 - 2	Select metals; antimony, arsenic, copper, lead, and zinc	1	SOP-01, SOP-02, SOP-03, SOP-04, SOP-05, SOP-06, SOP-07, SOP-08, and SOP-09	To determine the vertical extent of MC (select metals) contamination at the earthen berm (found during the Phase I RFI; Tetra Tech, 2011, results presented in Appendix B-3).
77RRSB066	77RR-SB066G-0.502	Subsurface Soil	0.5 - 2	Select metals; antimony, arsenic, copper, lead, and zinc	1	SOP-01, SOP-02, SOP-03, SOP-04, SOP-05, SOP-06, SOP-07, SOP-08, and SOP-09	To determine the vertical extent of MC (select metals) contamination at the earthen berm (found during the Phase I RFI; Tetra Tech, 2011, results presented in Appendix B-3).
77RRSB067	77RR-SB067G-0.502	Subsurface Soil	0.5 - 2	Select metals; antimony, arsenic, copper, lead, and zinc	1	SOP-01, SOP-02, SOP-03, SOP-04, SOP-05, SOP-06, SOP-07, SOP-08, and SOP-09	To determine the vertical extent of MC (select metals) contamination at the earthen berm (found during the Phase I RFI; Tetra Tech, 2011, results presented in Appendix B-3).
WOODED EMBANKMENT AREA (10 samples)							
77RRSB068	77RR-SB068G-0.502	Subsurface Soil	0.5 – 2	Select metals; antimony, arsenic, copper, lead, and zinc	1	SOP-01, SOP-02, SOP-03, SOP-04, SOP-05, SOP-06, SOP-07, SOP-08, and SOP-09	To determine the vertical extent of MC (select metals) contamination at the wooded embankment (found during the Phase I RFI; Tetra Tech, 2011, results presented in Appendix B-3).

Sampling Locations	ID Number	Matrix	Depth (feet bgs)	Analytical Group	Number of Samples Per Location (identify field duplicates)	Sampling SOP Reference	Sample Rationale
77RRSB069	77RR-SB069G-0.502	Subsurface Soil	0.5 – 2	Select metals; antimony, arsenic, copper, lead, and zinc	1	SOP-01, SOP-02, SOP-03, SOP-04, SOP-05, SOP-06, SOP-07, SOP-08, and SOP-09	To determine the vertical extent of MC (select metals) contamination at the wooded embankment (found during the Phase I RFI; Tetra Tech, 2011, results presented in Appendix B-3).
77RRSB070	77RR-SB070G-0.502	Subsurface Soil	0.5 – 2	Select metals; antimony, arsenic, copper, lead, and zinc	1	SOP-01, SOP-02, SOP-03, SOP-04, SOP-05, SOP-06, SOP-07, SOP-08, and SOP-09	To determine the vertical extent of MC (select metals) contamination at the wooded embankment (found during the Phase I RFI; Tetra Tech, 2011, results presented in Appendix B-3).
77RRSB071	77RR-SB071G-0.502	Subsurface Soil	0.5 – 2	Select metals; antimony, arsenic, copper, lead, and zinc	1	SOP-01, SOP-02, SOP-03, SOP-04, SOP-05, SOP-06, SOP-07, SOP-08, and SOP-09	To determine the vertical extent of MC (select metals) contamination at the wooded embankment (found during the Phase I RFI; Tetra Tech, 2011, results presented in Appendix B-3).
77RRSB072	77RR-SB072G-0.502	Subsurface Soil	0.5 – 2	Select metals; antimony, arsenic, copper, lead, and zinc	1	SOP-01, SOP-02, SOP-03, SOP-04, SOP-05, SOP-06, SOP-07, SOP-08, and SOP-09	To determine the vertical extent of MC (select metals) contamination at the wooded embankment (found during the Phase I RFI; Tetra Tech, 2011, results presented in Appendix B-3).
77RRSB073	77RR-SB073G-0.502	Subsurface Soil	0.5 – 2	Select metals; antimony, arsenic, copper, lead, and zinc	1	SOP-01, SOP-02, SOP-03, SOP-04, SOP-05, SOP-06, SOP-07, SOP-08, and SOP-09	To determine the vertical extent of MC (select metals) contamination at the wooded embankment (found during the Phase I RFI; Tetra Tech, 2011, results presented in Appendix B-3).
77RRSB074	77RR-SB074G-0.502	Subsurface Soil	0.5 – 2	Select metals; antimony, arsenic, copper, lead, and zinc	1	SOP-01, SOP-02, SOP-03, SOP-04, SOP-05, SOP-06, SOP-07, SOP-08, and SOP-09	To determine the vertical extent of MC (select metals) contamination at the wooded embankment (found during the Phase I RFI; Tetra Tech, 2011, results presented in Appendix B-3).
77RRSB075	77RR-SB075G-0.502	Subsurface Soil	0.5 – 2	Select metals; antimony, arsenic, copper, lead, and zinc	1	SOP-01, SOP-02, SOP-03, SOP-04, SOP-05, SOP-06, SOP-07, SOP-08, and SOP-09	To determine the vertical extent of MC (select metals) contamination at the wooded embankment (found during the Phase I RFI; Tetra Tech, 2011, results presented in Appendix B-3).
77RRSB076	77RR-SB076G-0.502	Subsurface Soil	0.5 – 2	Select metals; antimony, arsenic, copper, lead, and zinc	1	SOP-01, SOP-02, SOP-03, SOP-04, SOP-05, SOP-06, SOP-07, SOP-08, and SOP-09	To determine the vertical extent of MC (select metals) contamination at the wooded embankment (found during the Phase I RFI; Tetra Tech, 2011, results presented in Appendix B-3).
77RRSB077	77RR-SB077G-0.502	Subsurface Soil	0.5 - 2	Select metals; antimony, arsenic, copper, lead, and zinc	1	SOP-01, SOP-02, SOP-03, SOP-04, SOP-05, SOP-06, SOP-07, SOP-08, and SOP-09	To determine the vertical extent of MC (select metals) contamination at the wooded embankment (found during the Phase I RFI; Tetra Tech, 2011, results presented in Appendix B-3).
AREA BETWEEN EARTHEN BERM AND WOODED EMBANKMENT (10 samples)							
77RRSB078	77RR-SS078G-00.5 77RR-FDmmddyy-02	Surface Soil	0 – 0.5	Explosives and select metals; antimony, arsenic, copper, lead, and zinc	2 (duplicate)	SOP-01, SOP-02, SOP-03, SOP-04, SOP-05, SOP-06, SOP-07, SOP-08, and SOP-09	To determine the vertical and lateral extend ot potential MC (explosives and select metals) contamination in the area betwen the berms, behind the concrete wall. (only composite samples collected during the Phase I RFI; Tetra Tech, 2011, sample results presented in Appendix B-3).

Sampling Locations	ID Number	Matrix	Depth (feet bgs)	Analytical Group	Number of Samples Per Location (identify field duplicates)	Sampling SOP Reference	Sample Rationale
77RRSB078	77RR-SB078G-0.502	Subsurface Soil	0.5 – 2	Explosives and select metals; antimony, arsenic, copper, lead, and zinc	1	SOP-01, SOP-02, SOP-03, SOP-04, SOP-05, SOP-06, SOP-07, SOP-08, and SOP-09	To determine the vertical and lateral extend ot potential MC (explosives and select metals) contamination in the area betwen the berms, behind the concrete wall. (only composite samples collected during the Phase I RFI; Tetra Tech, 2011, sample results presented in Appendix B-3).
77RRSB079	77RR-SS079G-00.5	Surface Soil	0 – 0.5	Explosives and select metals; antimony, arsenic, copper, lead, and zinc	1	SOP-01, SOP-02, SOP-03, SOP-04, SOP-05, SOP-06, SOP-07, SOP-08, and SOP-09	To determine the vertical and lateral extend ot potential MC (explosives and select metals) contamination in the area betwen the berms, behind the concrete wall. (only composite samples collected during the Phase I RFI; Tetra Tech, 2011, sample results presented in Appendix B-3).
77RRSB079	77RR-SB079G-0.502	Subsurface Soil	0.5 – 2	Explosives and select metals; antimony, arsenic, copper, lead, and zinc	1	SOP-01, SOP-02, SOP-03, SOP-04, SOP-05, SOP-06, SOP-07, SOP-08, and SOP-09	To determine the vertical and lateral extend ot potential MC (explosives and select metals) contamination in the area betwen the berms, behind the concrete wall. (only composite samples collected during the Phase I RFI; Tetra Tech, 2011, sample results presented in Appendix B-3).
77RRSB080	77RR-SS080G-00.5	Surface Soil	0 – 0.5	Explosives and select metals; antimony, arsenic, copper, lead, and zinc	1	SOP-01, SOP-02, SOP-03, SOP-04, SOP-05, SOP-06, SOP-07, SOP-08, and SOP-09	To determine the vertical and lateral extend ot potential MC (explosives and select metals) contamination in the area betwen the berms, behind the concrete wall. (only composite samples collected during the Phase I RFI; Tetra Tech, 2011, sample results presented in Appendix B-3).
77RRSB080	77RR-SB080G-0.502	Subsurface Soil	0.5 – 2	Explosives and select metals; antimony, arsenic, copper, lead, and zinc	1	SOP-01, SOP-02, SOP-03, SOP-04, SOP-05, SOP-06, SOP-07, SOP-08, and SOP-09	To determine the vertical and lateral extend ot potential MC (explosives and select metals) contamination in the area betwen the berms, behind the concrete wall. (only composite samples collected during the Phase I RFI; Tetra Tech, 2011, sample results presented in Appendix B-3).
77RRSB081	77RR-SS081G-00.5	Surface Soil	0 – 0.5	Explosives and select metals; antimony, arsenic, copper, lead, and zinc	1	SOP-01, SOP-02, SOP-03, SOP-04, SOP-05, SOP-06, SOP-07, SOP-08, and SOP-09	To determine the vertical and lateral extend ot potential MC (explosives and select metals) contamination in the area betwen the berms, behind the concrete wall. (only composite samples collected during the Phase I RFI; Tetra Tech, 2011, sample results presented in Appendix B-3).
77RRSB081	77RR-SB081G-0.502	Subsurface Soil	0.5 – 2	Explosives and select metals; antimony, arsenic, copper, lead, and zinc	1	SOP-01, SOP-02, SOP-03, SOP-04, SOP-05, SOP-06, SOP-07, SOP-08, and SOP-09	To determine the vertical and lateral extend ot potential MC (explosives and select metals) contamination in the area betwen the berms, behind the concrete wall. (only composite samples collected during the Phase I RFI; Tetra Tech, 2011, sample results presented in Appendix B-3).

Sampling Locations	ID Number	Matrix	Depth (feet bgs)	Analytical Group	Number of Samples Per Location (identify field duplicates)	Sampling SOP Reference	Sample Rationale
77RRSB082	77RR-SS082G-00.5	Surface Soil	0 – 0.5	Explosives and select metals; antimony, arsenic, copper, lead, and zinc	1	SOP-01, SOP-02, SOP-03, SOP-04, SOP-05, SOP-06, SOP-07, SOP-08, and SOP-09	To determine the vertical and lateral extend ot potential MC (explosives and select metals) contamination in the area betwen the berms, behind the concrete wall. (only composite samples collected during the Phase I RFI; Tetra Tech, 2011, sample results presented in Appendix B-3).
77RRSB082	77RR-SB082G-0.502	Subsurface Soil	0.5 – 2	Explosives and select metals; antimony, arsenic, copper, lead, and zinc	1	SOP-01, SOP-02, SOP-03, SOP-04, SOP-05, SOP-06, SOP-07, SOP-08, and SOP-09	To determine the vertical and lateral extend ot potential MC (explosives and select metals) contamination in the area betwen the berms, behind the concrete wall. (only composite samples collected during the Phase I RFI; Tetra Tech, 2011, sample results presented in Appendix B-3).
SHORT YARDAGE RANGE TARGET STANDS (10 samples)							
77RRSB083	77RR-SS083G-00.5 77RR-FDmmddyy-03	Surface Soil	0 – 0.5	Explosives and select metals; antimony, arsenic, copper, lead, and zinc	2 (duplicate)	SOP-01, SOP-02, SOP-03, SOP-04, SOP-05, SOP-06, SOP-07, SOP-08, and SOP-09	To determine the vertical and lateral extent of potential MC (explosives and select metals) contamination in the area at the target stands (no samples were collected in this area during the Phase I RFI, Tetra Tech, 2011).
77RRSB083	77RR-SB083G-0.502	Subsurface Soil	0.5 – 2	Explosives and select metals; antimony, arsenic, copper, lead, and zinc	1	SOP-01, SOP-02, SOP-03, SOP-04, SOP-05, SOP-06, SOP-07, SOP-08, and SOP-09	To determine the vertical and lateral extent of potential MC (explosives and select metals) contamination in the area at the target stands (no samples were collected in this area during the Phase I RFI, Tetra Tech, 2011).
77RRSB084	77RR-SS084G-00.5	Surface Soil	0 – 0.5	Explosives and select metals; antimony, arsenic, copper, lead, and zinc	1	SOP-01, SOP-02, SOP-03, SOP-04, SOP-05, SOP-06, SOP-07, SOP-08, and SOP-09	To determine the vertical and lateral extent of potential MC (explosives and select metals) contamination in the area at the target stands (no samples were collected in this area during the Phase I RFI, Tetra Tech, 2011).
77RRSB084	77RR-SB084G-0.502	Subsurface Soil	0.5 – 2	Explosives and select metals; antimony, arsenic, copper, lead, and zinc	1	SOP-01, SOP-02, SOP-03, SOP-04, SOP-05, SOP-06, SOP-07, SOP-08, and SOP-09	To determine the vertical and lateral extent of potential MC (explosives and select metals) contamination in the area at the target stands (no samples were collected in this area during the Phase I RFI, Tetra Tech, 2011).
77RRSB085	77RR-SS085G-00.5	Surface Soil	0 – 0.5	Explosives and select metals; antimony, arsenic, copper, lead, and zinc	1	SOP-01, SOP-02, SOP-03, SOP-04, SOP-05, SOP-06, SOP-07, SOP-08, and SOP-09	To determine the vertical and lateral extent of potential MC (explosives and select metals) contamination in the area at the target stands (no samples were collected in this area during the Phase I RFI, Tetra Tech, 2011).
77RRSB085	77RR-SB085G-0.502	Subsurface Soil	0.5 – 2	Explosives and select metals; antimony, arsenic, copper, lead, and zinc	1	SOP-01, SOP-02, SOP-03, SOP-04, SOP-05, SOP-06, SOP-07, SOP-08, and SOP-09	To determine the vertical and lateral extent of potential MC (explosives and select metals) contamination in the area at the target stands (no samples were collected in this area during the Phase I RFI, Tetra Tech, 2011).
77RRSB086	77RR-SS086G-00.5	Surface Soil	0 – 0.5	Explosives and select metals; antimony, arsenic, copper, lead, and zinc	1	SOP-01, SOP-02, SOP-03, SOP-04, SOP-05, SOP-06, SOP-07, SOP-08, and SOP-09	To determine the vertical and lateral extent of potential MC (explosives and select metals) contamination in the area at the target stands (no samples were collected in this area during the Phase I RFI, Tetra Tech, 2011).

Sampling Locations	ID Number	Matrix	Depth (feet bgs)	Analytical Group	Number of Samples Per Location (identify field duplicates)	Sampling SOP Reference	Sample Rationale
77RRSB086	77RR-SB086G-0.502	Subsurface Soil	0.5 – 2	Explosives and select metals; antimony, arsenic, copper, lead, and zinc	1	SOP-01, SOP-02, SOP-03, SOP-04, SOP-05, SOP-06, SOP-07, SOP-08, and SOP-09	To determine the vertical and lateral extent of potential MC (explosives and select metals) contamination in the area at the target stands (no samples were collected in this area during the Phase I RFI, Tetra Tech, 2011).
77RRSB087	77RR-SS087G-00.5	Surface Soil	0 – 0.5	Explosives and select metals; antimony, arsenic, copper, lead, and zinc	1	SOP-01, SOP-02, SOP-03, SOP-04, SOP-05, SOP-06, SOP-07, SOP-08, and SOP-09	To determine the vertical and lateral extent of potential MC (explosives and select metals) contamination in the area at the target stands (no samples were collected in this area during the Phase I RFI, Tetra Tech, 2011).
77RRSB087	77RR-SB087G-0.502	Subsurface Soil	0.5 – 2	Explosives and select metals; antimony, arsenic, copper, lead, and zinc	1	SOP-01, SOP-02, SOP-03, SOP-04, SOP-05, SOP-06, SOP-07, SOP-08, and SOP-09	To determine the vertical and lateral extent of potential MC (explosives and select metals) contamination in the area at the target stands (no samples were collected in this area during the Phase I RFI, Tetra Tech, 2011).
AREAS OUTSIDE AND AROUND BERMS (up to 14 samples)							
77RRSB088	77RR-SS088G-00.5	Surface Soil	0 – 0.5	Select metals; antimony, arsenic, copper, lead, and zinc	1	SOP-01, SOP-02, SOP-03, SOP-04, SOP-05, SOP-06, SOP-07, SOP-08, and SOP-09	To determine the lateral extent of MC (select metals) contamination around the earthen berm and wooded embankmant (found during the Phase I RFI; Tetra Tech, 2011, results presented in Appendix B-3).
77RRSB089	77RR-SS089G-00.5	Surface Soil	0 – 0.5	Select metals; antimony, arsenic, copper, lead, and zinc	1	SOP-01, SOP-02, SOP-03, SOP-04, SOP-05, SOP-06, SOP-07, SOP-08, and SOP-09	To determine the lateral extent of MC (select metals) contamination around the earthen berm and wooded embankmant (found during the Phase I RFI; Tetra Tech, 2011, results presented in Appendix B-3).
77RRSB090	77RR-SS090G-00.5	Surface Soil	0 – 0.5	Select metals; antimony, arsenic, copper, lead, and zinc	1	SOP-01, SOP-02, SOP-03, SOP-04, SOP-05, SOP-06, SOP-07, SOP-08, and SOP-09	To determine the lateral extent of MC (select metals) contamination around the earthen berm and wooded embankmant (found during the Phase I RFI; Tetra Tech, 2011, results presented in Appendix B-3).
77RRSB091	77RR-SS091G-00.5	Surface Soil	0 – 0.5	Select metals; antimony, arsenic, copper, lead, and zinc	1	SOP-01, SOP-02, SOP-03, SOP-04, SOP-05, SOP-06, SOP-07, SOP-08, and SOP-09	To determine the lateral extent of MC (select metals) contamination around the earthen berm and wooded embankmant (found during the Phase I RFI; Tetra Tech, 2011, results presented in Appendix B-3).
77RRSB092	77RR-SS092G-00.5	Surface Soil	0 – 0.5	Select metals; antimony, arsenic, copper, lead, and zinc	1	SOP-01, SOP-02, SOP-03, SOP-04, SOP-05, SOP-06, SOP-07, SOP-08, and SOP-09	To determine the lateral extent of MC (select metals) contamination around the earthen berm and wooded embankmant (found during the Phase I RFI; Tetra Tech, 2011, results presented in Appendix B-3).
77RRSB093	77RR-SS093G-00.5	Surface Soil	0 – 0.5	Select metals; antimony, arsenic, copper, lead, and zinc	1	SOP-01, SOP-02, SOP-03, SOP-04, SOP-05, SOP-06, SOP-07, SOP-08, and SOP-09	To determine the lateral extent of MC (select metals) contamination around the earthen berm and wooded embankmant (found during the Phase I RFI; Tetra Tech, 2011, results presented in Appendix B-3).
77RRSB094	77RR-SS094G-00.5	Surface Soil	0 – 0.5	Select metals; antimony, arsenic, copper, lead, and zinc	1	SOP-01, SOP-02, SOP-03, SOP-04, SOP-05, SOP-06, SOP-07, SOP-08, and SOP-09	To determine the lateral extent of MC (select metals) contamination around the earthen berm and wooded embankmant (found during the Phase I RFI; Tetra Tech, 2011, results presented in Appendix B-3).

Sampling Locations	ID Number	Matrix	Depth (feet bgs)	Analytical Group	Number of Samples Per Location (identify field duplicates)	Sampling SOP Reference	Sample Rationale
77RRSB095	77RR-SS095G-00.5	Surface Soil	0 – 0.5	Select metals; antimony, arsenic, copper, lead, and zinc	1	SOP-01, SOP-02, SOP-03, SOP-04, SOP-05, SOP-06, SOP-07, SOP-08, and SOP-09	To determine the lateral extent of MC (select metals) contamination around the earthen berm and wooded embankmant (found during the Phase I RFI; Tetra Tech, 2011, results presented in Appendix B-3).
77RRSB096	77RR-SS096G-00.5	Surface Soil	0 – 0.5	Select metals; antimony, arsenic, copper, lead, and zinc	1	SOP-01, SOP-02, SOP-03, SOP-04, SOP-05, SOP-06, SOP-07, SOP-08, and SOP-09	To determine the lateral extent of MC (select metals) contamination around the earthen berm and wooded embankmant (found during the Phase I RFI; Tetra Tech, 2011, results presented in Appendix B-3).
77RRSB097	77RR-SS097G-00.5	Surface Soil	0 – 0.5	Select metals; antimony, arsenic, copper, lead, and zinc	1	SOP-01, SOP-02, SOP-03, SOP-04, SOP-05, SOP-06, SOP-07, SOP-08, and SOP-09	To determine the lateral extent of MC (select metals) contamination around the earthen berm and wooded embankmant (found during the Phase I RFI; Tetra Tech, 2011, results presented in Appendix B-3).
77RRSB098	77RR-SS098G-00.5	Surface Soil	0 – 0.5	Select metals; antimony, arsenic, copper, lead, and zinc	1	SOP-01, SOP-02, SOP-03, SOP-04, SOP-05, SOP-06, SOP-07, SOP-08, and SOP-09	To determine the lateral extent of MC (select metals) contamination around the earthen berm and wooded embankmant (found during the Phase I RFI; Tetra Tech, 2011, results presented in Appendix B-3).
77RRSB099	77RR-SS099G-00.5	Surface Soil	0 – 0.5	Select metals; antimony, arsenic, copper, lead, and zinc	1	SOP-01, SOP-02, SOP-03, SOP-04, SOP-05, SOP-06, SOP-07, SOP-08, and SOP-09	To determine the lateral extent of MC (select metals) contamination around the earthen berm and wooded embankmant (found during the Phase I RFI; Tetra Tech, 2011, results presented in Appendix B-3).
77RRSB100	77RR-SS100G-00.5	Surface Soil	0 – 0.5	Select metals; antimony, arsenic, copper, lead, and zinc	1	SOP-01, SOP-02, SOP-03, SOP-04, SOP-05, SOP-06, SOP-07, SOP-08, and SOP-09	To determine the lateral extent of MC (select metals) contamination around the earthen berm and wooded embankmant (found during the Phase I RFI; Tetra Tech, 2011, results presented in Appendix B-3).
77RRSB101	77RR-SS101G-00.5	Surface Soil	0 – 0.5	Select metals; antimony, arsenic, copper, lead, and zinc	1	SOP-01, SOP-02, SOP-03, SOP-04, SOP-05, SOP-06, SOP-07, SOP-08, and SOP-09	To determine the lateral extent of MC (select metals) contamination around the earthen berm and wooded embankmant (found during the Phase I RFI; Tetra Tech, 2011, results presented in Appendix B-3).
200 YARD FIRING LINE (10 samples)							
77RRSB102	77RR-SS102G-00.5 77RR-FDmmddyy-04	Surface Soil	0 – 0.5	NG and select metals; antimony, arsenic, copper, lead, and zinc	2 (duplicate)	SOP-01, SOP-02, SOP-03, SOP-04, SOP-05, SOP-06, SOP-07, SOP-08, and SOP-09	To further investigaiton potential NG contamination (only composite samples collected during the Phase I RFI and samples not analyzed for select metals; Tetra Tech, 2011, results presented in Appendix B-3).
77RRSB102	77RR-SB102G-0.502 77RR-FDmmddyy-05	Subsurface Soil	0.5 - 2	NG	2 (duplicate)	SOP-01, SOP-02, SOP-03, SOP-04, SOP-05, SOP-06, SOP-07, SOP-08, and SOP-09	To further investigaiton potential NG contamination (only composite samples collected during the Phase I RFI Tetra Tech, 2011, results presented in Appendix B-3).
77RRSB103	77RR-SS103G-00.5	Surface Soil	0 – 0.5	NG and select metals; antimony, arsenic, copper, lead, and zinc	1	SOP-01, SOP-02, SOP-03, SOP-04, SOP-05, SOP-06, SOP-07, SOP-08, and SOP-09	To further investigaiton potential NG contamination (only composite samples collected during the Phase I RFI and samples not analyzed for select metals; Tetra Tech, 2011, results presented in Appendix B-3).

Sampling Locations	ID Number	Matrix	Depth (feet bgs)	Analytical Group	Number of Samples Per Location (identify field duplicates)	Sampling SOP Reference	Sample Rationale
77RRSB103	77RR-SB103G-0.502	Subsurface Soil	0.5 - 2	NG	1	SOP-01, SOP-02, SOP-03, SOP-04, SOP-05, SOP-06, SOP-07, SOP-08, and SOP-09	To further investigaiton potential NG contamination (only composite samples collected during the Phase I RFI Tetra Tech, 2011, results presented in Appendix B-3).
77RRSB104	77RR-SS104G-00.5	Surface Soil	0 – 0.5	NG and select metals; antimony, arsenic, copper, lead, and zinc	1	SOP-01, SOP-02, SOP-03, SOP-04, SOP-05, SOP-06, SOP-07, SOP-08, and SOP-09	To further investigaiton potential NG contamination (only composite samples collected during the Phase I RFI and samples not analyzed for select metals; Tetra Tech, 2011, results presented in Appendix B-3).
77RRSB104	77RR-SB104G-0.502	Subsurface Soil	0.5 - 2	NG	1	SOP-01, SOP-02, SOP-03, SOP-04, SOP-05, SOP-06, SOP-07, SOP-08, and SOP-09	To further investigaiton potential NG contamination (only composite samples collected during the Phase I RFI Tetra Tech, 2011, results presented in Appendix B-3).
77RRSB105	77RR-SS105G-00.5	Surface Soil	0 – 0.5	NG and select metals; antimony, arsenic, copper, lead, and zinc	1	SOP-01, SOP-02, SOP-03, SOP-04, SOP-05, SOP-06, SOP-07, SOP-08, and SOP-09	To further investigaiton potential NG contamination (only composite samples collected during the Phase I RFI and samples not analyzed for select metals; Tetra Tech, 2011, results presented in Appendix B-3).
77RRSB105	77RR-SB105G-0.502	Subsurface Soil	0.5 - 2	NG	1	SOP-01, SOP-02, SOP-03, SOP-04, SOP-05, SOP-06, SOP-07, SOP-08, and SOP-09	To further investigaiton potential NG contamination (only composite samples collected during the Phase I RFI Tetra Tech, 2011, results presented in Appendix B-3).
77RRSB106	77RR-SS106G-00.5	Surface Soil	0 – 0.5	NG and select metals; antimony, arsenic, copper, lead, and zinc	1	SOP-01, SOP-02, SOP-03, SOP-04, SOP-05, SOP-06, SOP-07, SOP-08, and SOP-09	To further investigaiton potential NG contamination (only composite samples collected during the Phase I RFI and samples not analyzed for select metals; Tetra Tech, 2011, results presented in Appendix B-3).
77RRSB106	77RR-SB106G-0.502	Subsurface Soil	0.5 - 2	NG	1	SOP-01, SOP-02, SOP-03, SOP-04, SOP-05, SOP-06, SOP-07, SOP-08, and SOP-09	To further investigaiton potential NG contamination (only composite samples collected during the Phase I RFI Tetra Tech, 2011, results presented in Appendix B-3).
OTHER FIRING LINES (6 samples)							
77RRSB107	77RR-SB107G-0.502	Subsurface Soil	0.5 - 2	NG	1	SOP-01, SOP-02, SOP-03, SOP-04, SOP-05, SOP-06, SOP-07, SOP-08, and SOP-09	To further investigaiton potential NG contamination (only composite samples collected during the Phase I RFI Tetra Tech, 2011, results presented in Appendix B-3).
77RRSB108	77RR-SB108G-0.502	Subsurface Soil	0.5 - 2	NG	1	SOP-01, SOP-02, SOP-03, SOP-04, SOP-05, SOP-06, SOP-07, SOP-08, and SOP-09	To further investigaiton potential NG contamination (only composite samples collected during the Phase I RFI Tetra Tech, 2011, results presented in Appendix B-3).
77RRSB109	77RR-SB109G-0.502	Subsurface Soil	0.5 - 2	NG	1	SOP-01, SOP-02, SOP-03, SOP-04, SOP-05, SOP-06, SOP-07, SOP-08, and SOP-09	To further investigaiton potential NG contamination (only composite samples collected during the Phase I RFI Tetra Tech, 2011, results presented in Appendix B-3).
77RRSB110	77RR-SB110G-0.502	Subsurface Soil	0.5 - 2	NG	1	SOP-01, SOP-02, SOP-03, SOP-04, SOP-05, SOP-06, SOP-07, SOP-08, and SOP-09	To further investigaiton potential NG contamination (only composite samples collected during the Phase I RFI Tetra Tech, 2011, results presented in Appendix B-3).
77RRSB1011	77RR-SB111G-0.502	Subsurface Soil	0.5 - 2	NG	1	SOP-01, SOP-02, SOP-03, SOP-04, SOP-05, SOP-06, SOP-07, SOP-08, and SOP-09	To further investigaiton potential NG contamination (only composite samples collected during the Phase I RFI Tetra Tech, 2011, results presented in Appendix B-3).

Sampling Locations	ID Number	Matrix	Depth (feet bgs)	Analytical Group	Number of Samples Per Location (identify field duplicates)	Sampling SOP Reference	Sample Rationale
77RRSB112	77RR-SB112G-0.502	Subsurface Soil	0.5 - 2	NG	1	SOP-01, SOP-02, SOP-03, SOP-04, SOP-05, SOP-06, SOP-07, SOP-08, and SOP-09	To further investigaiton potential NG contamination (only composite samples collected during the Phase I RFI Tetra Tech, 2011, results presented in Appendix B-3).
DISCRETIONARY SAMPLES							
77RRSB113[(1)]	77RR-SS113G-XXXX	TBD	TBD	Explosives, NG, and select metals; antimony, arsenic, copper, lead, and zinc[(2)]	1	SOP-01, SOP-02, SOP-03, SOP-04, SOP-05, SOP-06, SOP-07, SOP-08, and SOP-09	To be collected at locations to be determined in the field to better characterize site soil and at the discretion of the FOL.
77RRSB114[(1)]	77RR-SB114G-XXXX	TBD	TBD	Explosives, NG, and select metals; antimony, arsenic, copper, lead, and zinc[(2)]	1	SOP-01, SOP-02, SOP-03, SOP-04, SOP-05, SOP-06, SOP-07, SOP-08, and SOP-09	To be collected at locations to be determined in the field to better characterize site soil and at the discretion of the FOL.
77RRSB115[(1)]	77RR-SS115G-XXXX	TBD	TBD	Explosives, NG, and select metals; antimony, arsenic, copper, lead, and zinc[(2)]	1	SOP-01, SOP-02, SOP-03, SOP-04, SOP-05, SOP-06, SOP-07, SOP-08, and SOP-09	To be collected at locations to be determined in the field to better characterize site soil and at the discretion of the FOL.
77RRSB116[(1)]	77RR-SB115G-XXXX	TBD	TBD	Explosives, NG, and select metals; antimony, arsenic, copper, lead, and zinc[(2)]	1	SOP-01, SOP-02, SOP-03, SOP-04, SOP-05, SOP-06, SOP-07, SOP-08, and SOP-09	To be collected at locations to be determined in the field to better characterize site soil and at the discretion of the FOL.
Bucket Evaluation							
77RRSB117 [(3)]	77RRSS117G-XXXX	TBD	TBD	pH	1	SOP-01, SOP-02, SOP-03, SOP-04 ; SOP-07, and SOP-08	To be collected during bucket evaluation.
77RRSB118 [(3)]	77RRSS118G-XXXX	TBD	TBD	pH	1	SOP-01, SOP-02, SOP-03, SOP-04 ; SOP-07, and SOP-08	To be collected during bucket evaluation.

1 – Discretionary samples; actual locations, sampling depths, and quantity collected will be determined during the field investigation.
2 – The analytic group for the discretionary samples will be based on the sample collection area, i.e., firing lines, earthen berm, etc.
3 – A bucket evaluation will be conducted to quantify lead impacts from bullets (slugs or casings). The bucket evaluation for a given subarea will be conducted after the soil sampling efforts such that they location of the bucket evaluation can be determined based on field observation of biased high bullet density. Approximately five pounds of soil will be collected and placed into a clean container (e.g., single-use bucket) for this evaluation. The Tetra Tech field geologist will classify the soil and collecte a soil sample for pH analysis. The total weight of the soil will be determined, then the entire sample screened using a 0.25-inch wire screen, and then the residual items (i.e., bullets) weighed such that the relative percent tby weight of bullets vs. soil may be determined.

TBD – To be determined.

SAP Worksheet #18.5 – Potential OB/OD Subarea Sampling Locations and Methods/SOP Requirements Table

Sampling Location	ID Number	Matrix	Depth (feet bgs)	Analytical Group	Number of Samples Per Location (identify field duplicates)	Sampling SOP Reference	Sample Rationale
THROUGHOUT SITE (four samples)							
77OBSB007	77OB-SS007G-00.5 77OB-FDmmddyy-01	Surface Soil	0 – 0.5	Explosives and select metals; antimony, arsenic, copper, lead, and zinc(2)	2 (duplicate)	SOP-01, SOP-02, SOP-03, SOP-04, SOP-05, SOP-06, SOP-07, SOP-08, and SOP-09	To characterize surfa soil at the site. To collect additional samples to add to Phase I RFI data (Tetra Tech, 2011, results presented in Appendix B-3) in order to have adequate number of samples to conducte risk assessment.
77OBSB008	77OB-SS008G-00.5	Surface Soil	0 – 0.5	Explosives and select metals; antimony, arsenic, copper, lead, and zinc(2)	1	SOP-01, SOP-02, SOP-03, SOP-04, SOP-05, SOP-06, SOP-07, SOP-08, and SOP-09	To characterize surfa soil at the site. To collect additional samples to add to Phase I RFI data (Tetra Tech, 2011, results presented in Appendix B-3) in order to have adequate number of samples to conducte risk assessment.
77OBSB009	77OB-SS009G-00.5	Surface Soil	0 – 0.5	Explosives and select metals; antimony, arsenic, copper, lead, and zinc(2)	1	SOP-01, SOP-02, SOP-03, SOP-04, SOP-05, SOP-06, SOP-07, SOP-08, and SOP-09	To characterize surfa soil at the site. To collect additional samples to add to Phase I RFI data (Tetra Tech, 2011, results presented in Appendix B-3) in order to have adequate number of samples to conducte risk assessment.
77OBSB010	77OB-SS010G-00.5	Surface Soil	0 – 0.5	Explosives and select metals; antimony, arsenic, copper, lead, and zinc(2)	1	SOP-01, SOP-02, SOP-03, SOP-04, SOP-05, SOP-06, SOP-07, SOP-08, and SOP-09	To characterize surfa soil at the site. To collect additional samples to add to Phase I RFI data (Tetra Tech, 2011, results presented in Appendix B-3) in order to have adequate number of samples to conducte risk assessment.
TO BE DETERMINED BASED ON RESULTS OF GEOPHYSICAL INVESTIGATION (up to 12 samples)							
77OBSB011(1)	77OB-SB011G-XXXX	TBD	TBD	Explosives and select metals; antimony, arsenic, copper, lead, and zinc(2)	1	SOP-01, SOP-02, SOP-03, SOP-04, SOP-05, SOP-06, SOP-07, SOP-08, and SOP-09	To determine the vertical extent of potential contamination (samples will be collected during intrusive activities). To collect additional samples to add to Phase I RFI data (Tetra Tech, 2011, results presented in Appendix B-3) in order to have adequate number of samples to conduct risk assessment.
77OBSB012(1)	77OB-SB012G-XXXX	TBD	TBD	Explosives and select metals; antimony, arsenic, copper, lead, and zinc(2)	1	SOP-01, SOP-02, SOP-03, SOP-04, SOP-05, SOP-06, SOP-07, SOP-08, and SOP-09	To determine the vertical extent of potential contamination (samples will be collected during intrusive activities). To collect additional samples to add to Phase I RFI data (Tetra Tech, 2011, results presented in Appendix B-3) in order to have adequate number of samples to conduct risk assessment.
77OBSB013(1)	77OB-SB013G-XXXX	TBD	TBD	Explosives and select metals; antimony, arsenic, copper, lead, and zinc(2)	1	SOP-01, SOP-02, SOP-03, SOP-04, SOP-05, SOP-06, SOP-07, SOP-08, and SOP-09	To determine the vertical extent of potential contamination (samples will be collected during intrusive activities). To collect additional samples to add to Phase I RFI data (Tetra Tech, 2011, results presented in Appendix B-3) in order to have adequate number of samples to conduct risk assessment.

Sampling Location	ID Number	Matrix	Depth (feet bgs)	Analytical Group	Number of Samples Per Location (identify field duplicates)	Sampling SOP Reference	Sample Rationale
77OBSB014[(1)]	77OB-SB014G-XXXX	TBD	TBD	Explosives and select metals; antimony, arsenic, copper, lead, and zinc[(2)]	1	SOP-01, SOP-02, SOP-03, SOP-04, SOP-05, SOP-06, SOP-07, SOP-08, and SOP-09	To determine the vertical extent of potential contamination (samples will be collected during intrusive activities). To collect additional samples to add to Phase I RFI data (Tetra Tech, 2011, results presented in Appendix B-3) in order to have adequate number of samples to conduct risk assessment.
77OBSB015[(1)]	77OB-SB015G-XXXX	TBD	TBD	Explosives and select metals; antimony, arsenic, copper, lead, and zinc[(2)]	1	SOP-01, SOP-02, SOP-03, SOP-04, SOP-05, SOP-06, SOP-07, SOP-08, and SOP-09	To determine the vertical extent of potential contamination (samples will be collected during intrusive activities). To collect additional samples to add to Phase I RFI data (Tetra Tech, 2011, results presented in Appendix B-3) in order to have adequate number of samples to conduct risk assessment.
77OBSB016[(1)]	77OB-SB016G-XXXX	TBD	TBD	Explosives and select metals; antimony, arsenic, copper, lead, and zinc[(2)]	1	SOP-01, SOP-02, SOP-03, SOP-04, SOP-05, SOP-06, SOP-07, SOP-08, and SOP-09	To determine the vertical extent of potential contamination (samples will be collected during intrusive activities). To collect additional samples to add to Phase I RFI data (Tetra Tech, 2011, results presented in Appendix B-3) in order to have adequate number of samples to conduct risk assessment.
77OBSB017[(1)]	77OB-SB017G-XXXX	TBD	TBD	Explosives and select metals; antimony, arsenic, copper, lead, and zinc[(2)]	1	SOP-01, SOP-02, SOP-03, SOP-04, SOP-05, SOP-06, SOP-07, SOP-08, and SOP-09	To determine the vertical extent of potential contamination (samples will be collected during intrusive activities). To collect additional samples to add to Phase I RFI data (Tetra Tech, 2011, results presented in Appendix B-3) in order to have adequate number of samples to conduct risk assessment.
77OBSB018[(1)]	77OB-SB018G-XXXX	TBD	TBD	Explosives and select metals; antimony, arsenic, copper, lead, and zinc[(2)]	1	SOP-01, SOP-02, SOP-03, SOP-04, SOP-05, SOP-06, SOP-07, SOP-08, and SOP-09	To determine the vertical extent of potential contamination (samples will be collected during intrusive activities). To collect additional samples to add to Phase I RFI data (Tetra Tech, 2011, results presented in Appendix B-3) in order to have adequate number of samples to conduct risk assessment.
77OBSB019[(1)]	77OB-SB019G-XXXX	TBD	TBD	Explosives and select metals; antimony, arsenic, copper, lead, and zinc[(2)]	1	SOP-01, SOP-02, SOP-03, SOP-04, SOP-05, SOP-06, SOP-07, SOP-08, and SOP-09	To determine the vertical extent of potential contamination (samples will be collected during intrusive activities). To collect additional samples to add to Phase I RFI data (Tetra Tech, 2011, results presented in Appendix B-3) in order to have adequate number of samples to conduct risk assessment.
77OBSB020[(1)]	77OB-SB020G-XXXX	TBD	TBD	Explosives and select metals; antimony, arsenic, copper, lead, and zinc[(2)]	1	SOP-01, SOP-02, SOP-03, SOP-04, SOP-05, SOP-06, SOP-07, SOP-08, and SOP-09	To determine the vertical extent of potential contamination (samples will be collected during intrusive activities). To collect additional samples to add to Phase I RFI data (Tetra Tech, 2011, results presented in Appendix B-3) in order to have adequate number of samples to conduct risk assessment.

Sampling Location	ID Number	Matrix	Depth (feet bgs)	Analytical Group	Number of Samples Per Location (identify field duplicates)	Sampling SOP Reference	Sample Rationale
77OBSB021[1]	77OB-SB021G-XXXX	TBD	TBD	Explosives and select metals; antimony, arsenic, copper, lead, and zinc[2]	1	SOP-01, SOP-02, SOP-03, SOP-04, SOP-05, SOP-06, SOP-07, SOP-08, and SOP-09	To determine the vertical extent of potential contamination (samples will be collected during intrusive activities). To collect additional samples to add to Phase I RFI data (Tetra Tech, 2011, results presented in Appendix B-3) in order to have adequate number of samples to conduct risk assessment.
77OBSB022[1]	77OB-SB022G-XXXX	TBD	TBD	Explosives and select metals; antimony, arsenic, copper, lead, and zinc[2]	1	SOP-01, SOP-02, SOP-03, SOP-04, SOP-05, SOP-06, SOP-07, SOP-08, and SOP-09	To determine the vertical extent of potential contamination (samples will be collected during intrusive activities). To collect additional samples to add to Phase I RFI data (Tetra Tech, 2011, results presented in Appendix B-3) in order to have adequate number of samples to conduct risk assessment.
DISCRETIONARY SAMPLES							
77OBSB023[1]	77OB-SS023G-XXXX	TBD	TBD	Explosives and select metals; antimony, arsenic, copper, lead, and zinc[2]	1	SOP-01, SOP-02, SOP-03, SOP-04, SOP-05, SOP-06, SOP-07, SOP-08, and SOP-09	To be collected at locations to be determined in the field to better characterize surface and/or subsurface soil and at the discretion of the FOL.
77OBSB024[1]	77OB-SB023G-XXXX	TBD	TBD	Explosives and select metals; antimony, arsenic, copper, lead, and zinc[2]	1	SOP-01, SOP-02, SOP-03, SOP-04, SOP-05, SOP-06, SOP-07, SOP-08, and SOP-09	To be collected at locations to be determined in the field to better characterize surface and/or subsurface soil and at the discretion of the FOL.
77OBSB025[1]	77OB-SB023G-XXXX	TBD	TBD	Explosives and select metals; antimony, arsenic, copper, lead, and zinc[2]	1	SOP-01, SOP-02, SOP-03, SOP-04, SOP-05, SOP-06, SOP-07, SOP-08, and SOP-09	To be collected at locations to be determined in the field to better characterize surface and/or subsurface soil and at the discretion of the FOL.
77OBSB026[1]	77OB-SB026G-XXXX	TBD	TBD	Explosives and select metals; antimony, arsenic, copper, lead, and zinc[2]	1	SOP-01, SOP-02, SOP-03, SOP-04, SOP-05, SOP-06, SOP-07, SOP-08, and SOP-09	To be collected at locations to be determined in the field to better characterize surface and/or subsurface soil and at the discretion of the FOL.

1 – Actual locations, depths, and number collected will be determined in the field based on the MEC investigation results and/or field observations.
2 – If evidence of landfill activities is observed by the MEC investigation; the analyses may be expanded to include NG and Appendix IX VOCs, SVOCs, pesticides, herbicides, PCBs, metals, cyanide, and sulfide (see Figure 11-1A).
TBD – To be determined.

SAP Worksheet #18.6 – Potential Munitions Trench Subarea Sampling Locations and Methods/SOP Requirements Table

Sampling Location	ID Number	Matrix	Depth (feet bgs)	Analytical Group	Number of Samples Per Location (identify field duplicates)	Sampling SOP Reference	Sample Rationale
THROUGHOUT SITE (seven samples)							
77MTSB004	77MT-SS004G-00.5 77MT-FDmmddyy-01	Surface Soil	0 – 0.5	Explosives and select metals; antimony, arsenic, copper, lead, and zinc(2)	2 (duplicate)	SOP-01, SOP-02, SOP-03, SOP-04, SOP-05, SOP-06, SOP-07, SOP-08, and SOP-09	To characterize surface soil at the site. To collect additional samples to add to Phase I RFI data (Tetra Tech, 2011, results presented in Appendix B-3) in order to have adequate number of samples to conduct risk assessment.
77MTSB005	77MT-SS005G-00.5	Surface Soil	0 – 0.5	Explosives and select metals; antimony, arsenic, copper, lead, and zinc(2)	1	SOP-01, SOP-02, SOP-03, SOP-04, SOP-05, SOP-06, SOP-07, SOP-08, and SOP-09	To characterize surface soil at the site. To collect additional samples to add to Phase I RFI data (Tetra Tech, 2011, results presented in Appendix B-3) in order to have adequate number of samples to conduct risk assessment.
77MTSB006	77MT-SS006G-00.5	Surface Soil	0 – 0.5	Explosives and select metals; antimony, arsenic, copper, lead, and zinc(2)	1	SOP-01, SOP-02, SOP-03, SOP-04, SOP-05, SOP-06, SOP-07, SOP-08, and SOP-09	To characterize surface soil at the site. To collect additional samples to add to Phase I RFI data (Tetra Tech, 2011, results presented in Appendix B-3) in order to have adequate number of samples to conduct risk assessment.
77MTSB007	77MT-SS007G-00.5	Surface Soil	0 – 0.5	Explosives and select metals; antimony, arsenic, copper, lead, and zinc(2)	1	SOP-01, SOP-02, SOP-03, SOP-04, SOP-05, SOP-06, SOP-07, SOP-08, and SOP-09	To characterize surface soil at the site. To collect additional samples to add to Phase I RFI data (Tetra Tech, 2011, results presented in Appendix B-3) in order to have adequate number of samples to conduct risk assessment.
77MTSB008	77MT-SS008G-00.5	Surface Soil	0 – 0.5	Explosives and select metals; antimony, arsenic, copper, lead, and zinc(2)	1	SOP-01, SOP-02, SOP-03, SOP-04, SOP-05, SOP-06, SOP-07, SOP-08, and SOP-09	To characterize surface soil at the site. To collect additional samples to add to Phase I RFI data (Tetra Tech, 2011, results presented in Appendix B-3) in order to have adequate number of samples to conduct risk assessment.
77MTSB009	77MT-SS009G-00.5	Surface Soil	0 – 0.5	Explosives and select metals; antimony, arsenic, copper, lead, and zinc(2)	1	SOP-01, SOP-02, SOP-03, SOP-04, SOP-05, SOP-06, SOP-07, SOP-08, and SOP-09	To characterize surface soil at the site. To collect additional samples to add to Phase I RFI data (Tetra Tech, 2011, results presented in Appendix B-3) in order to have adequate number of samples to conduct risk assessment.
77MTSB010	77MT-SS010G-00.5	Surface Soil	0 – 0.5	Explosives and select metals; antimony, arsenic, copper, lead, and zinc(2)	1	SOP-01, SOP-02, SOP-03, SOP-04, SOP-05, SOP-06, SOP-07, SOP-08, and SOP-09	To characterize surface soil at the site. To collect additional samples to add to Phase I RFI data (Tetra Tech, 2011, results presented in Appendix B-3) in order to have adequate number of samples to conduct risk assessment.

Sampling Location	ID Number	Matrix	Depth (feet bgs)	Analytical Group	Number of Samples Per Location (identify field duplicates)	Sampling SOP Reference	Sample Rationale
TO BE DETERMINED BASED ON RESULTS OF GEOPHYSICAL INVESTIGATION (10 samples)							
77MTSB011[1]	77MT-SB011G-XXXX 77MT-FDmmddyy-02	TBD	TBD	Explosives and select metals; antimony, arsenic, copper, lead, and zinc[2]	1	SOP-01, SOP-02, SOP-03, SOP-04, SOP-05, SOP-06, SOP-07, SOP-08, and SOP-09	To determine the vertical extent of potential contamination. No subsurface soil samples were collected during the Phase I RFI (Tetra Tech, 2011). To collect samples in order to have adequate numbe rof samples to conduct risk assessment.
77MTSB012[1]	77MT-SB012G-XXXX	TBD	TBD	Explosives and select metals; antimony, arsenic, copper, lead, and zinc[2]	1	SOP-01, SOP-02, SOP-03, SOP-04, SOP-05, SOP-06, SOP-07, SOP-08, and SOP-09	To determine the vertical extent of potential contamination. No subsurface soil samples were collected during the Phase I RFI (Tetra Tech, 2011). To collect samples in order to have adequate numbe rof samples to conduct risk assessment.
77MTSB013[1]	77MT-SB013G-XXXX	TBD	TBD	Explosives and select metals; antimony, arsenic, copper, lead, and zinc[2]	1	SOP-01, SOP-02, SOP-03, SOP-04, SOP-05, SOP-06, SOP-07, SOP-08, and SOP-09	To determine the vertical extent of potential contamination. No subsurface soil samples were collected during the Phase I RFI (Tetra Tech, 2011). To collect samples in order to have adequate numbe rof samples to conduct risk assessment.
77MTSB014[1]	77MT-SB014G-XXXX	TBD	TBD	Explosives and select metals; antimony, arsenic, copper, lead, and zinc[2]	1	SOP-01, SOP-02, SOP-03, SOP-04, SOP-05, SOP-06, SOP-07, SOP-08, and SOP-09	To determine the vertical extent of potential contamination. No subsurface soil samples were collected during the Phase I RFI (Tetra Tech, 2011). To collect samples in order to have adequate numbe rof samples to conduct risk assessment.
77MTSB015[1]	77MT-SB015G-XXXX	TBD	TBD	Explosives and select metals; antimony, arsenic, copper, lead, and zinc[2]	1	SOP-01, SOP-02, SOP-03, SOP-04, SOP-05, SOP-06, SOP-07, SOP-08, and SOP-09	To determine the vertical extent of potential contamination. No subsurface soil samples were collected during the Phase I RFI (Tetra Tech, 2011). To collect samples in order to have adequate numbe rof samples to conduct risk assessment.
77MTSB016[1]	77MT-SB016G-XXXX	TBD	TBD	Explosives and select metals; antimony, arsenic, copper, lead, and zinc[2]	1	SOP-01, SOP-02, SOP-03, SOP-04, SOP-05, SOP-06, SOP-07, SOP-08, and SOP-09	To determine the vertical extent of potential contamination. No subsurface soil samples were collected during the Phase I RFI (Tetra Tech, 2011). To collect samples in order to have adequate numbe rof samples to conduct risk assessment.
77MTSB017[1]	77MT-SB017G-XXXX	TBD	TBD	Explosives and select metals; antimony, arsenic, copper, lead, and zinc[2]	1	SOP-01, SOP-02, SOP-03, SOP-04, SOP-05, SOP-06, SOP-07, SOP-08, and SOP-09	To determine the vertical extent of potential contamination. No subsurface soil samples were collected during the Phase I RFI (Tetra Tech, 2011). To collect samples in order to have adequate numbe rof samples to conduct risk assessment.
77MTSB018[1]	77MT-SB018G-XXXX	TBD	TBD	Explosives and select metals; antimony, arsenic, copper, lead, and zinc[2]	1	SOP-01, SOP-02, SOP-03, SOP-04, SOP-05, SOP-06, SOP-07, SOP-08, and SOP-09	To determine the vertical extent of potential contamination. No subsurface soil samples were collected during the Phase I RFI (Tetra Tech, 2011). To collect samples in order to have adequate numbe rof samples to conduct risk assessment.

Sampling Location	ID Number	Matrix	Depth (feet bgs)	Analytical Group	Number of Samples Per Location (identify field duplicates)	Sampling SOP Reference	Sample Rationale
77MTSB019[1]	77MT-SB019G-XXXX	TBD	TBD	Explosives and select metals; antimony, arsenic, copper, lead, and zinc[2]	1	SOP-01, SOP-02, SOP-03, SOP-04, SOP-05, SOP-06, SOP-07, SOP-08, and SOP-09	To determine the vertical extent of potential contamination. No subsurface soil samples were collected during the Phase I RFI (Tetra Tech, 2011). To collect samples in order to have adequate numbe rof samples to conduct risk assessment.
77MTSB020[1]	77MT-SB020G-XXXX MT-FDmmddyy-02	TBD	TBD	Explosives and select metals; antimony, arsenic, copper, lead, and zinc[2]	2 (duplicate)	SOP-01, SOP-02, SOP-03, SOP-04, SOP-05, SOP-06, SOP-07, SOP-08, and SOP-09	To determine the vertical extent of potential contamination. No subsurface soil samples were collected during the Phase I RFI (Tetra Tech, 2011). To collect samples in order to have adequate numbe rof samples to conduct risk assessment.
DISCRETIONARY SAMPLES							
77MTSB021[1]	77MT-SS021G-XXXX	TBD	TBD	Explosives and select metals; antimony, arsenic, copper, lead, and zinc[2]	1	SOP-01, SOP-02, SOP-03, SOP-04, SOP-05, SOP-06, SOP-07, SOP-08, and SOP-09	To be collected at locations to be determined in the field to better characterize surface and/or subsurface soil and at the discretion of the FOL.
77MTSB022[1]	77MT-SB022G-XXXX	TBD	TBD	Explosives and select metals; antimony, arsenic, copper, lead, and zinc[2]	1	SOP-01, SOP-02, SOP-03, SOP-04, SOP-05, SOP-06, SOP-07, SOP-08, and SOP-09	To be collected at locations to be determined in the field to better characterize surface and/or subsurface soil and at the discretion of the FOL.
77MTSB023[1]	77MT-SS023G-XXxX	TBD	TBD	Explosives and select metals; antimony, arsenic, copper, lead, and zinc[2]	1	SOP-01, SOP-02, SOP-03, SOP-04, SOP-05, SOP-06, SOP-07, SOP-08, and SOP-09	To be collected at locations to be determined in the field to better characterize surface and/or subsurface soil and at the discretion of the FOL.
77MTSB024[1]	77MT-SB024G-XXXX	TBD	TBD	Explosives and select metals; antimony, arsenic, copper, lead, and zinc[2]	1	SOP-01, SOP-02, SOP-03, SOP-04, SOP-05, SOP-06, SOP-07, SOP-08, and SOP-09	To be collected at locations to be determined in the field to better characterize surface and/or subsurface soil and at the discretion of the FOL.

1 – Actual locations, depth, and number collected will be determined in the field based on the MEC investigation results.
2 – If evidence of landfill activities is observed during the MEC investigation; the analyses may be expanded to include NG and Appendix IX VOCs, SVOCs, pesticides, herbicides, PCBs, metals, cyanide, and sulfide (see Figure 11-1A).
TBD – To be determined.

SAP Worksheet #18.7 – IDW QA/QC Sampling Locations and Methods/SOP Requirements Table

Sampling Location	ID Number	Matrix	Depth (feet bgs)	Analytical Group	Number of Samples	Sampling SOP Reference	Sample Rationale
Trip blank (3)	77-TBmmddyy-XX	aqueous	NA	VOCs	3	SOP-01, SOP-02, SOP-03, and SOP-04	NA
Soil sampling rinsate blank(1)	77-RBmmddyy-XX	aqueous	NA	(2)	Up to 12	SOP-01, SOP-02, SOP-03, and SOP-04	NA
IDW	77-IDWmmddyy-XX	soil	NA	TCLP Regulatory List Organics	1	SOP-01, SOP-02, SOP-03, SOP-04, and SOP-08	NA
IDW	77-IDWmmddyy-XX	soil	NA	TCIP Regulatory List Inorganics	1	SOP-01, SOP-02, SOP-03, SOP-04, and SOP-08	NA
IDW	77-IDWmmddyy-XX	soil	NA	Ignitability	1	SOP-01, SOP-02, SOP-03, SOP-04, and SOP-08	NA
IDW	77-IDWmmddyy-XX	soil	NA	pH	1	SOP-01, SOP-02, SOP-03, SOP-04, and SOP-08	NA
IDW	77-IDWmmddyy-XX	soil	NA	Reactive Cyanide	1	SOP-01, SOP-02, SOP-03, SOP-04, and SOP-08	NA
IDW	77-IDWmmddyy-XX	soil	NA	Reactive Sulfide	1	SOP-01, SOP-02, SOP-03, SOP-04, and SOP-08	NA

1 – For soil sampling equipment rinsates will be collected at a frequency of 1 per 20 samples per medium per analysis.
2 – Analytical group will be determined based on subarea.
3- Assumes landfilling encountered at OB/OD Subarea and/or Potential Munitions Trench Subarea such that Appendix IX VOC samples are collected.
NA – Not applicable.

SAP Worksheet #19 -- Analytical SOP Requirements Table

(UFP-QAPP Manual Section 3.1.1)

Matrix	Analytical Group	Analytical and Preparation Method/ SOP Reference [1]	Containers (number, size, and type)	Sample Volume (units)	Preservation Requirements (chemical, temperature, light protected)	Maximum Holding Time (preparation/ analysis)
Aqueous QC samples	VOCs	SW-846 5030/8260B, Empirical SOP-202	Three 40-mL glass vials	5 mL	Hydrochloric acid (HCl) to pH<2; Cool to 0 to 6 °C; no headspace	14 days to analysis
Soil	VOCs	SW-846 5035/8260B, Empirical SOP-202/225	Three 5-gram (g) Encore samplers or terracores	5 g	Sodium bisulfate in water, cool to < 6 °C; methanol, cool to < 6 °C, not frozen	48 hours from sampling to preparation, 14 days to analysis
Aqueous QC samples	Empirical SVOCs (Low level scan) - See Worksheet #15 for compound list	SW-846 3510C/8270D-Low, Empirical SOP-201/300	Two 1-liter (L) glass amber bottles	1,000 mL	Cool to 0 to 6 °C	7 days until extraction, 40 days to analysis
Soil	Empirical SVOCs (Low level scan) - See Worksheet #15 for compound list	SW-846 3546/ 8270D-Low, Empirical SOP-201/343	One 4-ounce (oz) glass jar with a Teflon-lined lid	15 g	Cool to 0 to 6 °C	14 days until extraction, 40 days to analysis
Aqueous QC samples	TestAmerica SVOCs - See Worksheet #15 for compound list	SW-846 3520B/8270D TestAmerica Savannah SOP SA-EX-030, SOP SA-SM-033	Two 1-L amber glass bottles	1 L	Cool to 0 to 6 °C	7 days for preparation; 40 days to analysis
Soil	TestAmerica SVOCs - See Worksheet 15 for compound list	SW-846 3546/ 8270D, Test America Savannah SOP SA-EX-040, SOP SA-SM-033	One 4-oz glass jar with a Teflon-lined lid	30 g	Cool to 0 to 6 °C	14 days until extraction, 40 days to analysis
Aqueous QC samples	TestAmerica Pesticides - See Worksheet #15 for list	SW-846 3520B 8081B, TestAmerica Savannah SOP SA-EX-040 SOP SA-SG-45	Two 1-L glass amber bottles	1 L	Cool to 0 to 6 °C	7 days until extraction, 40 days to analysis

Matrix	Analytical Group	Analytical and Preparation Method/ SOP Reference [1]	Containers (number, size, and type)	Sample Volume (units)	Preservation Requirements (chemical, temperature, light protected)	Maximum Holding Time (preparation/ analysis)
Soil	TestAmerica Pesticides - See Worksheet #15 for list	SW-846 3546/8081B, TestAmerica Savannah SOP SA-EX-040, SOP SA-SG-45	One 4-oz glass jar with a Teflon-lined lid	30 g	Cool to 0 to 6 °C	14 days until extraction, 40 days to analysis
Aqueous QC samples	Pesticides/PCBs	SW-846 3510C / 8081B/8082A, Empirical SOP-211/302	Two 1-L glass amber bottles	1,000 mL	Cool to 0 to 6 °C	7 days until extraction, 40 days to analysis
Soil	Pesticides/PCBs	SW-846 3546 /8081B/ 8082A, Empirical SOP-211/343	One 4-oz glass jar with a Teflon-lined lid	15 g	Cool to 0 to 6 °C	14 days until extraction, 40 days to analysis
Aqueous QC samples	Herbicides	SW-846 8151A, Empirical SOP-208/304	Two 1-L glass amber bottles	1,000 ml	Cool to 0 to 6 °C	7 days until extraction, 40 days to analysis
Soil	Herbicides	SW-846 8151A, Empirical SOP-308/310	One 4-oz glass jar with a Teflon-lined lid	15 g	Cool to 0 to 6 °C	14 days until extraction, 40 days to analysis
Aqueous QC samples	Metals and Select Metals	SW-846 3005A/ 6010C, SW-846 7470A Empirical SOP-100/103/105	One 500-mL plastic bottle	50 mL	Nitric acid (HNO_3) to pH <2; Cool to 0 to 6 °C	180 days to analysis except mercury which is 28 days to analysis
Soil	Metals and Select Metals	SW-846 3050B/ 6010C, SW-846 7471A Empirical SOP-100/104/105	One 4-oz glass jar with a Teflon-lined lid	1 to 2 grams	Cool to 0 to 6 °C	180 days to analysis except mercury which is 28 days to analysis
Aqueous QC samples	Explosives (plus NG)	SW-846 8330B Empirical SOP-327	2- 1-liter amber glass	1000 mL	Cool to 0 to 6 °C	7 days to extraction; 40 days to analysis
Soil	Explosives (plus NG)	SW-846 8330B Empirical SOP-327	One 4-oz glass jar with a Teflon-lined lid	30 g	Cool to 0 to 6 °C	14 days to extraction; 40 days to analysis
Aqueous QC samples	Cyanide	SW-846 9012A, Empirical SOP-164/175	One 250-mL plastic bottle	50 mL	Sodium hydroxide to a pH > 12; Cool to ≤6 °C	14 days to analysis
Soil	Cyanide	SW-846 9012A, Empirical SOP-164/175	One 4-oz glass jar	5 g	Cool to 0 to 6 °C	14 days to analysis
Aqueous QC samples	Sulfide	SM4500S-2 CF, Empirical SOP-153	One 250-mL plastic bottle	250 mL	Zinc Acetate and Sodium Hydroxide; Cool to ≤ 6°C	7 days to analysis

Matrix	Analytical Group	Analytical and Preparation Method/ SOP Reference [1]	Containers (number, size, and type)	Sample Volume (units)	Preservation Requirements (chemical, temperature, light protected)	Maximum Holding Time (preparation/ analysis)
Soil	Sulfide	SW-846 9030, 9034 Empirical SOP-144	One 4-oz glass jar	25 g	Cool to 0 to 6 °C	7 days to analysis
Soil [3]	TCLP Regulatory List Organics	SW-846 1311; SW-846 5030/8260B; SW-846 8151A ; SW-846 3510C 8081A; SW-846 3510C/8270D	One 4-oz glass jar	25 g VOCs/ 100 g SVOC	Cool to 0 to 6 °C	14 days to TCLP extraction. Then14 days to analysis for VOC and 7 days until extraction, 40 days to analysis for all SVOCs
Soil[3]	TCLP Regulatory List Inorganics	SW-846 1311; SW-846 3010A/6010C, SW-846 7470A	One 4-oz glass jar	100 g	Cool to 0 to 6 °C	180 days to TCLP extraction except mercury which is 28 days. Then 180 days to analysis except mercury which is 28 days to analysis
Soil[3]	Ignitability	SW-846 1010A Unspecified	One 4-oz glass jar	unspecified	Cool to ≤ 6 °C	7 days to analysis
Soil	pH	SW-846 9045D	One 4-oz glass jar with a Teflon-lined lid	20 g	Cool to < 6 °C	ASAP
Soil[3]	Reactive Cyanide	SW-846 9012A	One 4-oz glass jar	5 g	Cool to 0 to 6 °C	14 days to analysis
Soil[3]	Reactive Sulfide	SW-846 9030, 9034	One 4-oz glass jar	25 g	Cool to 0 to 6 °C	7 days to analysis

1 Specify the appropriate reference letter or number from the Analytical SOP References table (Worksheet #23).
2 Soil IDW sample analyses are presented on this worksheet for use by field personnel. Quality control information is not presented in any of the remaining worksheets.
3 IDW sample analyses are presented on this worksheet for use by field personnel. Quality control information is not presented in any of the remaining worksheets.

SAP Worksheet #20 -- Field Quality Control Sample Summary Table – Analytical Samples

(UFP-QAPP Manual Section 3.1.1)

Matrix	Analytical Group	Concentration Level	Field Samples [1]	Field Duplicates	MS/MSDs[2]	Rinsate Blanks[3]	Trip Blanks[4]	Total Samples to Lab
Soil	Select Metals	Low to Moderate	140	11	11	11	0	162
Soil	Explosives	Low	20	2	2	1	0	23
	NG	Low	33	3	3	2	0	38
Soil	Explosives and NG	Low	45	3	3	4	0	52
Soil	VOCs	Low to Moderate	41	3	3	4	3	48
Soil	SVOCs	Low to Moderate	41	3	3	4	0	48
Soil	Pesticides	Low to Moderate	41	3	3	4	0	48
Soil	Herbicides	Low	41	3	3	4	0	48
Soil	PCBs	Low	41	3	3	4	0	48
Soil	Sulfide	Low	41	3	3	4	0	48
Soil	Cyanide	Low	41	3	3	4	0	48

Matrix	Analytical Group	Concentration Level	Field Samples [1]	Field Duplicates	MS/MSDs[2]	Rinsate Blanks[3]	Trip Blanks[4]	Total Samples to Lab
Soil	Metals	Low	41	3	3	4	0	48
Soil	pH	Low	4	0	0	0	0	4
Soil	TCLP Regulatory List Organics	Low	1	0	0	0	0	1
Soil	TCIP Regulatory List Inorganics	Low	1	0	0	0	0	1
Soil	Ignitability	Low	1	0	0	0	0	1
Soil	pH	Low	1	0	0	0	0	1
Soil	Reactive Cyanide	Low	1	0	0	0	0	1
Soil	Reactive Sulfide	Low	1	0	0	0	0	1

1 Assumes that all samples collected at Potential OB/OD Subarea and Potential Munitions Trench Subarea will be analyzed for the expanded analyte list consisting of Appendix IX VOCs, SVOCs, pesticides, herbicides, PCBs, metals, cyanide, sulfide, and NG.
2 Although the MS/MSD is not typically considered a field QC, it is included here because location determination is often established in the field. MS/MSDs are not included in the total number of samples sent to the laboratory.
3 Rinsate blanks will be collected at a frequency of one per piece of equipment per medium at each subarea.
4 Trip blanks, as necessary, will be submitted only for VOC analysis.

SAP Worksheet #21 -- Project Sampling SOP References Table

(UFP-QAPP Manual Section 3.1.2)

Reference Number	SOP Title	Originating Organization of Sampling SOP	Equipment Type	Modified for Project Work? (Y/N)	Comments
SOP-01	Sample Custody, Handling, and Documentation of Field Activities	Tetra Tech	Field logbook, sample log sheets, boring logs, GPS, and digital camera	N	Provided in Appendix C
SOP-02	Sample Labeling	Tetra Tech	Sample labels	N	Provided in Appendix C
SOP-03	Sample Preservation, Packaging, and Shipping	Tetra Tech	Sample containers, sterile filter, and miscellaneous shipping supplies	N	Provided in Appendix C
SOP-04	Sample Identification Nomenclature	Tetra Tech	NA	Y (modified to show site-specific sample nomenclature)	Provided in Appendix C
SOP-05	Soil Coring and Sampling Using Hand Auger Techniques	Tetra Tech	Stainless steel auger bucket, extension rods, T-handle,	N	Provided in Appendix C
SOP-06	Soil Sampling	Tetra Tech	Sample containers, plastic baggies, stainless steel trowels, Encore™, and mixing bowls	N	Provided in Appendix C

Reference Number	SOP Title	Originating Organization of Sampling SOP	Equipment Type	Modified for Project Work? (Y/N)	Comments
SOP-07	Decontamination of Field Sampling Equipment	Tetra Tech	Decontamination equipment, scrub brushes, 5-gallon buckets, spray bottles, phosphate-free detergent, and de-ionized water	N	Provided in Appendix C
SOP-08	Management of Investigation-Derived Waste	Tetra Tech	55-gallon drums, and IDW drum labels	N	Provided in Appendix C
SOP-09	Global Positioning System	Tetra Tech	GPS Unit	N	Provided in Appendix C
HS-2.0	Munitions and Explosives of Concern and Chemical Warfare Activities	Tetra Tech	Metals Detector	N	Provided in Appendix C

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

(UFP-QAPP Manual Section 3.1.2.4)

Field Equipment	Activity	Frequency	Acceptance Criteria	CA	Responsible Person	SOP Reference	Comments
Hand Auger	Inspection	Per use	NA.	Replace	Tetra Tech FOL or designee	SOP-05, SOP-06	SOP located in Appendix C
Disposable Hand Trowel	Inspection	Per use	NA.	Replace	Tetra Tech FOL or designee	SOP-05, SOP-06	SOP located in Appendix C
GPS	Positioning	Twice daily	Accuracy: sub-meter horizontal dilution of precision (HDOP)<3, number of satellites at least four	Wait for better signal, replace unit, or choose alternate location technique	Tetra Tech FOL or designee	SOP09	SOP located in Appendix C

SAP Worksheet #23 -- Analytical SOP References Table

(UFP-QAPP Manual Section 3.2.1)

Lab SOP Number	Title, Revision Date, and/or Number	Definitive or Screening Data	Matrix and Analytical Group	Instrument	Organization Performing Analysis	Variance to QSM? (Y/N)	Modified for Project Work? (Y/N)
Empirical SOP-100	Metals Digestion/ Preparation, Methods 3005A/ USEPA CLP ILMO 4.1 Aqueous, 3010A, 3030C, 3050B, USEPA CLP ILMO 4.1 (Soil/Sediment), 200.7, Standard Methods 3030C (REV22, 11/17/10)	Definitive	Soil and aqueous QC samples/ Metals Digestion	NA/Preparation	Empirical	NA	N
Empirical SOP-103	Mercury Analysis in Water by Manual Cold Vapor Technique, Methods USEPA SW846 7470A and 245.1, CLP-M 4.1 (REV20, 05/16/11)	Definitive	Aqueous QC samples/ Mercury	Flow Injection Mercury Analyzer	Empirical	N	N
Empirical SOP-104	Mercury Analysis in Soil/Sediment by Manual Cold Vapor Technique, Methods SW846 7471A, 7471B, 245.5, and CLP-ILM 4.1 (REV20, 05/16/11)	Definitive	Soil/Mercury	Flow Injection Mercury Analyzer	Empirical	N	N
Empirical SOP-105	Metals by Inductively Coupled Plasma-Atomic Emission Spectroscopy (ICP-AES) Technique, SW-846 Methods 6010B, 6010C, USEPA Method 200.7, Standard Methods 19th Edition 2340B, USEPA CLP ILMO 4.1 (REV17, 05/16/11)	Definitive	Soil and aqueous QC samples/ Metals	Inductively Coupled Plasma – Atomic Emission Spectrometer (ICP-AES)	Empirical	N	N

Lab SOP Number	Title, Revision Date, and/or Number	Definitive or Screening Data	Matrix and Analytical Group	Instrument	Organization Performing Analysis	Variance to QSM? (Y/N)	Modified for Project Work? (Y/N)
Empirical SOP-144	Acid Soluble Sulfide Method SW846 9030B for the distillation & Method SW846 9034 for the titration (REV02, 05/16/11)	Definitive	Soil samples/ Sulfide	NA/ Distillation/Titration	Empirical	NA	N
Empirical SOP-153	Sulfide by Method 376.1 and Standard Methods SM4500S F(21st ED, Titrimetric, Iodine) with Sample Pretreatment to Remove Interfering Substances or to Concentrate the Sulfide (REV04, 09/07/10)	Definitive	Aqueous samples/ Sulfide	NA/Titration	Empirical	N	N
Empirical SOP-164	Distillation of Aqueous/Solid Samples for Cyanide, Total and Amenable, SW846 Method 9012A, USEPA Methods 335.1, 335.4, Standard Methods SM4500-CN C, G, 18th and 19th ED/ USEPA CLP ILMO 4.1 (REV16, 05/16/11)	Definitive	Soil and aqueous QC samples/ Cyanide Digestion	NA/ Distillation	Empirical	NA	N
Empirical SOP-175	Post-Distillation Analysis for Cyanide by Lachat Flow Injection Analyzer, Methods 335.4, SW846 9012A, USEPA-CLP 4.1; Addendum for USEPA CLP ILM 05.2 Aqueous/Soil/ Sediment (REV11, 09/16/11)	Definitive	Soil and aqueous QC samples/ Cyanide	Automated Ion Analyzer	Empirical	N	N

Lab SOP Number	Title, Revision Date, and/or Number	Definitive or Screening Data	Matrix and Analytical Group	Instrument	Organization Performing Analysis	Variance to QSM? (Y/N)	Modified for Project Work? (Y/N)
Empirical SOP-187	Electrometric Determination of pH, Methods 150.1, Standard Method 4500-H+B, and 9040B for Waters, Liquids, and Liquid Wastes, and 9045C for Soils and Soild Wastes (Revision 8, 07/12/10).	Definitive	Soil, groundwater, and surface water / pH	pH meter	Empirical	NA	N
Empirical SOP-198	Toxicity Characteristic Leaching Procedure Method 1311 (REV09, 10/31/11)	Definitive	Soil and aqueous QC samples/ Cyanide	Automated Ion Analyzer	Empirical	N	N
Empirical SOP-201	Gas Chromatography Mass Spectrometry (GC/MS) semivolatiles and Low-Concentration PAHs using USEPA Method 625 and SW846 Method 8270C and 8270D, Including Appendix IX Compounds (REV21, 05/16/11)	Definitive	Soil and aqueous QC samples/ Low level SVOCs	GC/MS	Empirical	N	N
Empirical SOP-202	GC/MS Volatiles using USEPA Method 624 and SW846 Method 8260B, Including Appendix IX Compounds (REV24, 09/13/11)	Definitive	Soil and aqueous QC samples/ VOCs	GC/MS	Empirical	N	N
Empirical SOP-208	Gas Chromatography/ Electron Capture Detector (GC/ECD) Chlorinated Acid Herbicides by EPA Method SW-846 8151A (REV16, 11/17/10)	Definitive	Soil and aqueous QC samples/ Herbicides	GC/ECD	Empirical	N	N

Lab SOP Number	Title, Revision Date, and/or Number	Definitive or Screening Data	Matrix and Analytical Group	Instrument	Organization Performing Analysis	Variance to QSM? (Y/N)	Modified for Project Work? (Y/N)
Empirical SOP-211	GC/ECD Organochlorine Pesticides/ PCBs using USEPA Method 608608.2 or SW846 Method 8081A/8082 or 8081B/8082A (REV24, 05/16/11)	Definitive	Soil and aqueous QC samples/ Pesticides and PCBs	GC/ECD	Empirical	N	N
Empirical SOP-225	GC/MS Volatile Non-Aqueous Matrix Extraction using SW-846 Method 5035 for 8260B Analysis (REV09, 09/07/10)	Definitive	Soil/VOCs Extraction	NA/ Extraction	Empirical	NA	N
Empirical SOP-300	GC/MS- Semivolatile BNA-Aqueous Matrix Extraction using SW-846 Method 3510C for 8270/625 Analysis (REV19, 11/17/10)	Definitive	Aqueous QC samples/ Low-level SVOC Extraction	NA/ Extraction	Empirical	NA	N
Empirical SOP-302	Pesticide/PCBs, Aqueous Matrix Extraction for USEPA 608/608.2 and SW846 Method 8081A/8082 Using SW846 Method 3510C (REV19, 01/12/11)	Definitive	Aqueous QC samples/ Pesticide and PCBs Extraction	NA/ Extraction	Empirical	NA	N
Empirical SOP-304	Herbicides Aqueous Matrix by Method EPA SW-846 8151A Herbicide - Aqueous Matrix Extraction (REV13, 11/17/10)	Definitive	Aqueous QC samples/ Herbicide Extraction	NA/ Extraction	Empirical	NA	N
Empirical SOP-310	Herbicides Non-Aqueous Matrix by SW-846 Method 8151A (REV13, 09/09/10)	Definitive	Soil samples/ Herbicide Extraction	NA/ Extraction	Empirical	NA	N
Empirical SOP-327	Nitroaromatics and Nitramines by High Performance Liquid Chromatography (HPLC) Method 8330, 8330A, 8330B and 8332 (REV21, 10/31/11)	Definitive	Soil aqueous QC samples / Explosives plus NG	HPLC/Ultraviolet (UV)	Empirical	N	N

Lab SOP Number	Title, Revision Date, and/or Number	Definitive or Screening Data	Matrix and Analytical Group	Instrument	Organization Performing Analysis	Variance to QSM? (Y/N)	Modified for Project Work? (Y/N)
Empirical SOP-343	Base, Neutral, Acid (BNA), Pesticides/PCBs, and Total Petroleum Hydrocarbon (TPH) non-Aqueous Matrix (Microwave Extraction) using SW-846 3546 (REV02, 11/17/10)	Definitive	Soil / low level SVOCs/Pesticide and PCBs Extraction	NA/ Extraction	Empirical	NA	N
Test America Savannah SOP SA-EX-040	Soil Extraction Procedures: Microwave and Sonication (Revision 6, 06/23/2011)	Definitive	Soil/SVOCs and Pesticide Extraction	NA/ Extraction	TestAmerica Savannah	NA	N
Test America Savannah SA-EX-030	Liquid Extraction Procedures: Continuous Liquid-Liquid & Separatory Funnel, Revision 8, 01/06/2011	Definitive	Aqueous QC samples/ SVOCs and Pesticides Extraction	NA/ Extraction	TestAmerica Savannah	NA	N
Test America Savannah SA-SM-033	Semivolatile Organic Compounds by GC/MS, Revision 2, 01/06/11.	Definitive	Soil and Aqueous QC samples / SVOCs	GC/MS	TestAmerica Savannah	Y - see variance list in Appendix	N
Test America Savannah SA-SG-045	Pesticides and PCBs by GC/ECD, Revision 13B, 08/22/11.	Definitive	Soil and Aqueous QC samples / Pesticides	GC/MS	TestAmerica Savannah	Y - see variance list in Appendix	N

Copies of laboratory certifications are included in Appendix D.

SAP Worksheet #24 -- Analytical Instrument Calibration Table

(UFP-QAPP Manual Section 3.2.2)

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference (1)
GC/MS VOCs	Bromofluoro-benzene (BFB) Tune	Prior to each Initial Calibration (ICAL) and at the beginning of each 12-hour period.	Must meet the ion abundance criteria required by the method (SW-846 8260B; Section 7.3.1; Table 4).	Retune and/or clean or replace source. No samples may be accepted without a valid tune.	Analyst/ Supervisor	Empirical SOP-202
	ICAL – a minimum of a 5-point calibration is prepared for all target analytes	Upon instrument receipt, for major instrument changes, or when continuing calibration verification (CCV) does not meet criteria.	The average response factor (RF) for System Performance Check Compound (SPCCs) must be ≥ 0.30 for chlorobenzene and 1,1,2,2-tetrachloroethane, ≥ 0.1 for chloromethane, bromoform, and 1,1-dichloroethane. The percent relative standard deviation (%RSD) for RFs for calibration check compounds (CCCs) must be ≤ 30%; and %RSD for each target analyte must be ≤ 15%, or the linear regression correlation coefficient (r) must be ≥ 0.995; or the coefficient of determination (r^2) must be ≥ 0.99 (6 points are required for second order).	Correct problem then repeat ICAL. No samples may be run until ICAL has passed.	Analyst/ Supervisor	
	Retention Time (RT) Window Position Establishment	Once per ICAL for each analyte and surrogate.	Position shall be set using the midpoint standard of the ICAL curve when ICAL is performed. On days when ICAL is not performed, the initial CCV is used.	NA.	Analyst/ Supervisor	
	Evaluation of Relative Retention Times (RRTs)	With each sample.	RRT of each target analyte must be within ± 0.06 RRT units.	Correct problem, then rerun ICAL.	Analyst/ Supervisor	
	Initial Calibration Verification (ICV) – Second Source	Once after each ICAL, prior to beginning a sample run.	The percent recovery (%R) for all target analytes must be within 80-120% of true values.	Correct problem and verify ICV. If that fails, correct problem and repeat ICAL. No samples may be run until ICV has been verified.	Analyst/ Supervisor	

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference (1)
	CCV	Perform one per 12-hour analysis period after tune and before sample analysis.	The minimum RF for SPCCs must be ≥ 0.30 for chlorobenzene and 1,1,2,2-tetrachloroethane, ≥ 0.1 for chloromethane, bromoform, and 1,1-dichloroethane. The percent difference or percent drift (%D) for all target analytes and surrogates must be ≤ 20%.	If %D is high and sample result is ND, qualify/narrate with project approval. If %D is low or project approval not received, reanalyze all samples since the last successful CCV.	Analyst/ Supervisor	
GC/MS SVOCs	Breakdown Check (DDT only)	At the beginning of each 12-hour analytical sequence.	The degradation must be ≤ 20% for DDT to verify inertness of the injection port.	Correct the problem then repeat breakdown check. No samples shall be run until degradation is ≤20% for DDT.	Analyst/ Supervisor	TestAmerica Savannah SOP SA-SM-033
	Tune Verification – decafluoro-triphenyl-phosphine (DFTPP)	Prior to each ICAL and at the beginning of each 12-hour analytical sequence.	Must meet the ion abundance criteria outlined in the SOP.	Retune and/or clean or replace source. No samples may be accepted without a valid tune.	Analyst/ Supervisor	
	ICAL – A minimum of a 5-point calibration is prepared for all target analytes	Upon instrument receipt, instrument change (new column, source cleaning, etc.), when CCV is out of criteria.	The average RF for SPCCs must be ≥ 0.050. The %RSD for RFs for CCCs must be ≤ 30%; and %RSD for each target analyte must be ≤ 15%, or r must be ≥ 0.995; or r^2 must be ≥ 0.99 (minimum of 6 points required for second order).	Correct problem then repeat ICAL. No samples may be run until ICAL has passed.	Analyst/ Supervisor	
	ICV – Second Source	Perform after each ICAL, prior to beginning a sample run.	95% of analytes in the ICV and the CCV must be within 20% of the expected value. Poor performer and/or erratic responders, as outlined in the laboratory's SOP, are exempt from this requirement.	Correct problem and verify ICV. If that fails, correct problem and repeat ICAL. No samples may be run until ICV has been verified.	Analyst/ Supervisor	
	RT Window Position Establishment	Once per ICAL for each analyte and surrogate.	Position shall be set using the midpoint standard of the ICAL curve when ICAL is performed. On days when ICAL is not performed, the initial CCV is used.	NA.	Analyst/ Supervisor	
	Evaluation of RTs	With each sample.	RT of each target analyte must be within ± 0.06 RRT units.	Correct problem, then rerun ICAL.	Analyst/ Supervisor	

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference (1)
	CCV	Analyze a standard at the beginning of each 12-hour shift after tune and before sample analysis.	SPCC RFs must be ≥ 0.050; 95% of target analytes must be ≤ 20%D.	If %D is high and sample result is ND, qualify/narrate with project approval. If %D is low or project approval not received, reanalyze all samples since the last successful CCV.	Analyst/ Supervisor	
GC/MS Low level SVOCs	Tune Verification – DFTPP	Prior to each ICAL and at the beginning of each 12-hour analytical sequence.	Must meet the ion abundance criteria required by the method (SW-846 8270C Low Level Full Scan; Section 7.3.1; Table 3).	Retune and/or clean or replace source. No samples may be accepted without a valid tune.	Analyst/ Supervisor	Empirical SOP-201
	ICAL – A minimum of a 5-point calibration is prepared for all target analytes	Upon instrument receipt, instrument change (new column, source cleaning, etc.), when CCV is out of criteria.	The average RF for SPCCs must be ≥ 0.050. The %RSD for RFs for CCCs must be ≤ 30%; and %RSD for each target analyte must be ≤ 15%, or r must be ≥ 0.995; or r^2 must be ≥ 0.99 (minimum of 6 points required for second order).	Correct problem then repeat ICAL. No samples may be run until ICAL has passed.	Analyst/ Supervisor	
	ICV – Second Source	Perform after each ICAL, prior to beginning a sample run.	The %R of all target analytes must be within 80-120% of the true value. SPCC RFs must be ≥ 0.050; CCCs must be ≤ 20%D.	Correct problem and verify ICV. If that fails, correct problem and repeat ICAL. No samples may be run until ICV has been verified.	Analyst/ Supervisor	
	RT Window Position Establishment	Once per ICAL for each analyte and surrogate.	Position shall be set using the midpoint standard of the ICAL curve when ICAL is performed. On days when ICAL is not performed, the initial CCV is used.	NA.	Analyst / Supervisor	
	Evaluation of RTs	With each sample.	RT of each target analyte must be within ± 0.06 RRT units.	Correct problem, then rerun ICAL.	Analyst / Supervisor	
	CCV	Analyze a standard at the beginning of each 12-hour shift after tune and before sample analysis.	SPCC RFs must be ≥ 0.050; all target analytes and surrogates must be ≤ 20%D.	If %D is high and sample result is non-detect (ND), qualify/narrate with project approval. If %D is low or project approval not received, reanalyze all samples since the last successful CCV.	Analyst/ Supervisor	

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference (1)
GC/ECD PCBs	ICAL - A minimum of a 5-point calibration of Aroclor 1660 (1016/1260 mixture) is prepared	Upon instrument receipt, major instrument change, when CCV does not meet criteria.	Option 1: %RSD must be ≤20% for Aroclor 1016/1260. If not met, Option 2: r must be ≥ 0.995; or Option 3: r^2 must be ≥ 0.99 for 6-point calibration. Mid-point calibration of other Aroclors – if an Aroclor is detected in a sample, a minimum of 5-point ICAL must be performed and meet the above criteria.	Correct problem then repeat ICAL. No samples may be run until ICAL has passed.	Analyst/ Supervisor	Empirical SOP-211
	ICV – Second Source	Once after each ICAL prior to sample analysis.	The %R of all target analytes must be within 80-120% of true value.	Evaluate, repeat, if still failing, recalibrate.	Analyst/ Supervisor	
	CCV	Analyze standard at the beginning and end of sequence and after every 10 samples.	The %D of all target analytes must be ≤20%.	If %D is high and sample result is ND, qualify/narrate with project approval. If %D is low or project approval not received, reanalyze all samples since the last successful CCV.	Analyst/ Supervisor	
GC/ECD Pesticides	Breakdown Check – Endrin/dichloro diphenyl trichloroethane (DDT)	At the beginning of each 12 hour period, prior to analysis of samples.	The degradation must be ≤ 15% for both DDT and Endrin to verify the inertness of the injection port.	Correct the problem then repeat breakdown check. No samples shall be run until degradation is ≤15% for both DDT and Endrin.	Analyst/ Supervisor	TestAmerica Savannah SOP SA-SG-45
	ICAL – A minimum of a 5-point calibration is prepared for all target analytes	Upon instrument receipt, major instrument change, or when the CCV does not meet criteria, prior to sample analysis.	The %RSD for RFs for each target analyte must be ≤ 20%, or r must be ≥ 0.995, or r^2 must be ≥ 0.99 (minimum of 6 points required for second order).	Correct problem and repeat ICAL. No samples may be run until ICAL has passed.	Analyst/ Supervisor	
	ICV – Second Source	Once after each ICAL prior to sample analysis.	The %R of all target analytes must be within 80-120% of true value.	Correct problem and verify ICV. If that fails, correct problem and repeat ICAL. No samples may be run until ICV has been verified.	Analyst/ Supervisor	

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference (1)
	CCV	Analyze standard at the beginning and end of sequence and after every 10 samples.	The %D of all target analytes must be ≤20%.	If %D is high and sample result is ND, qualify/narrate with project approval. If %D is low or project approval not received, reanalyze all samples since the last successful CCV.	Analyst/ Supervisor	
GC/ECD Pesticides	Breakdown Check – Endrin/DDT	At the beginning of each 12 hour period, prior to analysis of samples.	The degradation must be ≤ 15% for both DDT and Endrin to verify the inertness of the injection port.	Correct the problem then repeat breakdown check. No samples shall be run until degradation is ≤15% for both DDT and Endrin.	Analyst/ Supervisor	Empirical SOP-211
	ICAL – A minimum of a 5-point calibration of individual pesticides, with a mid-point calibration of toxaphene and chlordane, is prepared for all target analytes	Upon instrument receipt, major instrument change, or when the CCV does not meet criteria, prior to sample analysis.	The %RSD for RFs for each target analyte must be ≤ 20%, or r must be ≥ 0.995, or r^2 must be ≥ 0.99 (minimum of 6 points required for second order).	Correct problem and repeat ICAL. If a single-point calibration for toxaphene or chlordane is used and toxaphene or chlordane is identified in analysis of a sample, a minimum of a 5-point ICAL of the identified compound with reanalysis of sample must be performed. No samples may be run until ICAL has passed.	Analyst/ Supervisor	
	ICV – Second Source	Once after each ICAL prior to sample analysis.	The %R of all target analytes must be within 80-120% of true value.	Correct problem and verify ICV. If that fails, correct problem and repeat ICAL. No samples may be run until ICV has been verified.	Analyst/ Supervisor	
	CCV	Analyze standard at the beginning and end of sequence and after every 10 samples.	The %D of all target analytes must be ≤20%.	If %D is high and sample result is ND, qualify/narrate with project approval. If %D is low or project approval not received, reanalyze all samples since the last successful CCV.	Analyst/ Supervisor	

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference (1)
GC/ECD Herbicides	ICAL - A minimum of a 5-point calibration is prepared for all target analytes	Upon instrument receipt, major instrument change, or when the CCV does not meet criteria.	The %RSD for RFs for each target analyte must be ≤ 20%, or r must be ≥ 0.995, or r^2 must be ≥ 0.99 (minimum of 6 points required for second order).	Correct problem then repeat ICAL. No samples may be run until ICAL has passed.	Analyst/ Supervisor	Empirical SOP-208
	ICV – Second Source	Once after each ICAL prior to sample analysis.	The %R of all target analytes must be within 80-120% of true value.	Correct problem and verify ICV. If that fails, correct problem and repeat ICAL. No samples may be run until ICV has been verified.	Analyst/ Supervisor	
	CCV	Analyze standard at the beginning and end of sequence and after every 10 samples.	The %R of all target analytes must be within 80-120% of true value.	If %D is high and sample result is ND, qualify/narrate with project approval. If %D is low or project approval not received, reanalyze all samples since the last successful CCV.	Analyst/ Supervisor	
HPLC – Explosives (including NG)	Initial Calibration - minimum 5 points	Annually or more often as needed due to changes in response or retention times or following major instrument maintenance.	Average RF ≤20 percent %RSD ; if a linear fit is used, correlation coefficient (r) ≥0.995; or r^2 ≥0.99 using 6 points.	Determine and correct reason for failure. Repeat calibration.	Analyst/ Supervisor	Empirical SOP-327
	Second-source ICV	Following initial calibration prior to the analysis of samples.	80-120 %R of the true value	Investigate reasons for failure, reanalyze once. If still unacceptable, repeat calibration.	Analyst/ Supervisor	

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference (1)
	CCV	Daily prior to the analysis of samples, every 10 sample injections or 12 hours (whichever is more frequent), and at the end of the run.	Less than 20 percent difference or <20 %D for each target analyte.	If %D is high and sample result is ND (non-detect), qualify/narrate with project approval. If %D is low or project approval not received, reanalyze all samples since the last successful CCV.	Analyst/ Supervisor	
	Continuing calibration blank (CCB)	After the initial CCV, after every 10 samples, and at the end of the sequence.	No analytes detected > 2x method detection limit (MDL).	Correct the problem, then re-prepare and reanalyze calibration blank and previous 10 samples.	Analyst/ Supervisor	
ICP-AES Metals and CVAA mercury	ICAL - a 1-point calibration per manufacturer's guidelines is prepared for all target analytes	At the beginning of each day, or if the QC is out of criteria, prior to sample analysis.	None; only one high standard and a calibration blank must be analyzed. If more than one calibration standard is used, r must be ≥ 0.995.	Recalibrate and/or perform the necessary equipment maintenance. Check the calibration standards. Reanalyze the affected data.	Analyst/ Supervisor	Empirical SOP-103, 104, 105
	ICV – Second Source	Following ICAL, prior to the analysis of samples.	The %R of all target analytes must be within 90-110% of true value.	Investigate reasons for failure, reanalyze once. If still unacceptable, correct problem and repeat ICAL.	Analyst/ Supervisor	
	CCV	At the beginning and end of the sequence and after every 10 samples.	The %R must be within 90-110% of true value.	Recalibrate and/or perform the necessary equipment maintenance. Check the calibration standards. Reanalyze all affected samples.	Analyst/ Supervisor	
	Initial Calibration Blank (ICB)	Before beginning a sample sequence.	No target analytes detected > LOD.	Correct the problem, then re-prepare and reanalyze.	Analyst / Supervisor	
	CCB	After the initial CCV, after every 10 samples, and at the end of the sequence.	No target analytes detected > LOD.	Correct the problem, then re-prepare and reanalyze calibration blank and all affected samples.	Analyst / Supervisor	

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference (1)
	Low-Level Check Standard (if using 1-point ICAL) – not for mercury	Daily after 1-point ICAL and before samples.	The %R must be within 80-120% of true value.	Investigate and perform necessary equipment maintenance. Recalibrate and reanalyze all affected samples.	Analyst / Supervisor	
	Interference Check Standards (ICS – ICS A and ICS B) – not for mercury	At the beginning of an analytical run.	ICS A recoveries must be within the absolute value of the LOD; and ICS B recoveries must be within 80-120 %R of true value.	Terminate analysis; locate and correct problem; reanalyze ICS.	Analyst / Supervisor	
Lachat Cyanide	ICAL– A minimum of a 6-point calibration is prepared	Perform daily prior to sample analysis.	r must be ≥ 0.995. All calibration standards must be distilled if samples are expected to contain sulfides.	Correct problem then repeat ICAL. No samples may be run until ICAL has passed.	Analyst / Supervisor	Empirical SOP-164/175
	ICV – Second Source	At the start of every sequence prepared fresh daily (undistilled), prior to sample analysis.	The %R must be within 85-115% of true value.	Correct problem and verify ICV. If that fails, correct problem and repeat ICAL. No samples may be run until ICV has been verified.	Analyst / Supervisor	
	ICB	After the ICV (undistilled).	Must be < LOQ for the target analyte.	Determine source of contam-ination, correct problem, and restart sequence.	Analyst / Supervisor	
	CCV	Every 10 samples (undistilled).	The %R must be within 85-115% of true value.	Correct problem and rerun CCV. If that fails, repeat ICAL and reanalyze all samples analyzed since the last successful CCV.	Analyst / Supervisor	
	ICV (distilled, high and low)	Once per ICAL.	The %R must be within 85-115% of true value.	Determine cause for failure, correct problem, and redistill standards.	Analyst / Supervisor	

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference (1)
Sulfide	ICAL	Upon instrument receipt, for major instrument changes, when CCV does not meet criteria, or at minimum quarterly	r must be ≥ 0.995.	Correct problem and repeat ICAL.	Analyst/Supervisor	Empirical SOP153
	ICV	Once after each ICAL, prior to analytical sequence	The %R must be 90-110%.	Correct problem. Then rerun calibration verification. If that fails, repeat ICAL and reanalyze all samples run since last acceptable CCV	Analyst/Supervisor	
	ICB	Once after each ICAL, prior to analytical sequence	No analytes detected >LOD.	Correct problem. Re-prep/Re-analyze blank and all samples since last acceptable calibration blank.	Analyst/Supervisor	
	CCV	At the beginning and end of the sequence and every 10 field samples.	The %R must be 90-110%.	Correct problem. Then rerun calibration verification. If that fails, repeat ICAL and reanalyze all samples run since last acceptable CCV	Analyst/Supervisor	
	CCB	At the beginning and end of the sequence and every 10 field samples.	No analytes detected >LOD.	Correct problem. Re-prep/Re-analyze blank and all samples since last acceptable calibration blank.	Analyst/ Supervisor	
pH Meter	Calibration	Calibrate before use with two buffers in the area to be measured. Check with a third buffer.	0.05 pH units.	Recalibrate and/or perform necessary equipment maintenance.	Analyst/Supervisor	Empirical-187SOP-187

1 Laboratory SOPs are subject to revision and updates during duration of the project; the laboratory will use the most current revision of the SOP at the time of analysis.

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

(UFP-QAPP Manual Section 3.2.3)

Instrument/ Equipment	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	CA	Responsible Person	SOP Reference
GC/MS	Check pressure and gas supply daily. Bake out trap and column, change septa as needed, cut column as needed, change trap as needed. Other maintenance specified in Equipment Maintenance SOP.	VOCs	Ion source, injector liner, column, column flow, purge lines, purge flow, trap.	Prior to ICAL and/or as necessary.	Acceptable ICAL and CCV.	Correct the problem and repeat ICAL or CCV.	Analyst/ Supervisor	Empirical SOP-202
GC/MS	Check pressure and gas supply daily. Change septa as needed, change liner as needed, cut column as needed. Other maintenance specified in Equipment Maintenance SOP.	Low-Level SVOCs	Ion source, injector liner, column, column flow.	Prior to ICAL and/or as necessary.	Acceptable ICAL and CCV.	Correct the problem and repeat ICAL or CCV.	Analyst/ Supervisor	Empirical SOP-201
GC/MS	Change septum, install new liner, install new splitless disc and clip column,	SVOCs	Instrument performance and sensitivity	Recommended daily	Tune and CCV pass acceptance criteria.	Recalibrate, change column or re-maintenance	Analyst/ Supervisor	TestAmerica Savannah SOP SA-SM-033
	Change column		Instrument performance and sensitivity	As needed	Tune and ICAL pass acceptance criteria.	Maintenance system	Analyst/ Supervisor	
	Clean mass spec		Instrument performance and sensitivity	As needed	Tune passes criteria	Re-clean mass spec	Analyst/ Supervisor	
GC/ECD	Guard Column/Injector	Pesticides	Change sleeve and cut front of guard column	As needed	PEVAL and/or CCV pass criteria	Bake injector, then wipe with cotton swab, recalibrate instrument	Analyst/ Supervisor	TestAmerica Savannah SOP SA-SG-045
	Septum		Replace	As needed	PEVAL and/or CCV pass criteria	Replace with a new septa, recalibrate instrument	Analyst/ Supervisor	
	Splitless Disc		Replace	As needed	PEVAL and/or CCV pass criteria	Inspect disc for scratches, replace disc, recalibrate instrument	Analyst/ Supervisor	
	Autosampler		Syringe cleaned or replaced	As needed	PEVAL and/or CCV pass criteria	Recalibrate instrument	Analyst/ Supervisor	

Instrument/ Equipment	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	CA	Responsible Person	SOP Reference
	Column		Replace	As needed	PEVAL and ICAL must past criteria	Check column installation, recalibrate instrument	Analyst	
GC/ECD	Check pressure and gas supply daily. Bake out column, change septa and/or liner as needed, replace or cut column as needed. Other maintenance specified in Equipment Maintenance SOP.	Pesticides, PCBs, and Herbicides	Injector liner, septa, column, column flow.	Prior to ICAL and/or as necessary.	Acceptable ICAL and CCV.	If % D > 20% and samples are < LOD, narrate. If %D > 20% only on one column, narrate. If % D > 20% for closing CCV, and is likely due to matrix interference, narrate. Otherwise, reanalyze all samples since the last acceptable CCV.	Analyst/ Supervisor	Empirical SOP-208/211
ICP-AES	Clean the torch assembly and the spray chamber when they become discolored or when degradation in data quality is observed. Clean the nebulizer, and check the argon supply. Replace the peristaltic pump tubing as needed.	Metals	Inspect the torch, nebulizer chamber, pump, and tubing	Prior to ICAL and as necessary.	Acceptable ICAL and CCV.	Correct the problem and repeat ICAL or CCV.	Analyst/ Supervisor	Empirical SOP-105
Cold Vapor Atomic Absorption (CVAA)	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 Equipment Maintenance SOP.	Mercury	Inspect the tubing, filter, and the optical cell	Prior to ICAL and as necessary.	Acceptable ICAL and CCV.	Correct the problem and repeat ICAL or CCV.	Analyst/ Supervisor	Empirical SOP-103/104
HPLC	Check pressure and gas supply daily – change when <200 pounds per square inch (psi), change analytical column as needed, change mobile phase when insufficient for run or contamination, change inlet filters as needed for contamination.	Explosives	Check pump pressure, check for leaks, check for adequate mobile phase.	Prior to initial calibration or as necessary.	CCV < 20% difference.	Recalibrate and/or perform necessary equipment maintenance. Check calibration standards. Reanalyze affected data.	Analyst/ Supervisor	Empirical SOP-327
pH meter	Clean, drain, refill reference electrode as needed.	pH	Reference electrode for white crystals, Inspect electrode for damage.	Before use	± 0.09 units	Recalibrate and/or perform necessary equipment maintenance. Check buffers. Reanalyze affected data.	Analyst/ Supervisor	Empirical SOP-187

Instrument/ Equipment	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	CA	Responsible Person	SOP Reference
Lachat	Check and clean segments weekly, clean reagent tubes monthly. Change lamp, change diluent and wash tubes, change mixing paddles and syringes, and change dispensing needle, all as needed. Other maintenance specified in laboratory Equipment Maintenance SOP.	Cyanide	Tubing and rollers.	Prior to ICAL or as necessary.	Acceptable ICAL and CCV.	Recalibrate and/or perform necessary equipment maintenance. Reanalyze samples not bracketed by passing CCV.	Analyst/ Supervisor	Empirical SOP-164/175
Burette - Sulfide	Clean burette	Sulfide	Check burette tip for breakage	Before each use	Clean and unbroken	Replace broken burettes	Analyst/ Supervisor	Empirical SOP153

SAP Worksheet #26 -- Sample Handling System

(UFP-QAPP Manual Appendix B)

SAMPLE COLLECTION, PACKAGING, AND SHIPMENT
Sample Collection (Personnel/Organization): Tetra Tech FOL or designee / Tetra Tech
Sample Packaging (Personnel/Organization): Tetra Tech FOL or designee / Tetra Tech
Coordination of Shipment (Personnel/Organization): Tetra Tech FOL or designee / Tetra Tech
Type of Shipment/Carrier: Federal Express
SAMPLE RECEIPT AND ANALYSIS
Sample Receipt (Personnel/Organization): Sample Custodians / Empirical and TestAmerica
Sample Custody and Storage (Personnel/Organization): Sample Custodians/ Empirical and TestAmerica
Sample Preparation (Personnel/Organization): Extraction Laboratory, Metals Preparation Laboratory / Empirical and TestAmerica
Sample Determinative Analysis (Personnel/Organization): Gas Chromatography Laboratory, GC/MS Laboratory, Metals Laboratory / Empirical and TestAmerica
SAMPLE ARCHIVING
Field Sample Storage (Number of days from sample collection): 60 days from receipt
Sample Extract/Digestate Storage (No. of days from extraction/digestion): 3 months from sample digestion/extraction
Biological Sample Storage (Number of days from sample collection): N/A
SAMPLE DISPOSAL
Personnel/Organization: Sample Custodians / Empirical and TestAmerica

SAP Worksheet #27 – Sample Custody Requirements Table

(UFP-QAPP Manual Section 3.3.3)

Field Chain of Custody

To ensure the integrity of a sample from collection through analysis, an accurate written record that traces the possession and handling of the sample is necessary. This documentation is referred to as the chain-of-custody form. Chain-of-custody begins at the time of sample collection. A sample is under custody if any of the following conditions apply:

- It is in the owner's actual possession,
- It is in the owner's view, after being in his/her physical possession,
- It was in the owner's possession and then was locked or sealed to prevent tampering,
- It is in a secure area.

Custody documentation is designed to provide documentation of preparation, handling, storage, and shipping of all samples collected. A multi-part chain-of-custody form is used, with each page of the form signed and dated by the recipient of a sample or portion of a sample. The person releasing the sample and the person receiving the sample will retain copies of the chain-of-custody form each time a sample transfer occurs.

Preservation of the integrity of the samples collected during the Full RFI will be the responsibility of identified persons from the time the samples are collected until the samples, or their derived data, are incorporated into the final report.

The Tetra Tech FOL is responsible for the care and custody of the samples collected until they are delivered to the laboratory or are entrusted to a carrier. When transferring samples, the individuals relinquishing and receiving them will sign, date, and note the time on the chain-of-custody form. This form documents the sample custody transfer from the sampler to the laboratory, often through another person or agency (common carrier). Field chain-of-custody requirements are provided in SOP-01. Upon arrival at the laboratory, internal sample custody procedures will be followed as defined in the Laboratory SOPs.

Laboratory Chain of Custody – Empirical and TestAmerica

Laboratory sample custody procedures (receipt of samples, archiving, and disposal) will be according to the appropriate laboratory SOPs. Coolers are received and checked for proper temperature and

preservation. A sample cooler receipt form will be filled out to note conditions and any discrepancies. The chain-of-custody form will be checked against the sample containers for correctness. Samples will be logged into the laboratory information management system (LIMS) and given a unique log number that can be tracked through processing. The appropriate Laboratory PM will notify the Tetra Tech FOL of any problems on the same day that the issue is identified.

SAP Worksheet #28 -- Laboratory QC Samples Table

(UFP-QAPP Manual Section 3.4)

The QC limits for each analyses are provided in Appendix D.

Matrix	**Soil and Aqueous QC Samples**
Analytical Group	**VOCs**
Analytical Method / SOP Reference	**SW-846 8260B Empirical SOP-202**

QC Sample	Frequency / Number	Method / SOP QC Acceptance Limits	CA	Person(s) Responsible for CA	DQI	MPC
Method Blank	One per preparatory batch of 20 or fewer samples.	All target analytes must be ≤ ½ LOQ, except common lab contaminants, which must be < LOQ.	Correct problem. If required, reprepare and reanalyze method blank and all samples processed with the contaminated blank.	Analyst, Supervisor	Bias/ Contamination	Same as QC Acceptance Limits
LCS/ Laboratory Control Sample Duplicate (LCSD) (not required)	One per preparatory batch of 20 or fewer samples.	%Rs must meet the DoD Quality Systems Manual (QSM) Version 4.2 limits as per Appendix G of the DoD QSM. RPD must be ≤ 30% (for LCS/LCSD, if LCSD is performed).	Correct problem, then reprepare and reanalyze the LCS and all samples in the associated preparatory batch for failed analytes, if sufficient sample material is available. Contact client if samples cannot be reanalyzed within hold time.	Analyst, Supervisor	Accuracy/ Bias Precision also, if LCSD is analyzed	Same as QC Acceptance Limits
MS/MSD	One per preparatory batch of 20 or fewer samples of similar matrix.	%Rs must meet the DoD QSM Version 4.2 limits as per Appendix G of the DoD QSM. The RPD between MS and MSD should be ≤ 30%.	CA will not be taken for samples when recoveries are outside limits and surrogate and LCS criteria are met unless RPDs indicate obvious extraction/ analysis difficulties, then re-prepare and reanalyze MS/MSD.	Analyst, Supervisor	Accuracy/ Bias/ Precision	Same as QC Acceptance Limits

Matrix	**Soil and Aqueous QC Samples**
Analytical Group	**VOCs**
Analytical Method / SOP Reference	**SW-846 8260B Empirical SOP-202**

QC Sample	Frequency / Number	Method / SOP QC Acceptance Limits	CA	Person(s) Responsible for CA	DQI	MPC
Internal Standards (IS)	Every field sample, standard, and QC sample - three per sample- Fluorobenzene Chlorobenzene-d_5 1,4-dichlorobezene-d_4.	RTs must be within ± 30 seconds and the response areas must be within -50% to +100% of the ICAL midpoint standard for each IS.	Inspect mass spectrometer and gas chromatograph for malfunctions; mandatory reanalysis of samples analyzed while system was malfunctioning.	Analyst, Supervisor	Accuracy	Same as QC Acceptance Limits
Surrogates	All field and QC samples - four per sample- Dibromofluoromethane 1,2-dichloroethane-d_4 Toluene-d_8 BFB.	%Rs must meet the DoD QSM Version 4.2 limits as per Appendix G of the DoD QSM.	If sample volume is available, then re-prepare and reanalyze sample for confirmation of matrix interference when appropriate.	Analyst, Supervisor	Accuracy/ Bias	Same as QC Acceptance Limits
Results between DL and LOQ	NA.	Apply “J” qualifier to results detected between DL and LOQ.	NA.	Analyst, Supervisor	Accuracy	Same as QC Acceptance Limits

Matrix	**Soil and Aqueous QC Samples**
Analytical Group	**Low level SVOCs**
Analytical Method / SOP Reference	**SW-846 8270D-Low Empirical SOP-201**

QC Sample	Frequency / Number	Method / SOP QC Acceptance Limits	CA	Person(s) Responsible for CA	DQI	MPC
Method Blank	One per preparatory batch of 20 or fewer samples of similar matrix.	All target analytes must be ≤ ½ LOQ, except common lab contaminants, which must be < LOQ.	Correct problem. If required, reprepare and reanalyze method blank and all samples processed with the contaminated blank.	Analyst, Supervisor	Bias/ Contamination	Same as QC Acceptance Limits
LCS	One per preparatory batch of 20 or fewer samples of similar matrix.	%Rs must meet the DoD QSM Version 4.2 limits as per Appendix G of the DoD QSM.	Correct problem, then reprepare and reanalyze the LCS and all samples in the associated preparatory batch for failed analytes, if sufficient sample material is available. Contact Client if samples cannot be reanalyzed within hold time.	Analyst, Supervisor	Accuracy/ Bias	Same as QC Acceptance Limits
MS/MSD	One per preparatory batch of 20 or fewer samples of similar matrix.	%Rs must meet the DoD QSM Version 4.21 limits as per Appendix G of the DoD QSM. The RPD between MS and MSD should be ≤ 30%.	CA will not be taken for samples when recoveries are outside limits and surrogate and LCS criteria are met, unless RPDs indicate obvious extraction/ analysis difficulties, then re-prepare and reanalyze MS/MSD.	Analyst, Supervisor	Accuracy/ Bias	Same as QC Acceptance Limits

Matrix	**Soil and Aqueous QC Samples**
Analytical Group	**Low level SVOCs**
Analytical Method / SOP Reference	**SW-846 8270D-Low Empirical SOP-201**

QC Sample	Frequency / Number	Method / SOP QC Acceptance Limits	CA	Person(s) Responsible for CA	DQI	MPC
IS	Every field sample, standard, and QC sample - six per sample 1,4-Dichlorobenzene-d_4 Naphthalene-d_8 Acenaphthene-d_{10} Phenanthrene-d_{10} Chrysene-d_{12} Perylene-$d_{12.}$	RTs must be within ± 30 seconds and the response areas must be within -50% to +100% of the ICAL midpoint standard for each IS.	Re-analyze affected samples.	Analyst, Supervisor	Accuracy	Same as QC Acceptance Limits
Surrogates	All field and QC samples - two per sample 2-Fluorobiphenyl Terphenyl-$d_{14.}$	%Rs are as follows: Soil: 2-Fluorobiphenyl 34-167 Terphenyl-$d_{14.}$ 14-129 Aqueous: 2-Fluorobiphenyl 14-129 Terphenyl-$d_{14.}$ 14-129	(1) Check chromatogram for interference; if found, then flag data. (2) If not found, then check instrument performance; if problem is found, then correct and reanalyze sample. (3) If still out, then re-extract and reanalyze sample. (4) If reanalysis is out, then flag data.	Analyst, Supervisor	Accuracy/ Bias	Same as QC Acceptance Limits
Results between DL and LOQ	NA.	Apply “J” qualifier to results detected between DL and LOQ.	NA.	Analyst, Supervisor	Accuracy	Same as QC Acceptance Limits

Matrix	**Soil and Aqueous QC Samples**
Analytical Group	**Test America SVOCs**
Analytical Method / SOP Reference	**SW-846 8270D TestAmerica Savannah SOP SA-SM033**

QC Sample	Frequency / Number	Method / SOP QC Acceptance Limits	CA	Person(s) Responsible for CA	DQI	MPC
Method Blank	One per preparatory batch of 20 or fewer samples of similar matrix.	All target analytes must be ≤ ½ LOQ, except common lab contaminants, which must be < LOQ.	Correct problem. If required, reprepare and reanalyze method blank and all samples processed with the contaminated blank.	Analyst, Supervisor	Bias/ Contamination	Same as QC Acceptance Limits
LCS	One per preparatory batch of 20 or fewer samples of similar matrix.	%Rs must meet laboratory control and/or marginal exceedance limits, See Appendix D for limits.	Correct problem, then reprepare and reanalyze the LCS and all samples in the associated preparatory batch for failed analytes, if sufficient sample material is available.	Analyst, Supervisor	Accuracy/ Bias	Same as QC Acceptance Limits
MS/MSD	One per preparatory batch of 20 or fewer samples of similar matrix.	%Rs and %RPDs must meet the laboratory control and/or marginal exceedance limits, See Appendix D for limits.	CA will not be taken for samples when recoveries are outside limits and surrogate and LCS criteria are met, unless RPDs indicate obvious extraction/ analysis difficulties, then re-prepare and reanalyze MS/MSD.	Analyst, Supervisor	Accuracy/ Bias	Same as QC Acceptance Limits

Matrix	**Soil and Aqueous QC Samples**
Analytical Group	**Low-Level SVOCs**
Analytical Method / SOP Reference	**SW-846 8270D Test America SOP SA-SM-033-**

QC Sample	Frequency / Number	Method / SOP QC Acceptance Limits	CA	Person(s) Responsible for CA	DQI	MPC
IS	Every field sample, standard, and QC sample	Evaluate each CCV against the midpoint of the ICAL and to evaluate all field samples and QC items to their associated CCV. This is consistent with the requirements outlined in SW846 Update IV.	Re-analyze affected samples.	Analyst, Supervisor	Accuracy	Same as QC Acceptance Limits
Surrogates	All field and QC samples	Soil %Rs must be between: 2-Fluorobiphenyl 11-30 2-Fluorophenol 10-130 Nitrobenzene d-5 18-130 Phenol d-5 10-130 Terphenyl d -14 27-130 2,4,6-Tribromophenol 26-130 Aqueous %Rs must be between: 2-Fluorobiphenyl 34-30 2-Fluorophenol 25-130 Nitrobenzene d-5 32-130 Phenol d-5 27-130 Terphenyl d -14 36-130 2,4,6-Tribromophenol 30-130	(1) Check chromatogram for interference; if found, then flag data. (2) If not found, then check instrument performance; if problem is found, then correct and reanalyze sample. (3) If still out, then re-extract and reanalyze sample. (4) If reanalysis is out, then flag data.	Analyst, Supervisor	Accuracy/ Bias	Same as QC Acceptance Limits
Results between DL and LOQ	NA.	Apply “J” qualifier to results detected between DL and LOQ.	NA.	Analyst, Supervisor	Accuracy	Same as QC Acceptance Limits

Matrix	**Soil and Aqueous QC Samples**
Analytical Group	**Pesticides/ PCBs**
Analytical Method / SOP Reference	**SW-846 8081B, 8082A/ Empirical SOP-211**

QC Sample	Frequency / Number	Method / SOP QC Acceptance Limits	CA	Person(s) Responsible for CA	DQI	MPC
Method Blank	One per preparatory batch of 20 or fewer samples of similar matrix.	All target analytes must be ≤ ½ LOQ.	Correct problem. If required, reprepare and reanalyze method blank and all samples processed with the contaminated blank.	Analyst, Supervisor	Bias/ Contamination	Same as QC Acceptance Limits
LCS	One per preparatory batch of 20 or fewer samples of similar matrix. Pesticide: Spike with single component pesticide mix PCB: Spike with Aroclor 1016/1260 mix	%Rs must meet the DoD QSM Version 4.2 limits as per Appendix G of the DoD QSM.	Correct problem, then reprepare and reanalyze the LCS and all samples in the associated preparatory batch for failed analytes, if sufficient sample material is available. Contact client if samples cannot be reanalyzed within hold time.	Analyst, Supervisor	Accuracy/ Bias	Same as QC Acceptance Limits
MS/MSD	One per preparatory batch of 20 or fewer samples of similar matrix. Spike same as LCS.	%Rs must meet the DoD QSM Version 4.2 limits as per Appendix G of the DoD QSM. The RPD between MS and MSD should be ≤ 30%.	Evaluate the samples and associated QC and if the LCS results are acceptable, then narrate. If both the LCS and MS/MSD are unacceptable, then re-prepare the samples and QC.	Analyst, Supervisor	Accuracy/ Bias/ Precision	Same as QC Acceptance Limits

Matrix	**Soil and Aqueous QC Samples**
Analytical Group	**Pesticides/ PCBs**
Analytical Method / SOP Reference	**SW-846 8081B, 8082A/ Empirical SOP-211**

QC Sample	Frequency / Number	Method / SOP QC Acceptance Limits	CA	Person(s) Responsible for CA	DQI	MPC
Surrogates	All field and QC samples - two per sample tetrachloro-m-xylene decachlorobiphenyl.	%Rs must meet the DoD QSM Version 4.2 limits as per Appendix G of the DoD QSM.	No corrective will be taken when one surrogate is within criteria. If surrogates recoveries are high and sample is <LOQ, then no CA is taken. If surrogates recoveries are low, then the affected samples are re-extracted and reanalyzed.	Analyst, Supervisor	Accuracy/ Bias	Same as QC Acceptance Limits
Second Column Confirmation	All positive results must be confirmed.	Results between primary and secondary column must be RPD ≤ 40%. For Method 8082, report the higher of the two concentrations, unless there is interference.	None. Apply "J" flag if RPD >40% and discuss in the case narrative.	Analyst, Supervisor	Accuracy	Same as QC Acceptance Limits
Results between DL and LOQ	NA.	Apply "J" qualifier to results between DL and LOQ.	NA.	Analyst, Supervisor	Accuracy	Same as QC Acceptance Limits

Matrix	**Soil and Aqueous QC Samples**
Analytical Group	**Test America Pesticides**
Analytical Method / SOP Reference	**SW-846 8081B, 8082A/ TestAmerica Savannah SOP SA-SG-45**

QC Sample	Frequency / Number	Method / SOP QC Acceptance Limits	CA	Person(s) Responsible for CA	DQI	MPC
Method Blank	One per preparatory batch of 20 or fewer samples of similar matrix.	All target analytes must be ≤ ½ LOQ.	Correct problem. If required, reprepare and reanalyze method blank and all samples processed with the contaminated blank.	Analyst, Supervisor	Bias/ Contamination	Same as QC Acceptance Limits
LCS	One per preparatory batch of 20 or fewer samples of similar matrix. Pesticide: Spike with single component pesticide mix PCB: Spike with Aroclor 1016/1260 mix	%Rs must laboratory control and/or marginal exceedance limits, See Appendix D for limits.	Correct problem, then reprepare and reanalyze the LCS and all samples in the associated preparatory batch for failed analytes, if sufficient sample material is available. Contact client if samples cannot be reanalyzed within hold time.	Analyst, Supervisor	Accuracy/ Bias	Same as QC Acceptance Limits
MS/MSD	One per preparatory batch of 20 or fewer samples of similar matrix. (spike same as LCS).	%Rs and %RPDs must meet the laboratory control and/or marginal exceedance limits, See Appendix D for limits.	Evaluate the samples and associated QC and if the LCS results are acceptable, then narrate. If both the LCS and MS/MSD are unacceptable, then re-prepare the samples and QC.	Analyst, Supervisor	Accuracy/ Bias/ Precision	Same as QC Acceptance Limits

Matrix	**Soil and Aqueous QC Samples**
Analytical Group	**Test America Pesticides**
Analytical Method / SOP Reference	**SW-846 8081B, 8082A/ TestAmerica Savannah SOP SA-SG-45**

QC Sample	Frequency / Number	Method / SOP QC Acceptance Limits	CA	Person(s) Responsible for CA	DQI	MPC
Surrogates	All field and QC samples - two per sample tetrachloro-m-xylene decachlorobiphenyl.	Soil %Rs must be between: TCX 60-139 DCB 70-130 Aqueous %Rs must be between: TCX 36-130 DCB 40-130	No corrective action will be taken when one surrogate is within criteria. If surrogates recoveries are high and sample is <LOQ, then no CA is taken. If surrogates recoveries are low, then the affected samples are re-extracted and reanalyzed.	Analyst, Supervisor	Accuracy/ Bias	Same as QC Acceptance Limits
Second Column Confirmation	All positive results must be confirmed.	The %RPD will be evaluated between the primary and confirmation column. For results <40% RPD, the higher value will be reported. For results >40% RPD, the lower value will be reported and the data qualified as such.	None. Apply "J" flag if RPD >40% and discuss in the case narrative.	Analyst, Supervisor	Accuracy	Same as QC Acceptance Limits
Results between DL and LOQ	NA.	Apply "J" qualifier to results between DL and LOQ.	NA.	Analyst, Supervisor	Accuracy	Same as QC Acceptance Limits

Matrix	**Soil and Aqueous QC Samples**
Analytical Group	**Herbicides**
Analytical Method / SOP Reference	**SW-846 8151A/ Empirical SOP-304/310**

QC Sample	Frequency / Number	Method / SOP QC Acceptance Limits	CA	Person(s) Responsible for CA	DQI	MPC
Method Blank	One per preparatory batch of 20 or fewer samples.	All target analytes must be ≤ ½ LOQ.	Correct problem. If required, reprepare and reanalyze method blank and all samples processed with the contaminated blank.	Analyst, Supervisor	Bias/ Contamination	Same as QC Acceptance Limits.
LCS	One per preparatory batch of 20 or fewer samples of similar matrix.	%Rs must meet the DoD QSM Version 4.2 limits as per Appendix G of the DoD QSM.	Correct problem, then reprepare and reanalyze the LCS and all samples in the associated preparatory batch for failed analytes, if sufficient sample material is available. Contact client if samples cannot be reanalyzed within hold time.	Analyst, Supervisor	Accuracy/ Bias	Same as QC Acceptance Limits
MS/MSD	One per preparatory batch of 20 or fewer samples of similar matrix.	%Rs must meet the DoD QSM Version 4.2 limits as per Appendix G of the DoD QSM. The RPD between MS and MSD should be ≤ 30%.	Corrective action will not be taken for samples when recoveries are outside limits and surrogate and LCS criteria are met unless RPDs indicate obvious extraction/analysis difficulties, then re-prepare and reanalyze MS/MSD.	Analyst, Supervisor	Accuracy/ Bias/ Precision	Same as QC Acceptance Limits

Matrix	Soil and Aqueous QC Samples
Analytical Group	Herbicides
Analytical Method / SOP Reference	SW-846 8151A/ Empirical SOP-304/310

QC Sample	Frequency / Number	Method / SOP QC Acceptance Limits	CA	Person(s) Responsible for CA	DQI	MPC
Surrogates	One per sample: 2,4-Dichlorophenylacetic acid	The soil %Rs must be between 30-120 and aqueous %Rs must be between 20-140.	If surrogate recovery is high and sample is <LOQ, then no corrective action taken. If surrogate recovery is low, then the affected samples are re-extracted and reanalyzed.	Analyst, Supervisor	Accuracy/ Bias	Same as QC Acceptance Limits.
Second Column Confirmation	All positive results must be confirmed.	Results between primary and secondary column must be RPD ≤ 40%.	None. Apply "J" flag if RPD >40% and discuss in the case narrative.	Analyst, Supervisor	Precision	Same as QC Acceptance Limits.
Results between DL and LOQ	NA	Apply "J" qualifier to results detected between DL and LOQ.	NA.	Analyst, Supervisor	Accuracy	Same as QC Acceptance Limits.

Matrix	**Soil and Aqueous QC Samples**
Analytical Group	**Metals (Including Mercury)**
Analytical Method / SOP Reference	**SW-946 6010C, 7470A, 7471B/ Empirical SOP-103, 104, 105**

QC Sample	Frequency / Number	Method / SOP QC Acceptance Limits	CA	Person(s) Responsible for CA	DQI	MPC
Method Blank	One per preparatory batch of 20 or fewer samples of similar matrix.	All target analytes must be ≤ ½ LOQ.	Re-analysis to confirm the positive value. Re-prepare and reanalyze samples associated with the blank.	Analyst, Supervisor	Bias/ Contamination	Same as QC Acceptance Limits
LCS	One per preparatory batch of 20 or fewer samples of similar matrix.	%R must be within 80-120% of true value.	Correct problem, then reprepare and reanalyze the LCS and all samples in the associated preparatory batch for failed analytes, if sufficient sample material is available. Contact client if samples cannot be reanalyzed within hold time.	Analyst, Supervisor	Accuracy/ Bias	Same as QC Acceptance Limits
MS	One per preparatory batch of 20 or fewer samples of similar matrix.	%R should be within 80-120% of true value (if sample is < 4x spike added).	Flag results for affected analytes for all associated samples with "N".	Analyst, Supervisor	Accuracy/ Bias	Same as QC Acceptance Limits
Sample Duplicate	One per preparatory batch of 20 or fewer samples of similar matrix.	The RPD should be ≤ 20% for duplicate samples for both water and soils.	Narrate any results that are outside control limits.	Analyst, Supervisor	Precision	Same as QC Acceptance Limits
Serial Dilution (Inductively Coupled Plasma (ICP) Only)	One per preparatory batch with sample concentration(s) >50x LOD.	The 5-fold dilution result must agree within ±10%D of the original sample result if result is >50x LOD.	Perform post spike addition.	Analyst, Supervisor	Accuracy/ Bias	Same as QC Acceptance Limits

Matrix	**Soil and Aqueous QC Samples**
Analytical Group	**Metals (Including Mercury)**
Analytical Method / SOP Reference	**SW-946 6010C, 7470A, 7471B/ Empirical SOP-103, 104, 105**

QC Sample	Frequency / Number	Method / SOP QC Acceptance Limits	CA	Person(s) Responsible for CA	DQI	MPC
Post Spike (ICP Only)	One is performed when serial dilution fails or target analyte concentration(s) in all samples are < 50x LOD.	The %R must be within 75-125% of expected value to verify the absence of an interference. Spike addition should produce a concentration of 10-100x LOQ.	Flag results for affected analytes for all associated samples with “J”.	Analyst, Supervisor	Accuracy/ Bias	Same as QC Acceptance Limits
Results between DL and LOQ	NA.	Apply “J” qualifier to results between DL and LOQ.	NA.	Analyst, Supervisor	Accuracy	Same as QC Acceptance Limits

Matrix	**Soil and Aqueous QC Samples**
Analytical Group	**Explosives (including NG)**
Analytical Method / SOP Reference	**SW-846 8330B Empirical SOP-327**

QC Sample	Frequency / Number	Method / SOP QC Acceptance Limits	CA	Person(s) Responsible for CA	DQI	MPC
Method Blank	One per preparatory batch of 20 or fewer samples.	All target analytes must be ≤ ½ LOQ.	If the method blank acceptance criteria are not met, identify and correct the source of contamination, and re-prepare and reanalyze the associated samples.	Analyst, Supervisor	Bias/ Contamination	Same as QC Acceptance Limits
LCS	One per preparatory batch of 20 or fewer samples of similar matrix.	%Rs for aqueous and soil must be between 60-120%	Correct problem, then reprepare and reanalyze the LCS and all samples in the associated preparatory batch for failed analytes, if sufficient sample material is available. Contact Client if samples cannot be reanalyzed within hold time.	Analyst, Supervisor	Accuracy/ Bias	Same as QC Acceptance Limits
MS/MSD	One per preparatory batch of 20 or fewer samples of similar matrix.	%Rs for aqueous and soil must be between 50 and 140% RPD ≤50%.	CA will not be taken for samples when %Rs are outside limits and surrogate and LCS criteria are met unless RPDs indicate obvious extraction/ analysis difficulties, then re-prepare and reanalyze MS/MSD.	Analyst, Supervisor	Accuracy/ Bias/ Precision	Same as QC Acceptance Limits
Surrogate	All field and QC samples - one per sample. One surrogate 1-chloro-3-nitrobenzene.	The soil %Rs must be between 55-140 and aqueous %Rs must be between 40-145.	If surrogate %Rs are outside the established limits, verify calculations, dilutions, and standard solutions. Also verify that the instrument performance is acceptable. If the surrogate %R is outside the established limits due to well-documented matrix effects, the results must be flagged and an explanation included in the report narrative.	Analyst, Supervisor	Accuracy	Same as QC Acceptance Limits
Results between DL and LOQ	NA.	Apply "J" qualifier to results detected between DL and LOQ.	NA.	Analyst, Supervisor	Accuracy	Same as QC Acceptance Limits
Second Column Confirmation	All positive results must be confirmed.	Results between primary and secondary column must be RPD ≤ 40%.	None. Apply "J" flag if RPD >40% and discuss in the case narrative.	Analyst, Supervisor	Accuracy	Same as QC Acceptance Limits

Matrix	**Soil and Aqueous QC Samples**
Analytical Group	**Cyanide**
Analytical Method / SOP Reference	**SW-946 9010B, 9012A/ Empirical SOP-164, 175**

QC Sample	Frequency / Number	Method / SOP QC Acceptance Limits	CA	Person(s) Responsible for CA	DQI	MPC
Method Blank	One per preparatory batch of 20 or fewer samples of similar matrix.	Cyanide must be ≤ ½ LOQ.	Stop analysis, correct problem, and recalibrate.	Analyst, Supervisor	Bias/ Contamination	Same as QC Acceptance Limits.
LCS	One per preparatory batch of 20 or fewer samples of similar matrix.	%Rs must meet the DoD QSM Version 4.2 limits as per Appendix G of the DoD QSM.	Re-prepare and reanalyze the LCS and all associated samples.	Analyst, Supervisor	Accuracy/ Bias	Same as QC Acceptance Limits.
MS	One per preparatory batch of 20 or fewer samples of similar matrix.	%Rs must meet the DoD QSM Version 4.2 limits as per Appendix G of the DoD QSM.	Flag data with an "N", unless recovery is > 4x the spike added; If the sample results exceed 4x the spike added, then spike the un-spiked aliquot of the sample at 2x the indigenous level or 2x the LOQ.	Analyst, Supervisor	Accuracy/ Bias	Same as QC Acceptance Limits.
Sample Duplicate	One per preparatory batch of 20 or fewer samples of similar matrix.	RPD should be ≤ 20%, if concentration is > 5x LOQ; or within ± the LOQ, if the concentration is < 5x LOQ.	Flag data for associated samples with a "*".	Analyst, Supervisor	Precision	Same as QC Acceptance Limits.

Matrix	**Soil and Aqueous QC Samples**
Analytical Group	**Sulfide**
Analytical Method / SOP Reference	**SW-846 9030 Empirical SOP-144/153**

QC Sample	Frequency / Number	Method / SOP QC Acceptance Limits	CA	Person(s) Responsible for CA	DQI	MPC
Method Blank	One per batch	No target compounds should be ≥1/2 the LOQ.	Reanalyze samples	Analyst/Supervisor	Bias/ Contamination	Same as QC Acceptance Limits
Laboratory Control Sample	One per batch	%Rs must be 80-120%.	Reanalyze samples	Analyst/Supervisor	Accuracy/Bias	Same as QC Acceptance Limits
Matrix Spike/ Matrix Spike Duplicate	One per batch	%Rs must be 80-120%. RPD must be ≤20%.	CA will be not taken for samples when recoveries are outside limits and LCS criteria are met. If both the LCS and MS/MSD are unacceptable, reanalyze samples and QC.	Analyst/Supervisor	Accuracy/Bias/ Precision	Same as QC Acceptance Limits
Sample Duplicate	Minimum of 10% of lab samples unless MSD performed	RPD must be ≤20%.	If RPD > 20%, sample should be reanalyzed. If still high, result is flagged.	Analyst/Supervisor	Precision	Same as QC Acceptance Limits

Matrix	Soil
Analytical Group	pH
Analytical Method / SOP Reference	SW-846 9045D/ SOP-187

QC Sample	Frequency / Number	Method / SOP QC Acceptance Limits	CA	Person(s) Responsible for CA	DQI	MPC
Laboratory Duplicate	One per preparation batch of 10 or fewer samples.	± 0.09 units	Recalibrate and reanalyze samples.	Analyst, Supervisor	Precision	Same as QC Acceptance Limits
LCS	Once per 20 samples.	± 0.25 units	Re-analyze associated samples.	Analyst, Supervisor	Accuracy/bias	Same as QC Acceptance Limits

SAP Worksheet #29 -- Project Documents and Records Table

(UFP-QAPP Manual Section 3.5.1)

Document	Where Maintained
Field Documents Field Logbook Field Sample Forms Chain of Custody Records Air Bills Sampling Instrument Calibration Logs Sampling Notes Photographs FTMR Forms This SAP HASP	Field documents will be maintained in the project file located in the Tetra Tech Pittsburgh Pennsylvania office.
Laboratory Documents Sample receipt, custody, and tracking record Equipment calibration logs Sample preparation logs Analysis Run logs CA forms Reported field sample results Reported results for standards, QC checks, and QC samples Extraction/clean-up records Raw data	Laboratory documents will be included in the hardcopy and portable documents format deliverables from the laboratory. Laboratory data deliverables will be maintained in the Tetra Tech Pittsburgh project file and in long-term data package storage at a third-party professional document storage firm, Business Records Management, located at 651 Mansfield Ave., Pittsburgh, PA 15220. Electronic data results will be maintained in a database on a password protected Structured Query Language (SQL) server.
Assessment Findings All versions of the SAP All letter and e-mail correspondence with regulatory agencies, including approvals and comments Field Sampling Audit Checklist (if conducted) Analytical Audit Checklist (if conducted) Data Validation Memoranda (includes tabulated data summary forms)	All assessment documents will be maintained in the Tetra Tech Pittsburgh office.
Reports Interim report/memorandum Full RFI Report	All reports will be stored in hardcopy in the Tetra Tech Pittsburgh office project file and electronically in the server library.

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

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

- **Data Tracking**. Data is tracked from generation to archiving in the Tetra Tech project-specific files. The Tetra Tech Project Chemist (or designee) is responsible for tracking the samples collected and shipped to Empirical and TestAmerica. Upon receipt of the data packages from Empirical and TestAmerica, the Project Chemist will oversee the data validation effort, which includes verifying that the data packages are complete and that results for all samples have been delivered by Empirical and TestAmerica.

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

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

- **Electronic Data**. All electronic data is validated and qualifiers added and then will be complied into a NIRIS Electronic Data Delierable (NEED) and loaded into NIRIS in accordance with proprietary Tetra Tech processes. This process includes a QA review of the data to ensure that the content and format of the data satisfy the requirements of NIRIS uploads. The NEDD is submitted through a datachecker into NIRIS which also ensures the format is acceptable.

SAP Worksheet #30 -- Analytical Services Table

(UFP-QAPP Manual Section 3.5.2.3)

Matrix	Analytical Group	Sample Locations/ Identification Numbers	Analytical Method	Data Package Turnaround Time	Laboratory / Organization (name and address, contact person and telephone number)	Backup Laboratory/ Organization (name and address, contact person, and telephone number)
Soil and aqueous QC	VOCs	See Worksheet #18	SW-846 8260B	23 calendar days	Brian Richard brichard@empirlabs.com Empirical Laboratories, LLC 621 Mainstream Drive, Suite 270 Nashville, TN 37228 (615) 345-1115	NA
	Low-level SVOCs		SW-846 8270D-Low			
	Pesticide/PCBs		SW-846 8081B/8082A			
	Herbicides		SW-846 8151A			
	Explosives plus NG		SW-846 8330B			
	Metals		SW-846 6010C/7470A, 7471B			
	pH		SW-846 9045C			
	Cyanide		SW-846 9012A			
	Sulfide		SW-846 9030			
Soil and aqueous QC	TestAmerica SVOCs		SW-846 8270D		TestAmerica Savannah 5102 LaRoche Avenue Savannah, GA 31404 Lidya Gulizia Lidya.gulizia@testamericainc.com 912-354-7858, ext. 3007	NA
	TestAmerica Pesticides		SW-846 8081B			

Matrix	Analytical Group	Sample Locations/ Identification Numbers	Analytical Method	Data Package Turnaround Time	Laboratory / Organization (name and address, contact person and telephone number)	Backup Laboratory/ Organization (name and address, contact person, and telephone number)
IDW	TCLP Regulatory List Organics	Not Applicable	SW-846 1311; SW-846 5030/8260B; SW-846 8151A; SW-846 3510C 8081A; SW-846 3510C/8270D	21 days	Brian Richard brichard@empirlabs.com Empirical Laboratories, LLC 621 Mainstream Drive, Suite 270 Nashville, TN 37228 (615) 345-1115	NA
	TCLP Regulatory List Inorganics		SW-846 1311; SW-846 3010A/6010C, SW-846 7470A			
	Ignitability		SW-846 1010A Unspecified			
	pH		SW-846 9045D			
	Reactive Cyanide		SW-846 9012A			
	Reactive Sulfide		SW-846 9030, 9034			

SAP Worksheet #31 -- Planned Project Assessments Table

(UFP-QAPP Manual Section 4.1.1)

Assessment Type	Frequency	Internal or External	Organization Performing Assessment	Person(s) Responsible for Performing Assessment (title and organizational affiliation)	Person(s) Responsible for Responding to Assessment Findings (title and organizational affiliation)	Person(s) Responsible for Identifying and Implementing CA (title and organizational affiliation)	Person(s) Responsible for Monitoring Effectiveness of CA (title and organizational affiliation)
Laboratory System Audit[1]	Every 2 years	External	DoD ELAP Accrediting Body	DoD ELAP Accrediting Body Auditor	Laboratory QAM or Laboratory Manager, Empirical	Laboratory QAM or Laboratory Manager, Empirical	Laboratory QAM or Laboratory Manager, Empirical

1 Empirical and TestAmerica are DoD ELAP accredited by a recognized accrediting body. Copies of DoD ELAP accreditation letters are included in Appendix D.

SAP Worksheet #32 -- Assessment Findings and Corrective Action Responses Table

(UFP-QAPP Manual Section 4.1.2)

Assessment Type	**Nature of Deficiencies Documentation**	**Individual(s) Notified of Findings** (name, title, organization)	**Time Frame of Notification**	**Nature of CA Response Documentation**	**Individual(s) Receiving CA Response** (name, title, organization)	**Time Frame for Response**
Laboratory System Audit	Written audit report	Marcia McGinnity, Laboratory Data Quality Manager (DQM), Empirical Andrea Teal Laboratory QAM, TestAmerica Savannah	Specified by DoD ELAP Accrediting Body	Letter	DoD ELAP Accrediting Body	Specified by DoD ELAP Accrediting Body

SAP Worksheet #33 -- QA Management Reports Table

(UFP QAPP Manual Section 4.2)

Type of Report	**Frequency** (daily, weekly monthly, quarterly, annually, etc.)	**Projected Delivery Date(s)**	**Person(s) Responsible for Report Preparation** (title and organizational affiliation)	**Report Recipient(s)** (title and organizational affiliation)
Data Validation Report	Per sample delivery group (SDG)	Within 3 weeks after receiving the data from the laboratory	Project Chemist or Data Validator, Tetra Tech	PM, Tetra Tech; project file
Project Monthly Progress Report	Monthly for duration of the project	Monthly	PM, Tetra Tech	PM, Tetra Tech; QAM, Tetra Tech; Program Manager, Tetra Tech; Navy RPM; project file
Laboratory QA Report	When significant plan deviations result from unanticipated circumstances	Immediately upon detection of problem (on the same day)	Laboratory PM, Empirical and Test America	PM and project file, Tetra Tech

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

(UFP-QAPP Manual Section 5.2.1)

Verification Input	Description	Internal / External	Responsible for Verification (name, organization)
Chain-of-Custody Forms	The Tetra Tech FOL or designee will review and sign the chain-of-custody form to verify that all samples listed are included in the shipment to the laboratory and the sample information is accurate. The forms will be signed by the sampler and a copy will be retained for the project file, the Tetra Tech PM, and the Tetra Tech Data Validators. See SOP-01.	Internal	Sampler and FOL, Tetra Tech
	The Laboratory Sample Custodian will review the sample shipment for completeness and integrity thereby accepting the shipment. The Tetra Tech Data Validators will check that the chain-of-custody form was signed and dated by the Tetra Tech FOL or designee relinquishing the samples and also by the Laboratory Sample Custodian receiving the samples for analyses.	Internal/ External	1 - Laboratory Sample Custodian, Empirical and TestAmerica 2 - Data Validators, Tetra Tech
SAP Sample Tables/ Chain-of-Custody Forms	Verify that all proposed samples listed in the SAP tables have been collected.	Internal	FOL or designee, Tetra Tech
Sample Log Sheets	Verify that information recorded in the log sheets is accurate and complete.	Internal	FOL or designee, Tetra Tech
SAP/Field Logs/ Analytical Data Packages	Ensure that all sampling SOPs were followed. Verify that deviations have been documented and measurement performance criterion MPC have been achieved. Particular attention should be given to verify that samples were correctly identified, that sampling location coordinates are accurate, and that documentation establishes an unbroken trail of documented chain-of-custody from sample collection to report generation. Verify that the correct sampling and analytical methods/SOPs were applied. Verify that the sampling plan was implemented and carried out as written and that any deviations are documented.	Internal	PM or designee, Tetra Tech
SAP/Laboratory SOPs/ Raw Data/ Applicable Control Limits Tables	Ensure that all laboratory SOPs were followed. Verify that the correct analytical methods/SOPs were applied. Establish that all method QC samples were analyzed and in control as listed in the analytical SOPs. If method QA is not in control, the Laboratory QAM will contact the Tetra Tech PM via telephone or e-mail for guidance prior to report preparation.	Internal	Laboratory QAM, Empirical and Test America
SAP/Chain-of-Custody Forms	Check that field QC samples listed in Worksheet #20 were collected as required.	Internal	FOL or designee, Tetra Tech

Verification Input	Description	Internal / External	Responsible for Verification (name, organization)
Electronic Data Deliverables (EDDs)/ Analytical Data Packages	Each EDD will be verified against the chain-of-custody form and hard copy data package for accuracy and completeness. Laboratory analytical results will be verified and compared to the electronic analytical results for accuracy. Sample results will be evaluated for laboratory contamination and will be qualified for false positives using the laboratory method/preparation blank summaries. Positive results reported between the MDL and the LOQ will be qualified as estimated. Extraneous laboratory qualifiers will be removed from the validation qualifier.	External	Data Validators, Tetra Tech
Analytical Data Packages	All analytical data packages will be verified internally for completeness by the laboratory performing the work. The Laboratory QAM will sign the case narrative for each data package.	Internal	Laboratory QAM, Empirical and Test America
	Each data package will be verified for completeness by the Tetra Tech Data Validator. Missing information will be requested by the Tetra Tech Data Validator from the Laboratory PM.	External	Data Validators, Tetra Tech

Notes: Verification includes field data verification and laboratory data verification. Verification inputs as per Worksheet #34 will be checked.

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

(UFP-QAPP Manual Section 5.2.2) (Figure 37 UFP-QAPP Manual) (Table 9 UFP-QAPP Manual)

Step IIa / IIb	Validation Input	Description	Responsible for Validation (name, organization)
IIa	SAP/Sample Log Sheets	Verify that actual sample locations are correct and in accordance with the SAP proposed locations. Document any discrepancies in the final report.	PM, FOL, or designee, Tetra Tech
IIa	Chain-of-Custody Forms	Ensure that the custody and integrity of the samples was maintained from collection to analysis and the custody records are complete and any deviations are recorded. Review that the samples were shipped and stored at the required temperature and sample pH for chemically-preserved samples meet the requirements listed in Worksheet #19. Ensure that the analyses were performed within the holding times listed in Worksheet #19.	Project Chemist or Data Validators, Tetra Tech
IIa/IIb	SAP/Laboratory Data Packages/ EDDs	Ensure that the laboratory QC samples listed in Worksheet #28 were analyzed and that the MPCs listed in Worksheet #12 were met for all field samples and QC analyses. Check that specified field QC samples were collected and analyzed and that the analytical QC criteria set up for this project were met.	Project Chemist or Data Validators, Tetra Tech
		Check the field sampling precision by calculating the RPD for field duplicate samples. Check the laboratory precision by reviewing the RPD or percent difference values from laboratory duplicate analyses; MS/MSDs; and LCS/LCSD, if available.	
		Check that the laboratory recorded the temperature at sample receipt and the pH of the chemically preserved samples to ensure sample integrity from sample collection to analysis.	
		Review the chain-of-custody forms generated in the field to ensure that the required analytical samples have been collected, appropriate sample identifications have been used, and correct analytical methods have been applied. The Tetra Tech Data Validator will verify that elements of the data package required for validation is present, and if not, the laboratory will be contacted and the missing information will be requested. Validation will be performed as per Worksheet #36.	

Step IIa / IIb	Validation Input	Description	Responsible for Validation (name, organization)
IIb	SAP/ Laboratory Data Packages/ EDDs	Ensure that the LOQs listed in Worksheet #15 were achieved.	Project Chemist or Data Validators, Tetra Tech
		Discuss the impact of matrix interferences or sample dilutions performed because of the high concentration of one or more other contaminants, on the other target compounds reported as non-detected.	
		Summarize deviations from methods, procedures, or contracts in the Data Validation Report. If possible determine the impact of any deviation from sampling or analytical methods and SOPs requirements and matrix interferences effect on the analytical results. Qualify data results based on method or QC deviation and explain all the data qualifications.	

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

(UFP-QAPP Manual Section 5.2.2.1)

Step IIa / IIb	Matrix	Analytical Group	Validation Criteria	Data Validator (title and organizational affiliation)
IIa and IIb	Soil and Aqueous QC samples	VOCs	Full data validation will be performed using criteria for SW-846 Method 8260Blisted in this SAP and the current DoD QSM. If not included in the aforementioned, then the logic outlined in USEPA Region II Data Validation SOP, "Validating Volatile Organic Compounds by SW-846 Method 8260" HW-24 Rev. 2 (August 2008), will be used to apply qualifiers to data.	Data Validation Specialist, Tetra Tech
IIa and IIb	Soil and Aqueous QC samples	SVOCs	Full data validation will be performed using criteria for SW-846 Methods 8270D, listed in this SAP and the current DoD QSM. If not included in the aforementioned, then the logic outlined in USEPA Region II SOP, "Validating Semivolatile Organic Compounds by SW-846 Method 8270" HW-22 Rev. 4 (August 2009) will be used to apply qualifiers to data.	Data Validation Specialist, Tetra Tech
IIa and IIb	Soil and Aqueous QC samples	Pesticides	Full data validation will be performed using criteria for SW-846 Methods 8081B, listed in this SAP and the current DoD QSM. If not included in the aforementioned, then the logic outlined in USEPA Region II Data Validation SOP "Validating Pesticide Compounds Organochlorine pesticides by Gas Chromatography SW-846 Method 8081B" HW-44 Rev. 1 (August 2006) will be used to apply qualifiers to data.	Data Validation Specialist, Tetra Tech

Step IIa / IIb	Matrix	Analytical Group	Validation Criteria	Data Validator (title and organizational affiliation)
IIa and IIb	Soil and Aqueous QC samples	PCBs	Full data validation will be performed using criteria for SW-846 Methods 8082A, listed in this SAP and the current DoD QSM. If not included in the aforementioned, then the logic outlined in USEPA Region II Data Validation SOP "Validating PCB Compounds by Gas Chromatography SW-846 Method 8082A" HW-45 Rev. 1 (August 2006) will be used to apply qualifiers to data.	Data Validation Specialist, Tetra Tech
IIa and IIb	Soil and Aqueous QC samples	Herbicides	Full data validation will be performed using criteria for SW-846 Methods 8151A, listed in this SAP and the current DoD QSM. If not included in the aforementioned, then the logic outlined in USEPA Region II Data Validation SOP "Validating Herbicides by GC SW-846 Method 8151A" HW-17 Rev. 3 (August 2008) will be used to apply qualifiers to data.	Data Validation Specialist, Tetra Tech
IIa and IIb	Soil and Aqueous QC samples	Explosives plus NG	Full data validation will be performed using criteria for SW-846 Methods 8330B, listed in this SAP and the current DoD QSM. If not included in the aforementioned, then the logic outlined in USEPA Region II Data Validation SOP "Validating Nitroaromatics and Nitroamines by HPLC SW-846 Method 8330A" HW-16 Rev. 2 (August 2006) will be used to apply qualifiers to data.	Data Validation Specialist, Tetra Tech

Step IIa / IIb	Matrix	Analytical Group	Validation Criteria	Data Validator (title and organizational affiliation)
IIa and IIb	Soil and Aqueous QC samples	Metals (including Mercury) and cyanide	Full data validation will be performed Using criteria for SW-846 Methods 6010C, 7470A , 7471B, 9012B listed in this SAP and the current DoD QSM. If not included in the aforementioned, then the logic outlined in USEPA Region II SOP, "Evaluation of Metals Data for the Contract Laboratory Program (CLP) based on SOW ILM05.3", SOP HW-2 Rev. 13 (September 2006) will be used to apply qualifiers to data.	Data Validation Specialist, Tetra Tech
IIa and IIb	Soil and Aqueous QC samples	Sulfide and pH	Method-specific criteria listed in Worksheets #12, #15, #24, and #28 will be used.	Data Validation Specialist, Tetra Tech

Full data validation is defined as in-depth examination of data to check for adherence to method requirements, technical quality, analyte identification, and result quantitation. It is conducted to support risk assessments and to propose NFA scenarios. A formal report is prepared which details technical findings, presents qualified analytical data and results as reported by the laboratory prior to validation, and includes laboratory quality control summaries and calculation verifications as supporting documentation.

Validation forms will be obtained from the website http://www.epa.gov/Region2/qa/documents.htm.

SAP Worksheet #37 -- Usability Assessment

(UFP-QAPP Manual Section 5.2.3)

Data Usability Assessment
The usability of the data directly affects whether project objectives can be achieved. A Data Quality Review (DQR) was performed for the data collected during the Phase I RFI (Tetra Tech, 2011, results are presented in Appendix B-3) and a DQR will be performed for the data collected during the Full RFI, both DQRs will be provided in the Full RFI Report. Data collected during the Phase I RFI (Tetra Tech, 2011, results are presented in Appendix B-3) will be combined with data collected during the Full RFI (as presented in this SAP), for screening and risk evaluation in the Full RFI Report. All analytes that were detected during the Phase I RFI were carried through to the Full RFI analyte set. For data collected during the Full RFI, the characteristics discussed below will be evaluated during the data usability assessment at a minimum, and the results of these evaluations will be included in the project report. The characteristics will be evaluated for multiple concentration levels if the evaluator determines that this is necessary. To the extent required by the type of data being reviewed, the assessors will consult with other technically competent individuals to render sound technical assessments of these DQI characteristics: **Completeness** o For each matrix that was scheduled to be sampled, the Tetra Tech FOL acting on behalf of the Project Team will prepare a table listing planned samples/analyses to collected samples/analyses. If deviations from the scheduled sample collection or analyses are identified the Tetra Tech PM and Project Risk Assessor will determine whether the deviations compromise the ability to meet project objectives. If they do, the Tetra Tech PM will consult with the Navy RPM and other Project Team members, as necessary (determined by the Navy RPM), to develop appropriate CAs. **Precision** o The Tetra Tech Project Chemist acting on behalf of the Project Team will determine whether precision goals for field duplicates and laboratory duplicates were met. This will be accomplished by comparing duplicate results to precision goals identified in Worksheets #s #12 and #28. This will also include a comparison of field and laboratory precision, with the expectation that laboratory duplicate results will be no less precise than field duplicate results. If the goals are not met or if data have been flagged as estimated (J qualifier), limitations on the use of the data will be described in the project report. **Accuracy** o The Tetra Tech Project Chemist acting on behalf of the Project Team will determine whether the accuracy/bias goals were met for project data. This will be accomplished by comparing percent recoveries of LCS, LCSD, MS, MSD, and surrogate compounds to accuracy goals identified in Worksheet #28. This assessment will include an evaluation of field and laboratory contamination; instrument calibration variability, and analyte %Rs for surrogates, MSs, and LCSs. If the goals are not met, limitations on the use of the data will be described

Data Usability Assessment

in the project report. Bias of the qualified results and a description of the impact of identified non-compliances on a specific data package or on the overall project data will be described in the project report.

Representativeness

- A Tetra Tech Project Scientist identified by the Tetra Tech PM and acting on behalf of the Project Team will determine whether the data are adequately representative of intended populations, both spatially and temporally. This will be accomplished by verifying that samples were collected and processed for analysis in accordance with the SAP, by reviewing spatial and temporal data variations, and by comparing these characteristics to expectations. The usability report will describe the representativeness of the data for each matrix and analytical fraction. This will not require quantitative comparisons unless professional judgment of the Tetra Tech Project Scientist indicates that a quantitative analysis is required.

Comparability

- The Tetra Tech Project Chemist acting on behalf of the Project Team will determine whether the data generated under this project are sufficiently comparable to historical site data generated by different methods and for samples collected using different procedures and under different site conditions. This will be accomplished by comparing overall precision and bias among data sets for each matrix and analytical fraction. This will not require quantitative comparisons unless professional judgment of the Tetra Tech Project Chemist indicates that such quantitative analysis is required.

Sensitivity

- The Tetra Tech Project Chemist acting on behalf of the Project Team will determine whether project sensitivity goals listed in Worksheet #15 were achieved. The overall sensitivity and quantitation limits from multiple data sets for each matrix and analysis will be compared. If sensitivity goals are not achieved, the limitations on the data will be described. The Project Chemist will enlist the help of the Project Risk Assessor to evaluate deviations from planned sensitivity goals.

Project Assumptions and Data Outliers

- The Tetra Tech PM and designated team members will evaluate whether project assumptions are valid. This will typically be a qualitative evaluation but may be supported by quantitative evaluations. The type of evaluation depends on the assumption being tested. Quantitative assumptions include assumptions related to data distributions (e.g., normal versus log-normal) and estimates of data variability. Statistical tests for outliers will be conducted using standard statistical techniques appropriate for this task. Potential outliers will be removed if a review of the associated value indicates that the results have an assignable cause that renders them inconsistent with the rest of the data. During this evaluation, the team will consider whether outliers could be indications of unanticipated site conditions. Consideration will be given to whether outliers represent an unanticipated site condition.

Data Usability Assessment
Describe the evaluative procedures used to assess overall measurement error associated with the project: After completion of the data validation, the Phase I RFI (Tetra Tech, 2011, Phase I results are presented in Appendix B-3 of Volume I) and Full RFI data will be combined, the data and data quality will be reviewed to determine whether sufficient data of acceptable quality are available for decision making. In addition to the evaluations described above, a series of inspections and statistical analyses will be performed to estimate these data quality indicator (DQI) characteristics. The statistical evaluations will include simple summary statistics for target analytes, such as maximum concentration, minimum concentration, number of samples exhibiting non-detected results, number of samples exhibiting positive results, and the proportion of samples with detected and non-detected results. The Project Team members identified by the Tetra Tech PM will assess whether the data collectively support the attainment of project objectives. The Project Team will consider whether any missing or rejected data have compromised the ability to make decisions or to make the decisions with the desired level of confidence. The data will be evaluated to determine whether missing or rejected data can be compensated by other data. Rejected data will not be used for the achievement of project objectives. For statistical comparisons and mathematical manipulations, non-detected values will be represented by a concentration equal to one-half the sample-specific reporting limit. Duplicate results (original and duplicate) will not be averaged for the purpose of representing the range of concentrations, for COPC selection, or to represent the concentration at a particular sampled location. The greater of the two results will be used.
Identify the personnel responsible for performing the usability assessment: The Tetra Tech PM, Project Chemist, FOL, and Project Scientist will be responsible for conducting the listed data usability assessments. The data usability assessment will be reviewed with the Navy RPM, USEPA, and PREQB. If deficiencies affecting the attainment of project objectives are identified, the review will take place either in a face-to-face meeting or a teleconference, depending on the extent of identified deficiencies. If no significant deficiencies are identified, the data usability assessment will simply be documented in the project report and reviewed during the normal document review cycle.
Describe the documentation that will be generated during usability assessment and how usability assessment results will be presented so that they identify trends, relationships (correlations), and anomalies: The data (Phase I RFI and Full RFI data combined) (Tetra Tech, 2011, Phase I results are presented in Appendix B-3 of Volume I) will be presented in tabular format, including data qualifications such as estimation (J, UJ) or rejection (R). Written documentation will support the non-compliance estimated or rejected data results. The project report will identify and describe the data usability limitations and suggest re-sampling or other CAs, if necessary.

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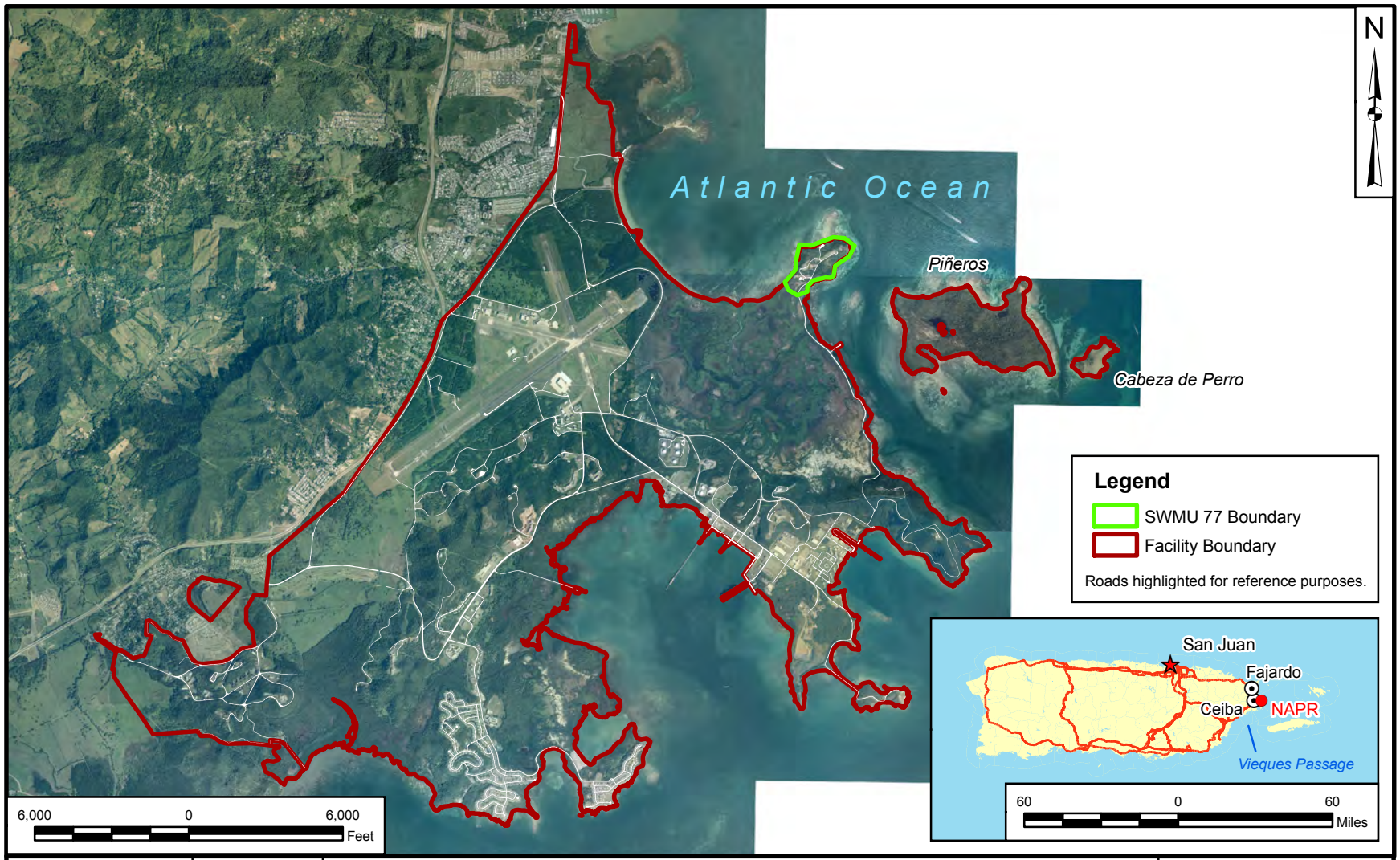

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M. COFFMAN	11/17/11
REVISED BY	DATE
MK BOND	11/17/11
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NAVFAC

FACILITY MAP

NAVAL ACTIVITY PUERTO RICO (NAPR)

CEIBA, PERTO RICO

CONTRACT NUMBER	
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FIGURE NO.	REV
FIGURE 10-1	1

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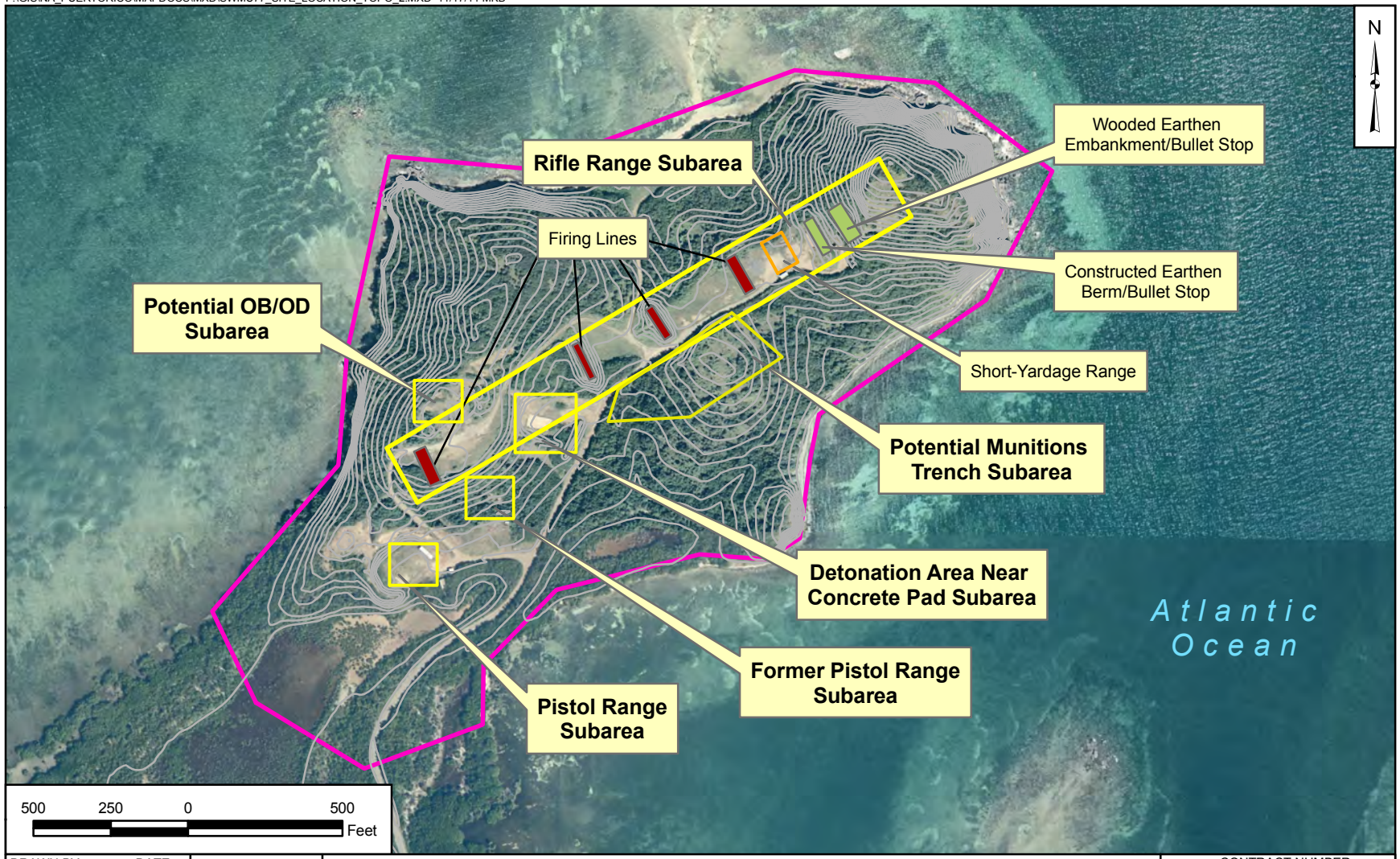

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NAVFAC

SUBAREA LOCATION AND TOPOGRAPHY
SWMU 77
NAVAL ACTIVITY PUERTO RICO
CEIBA, PUERTO RICO

CONTRACT NUMBER	
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FIGURE 10-2	0

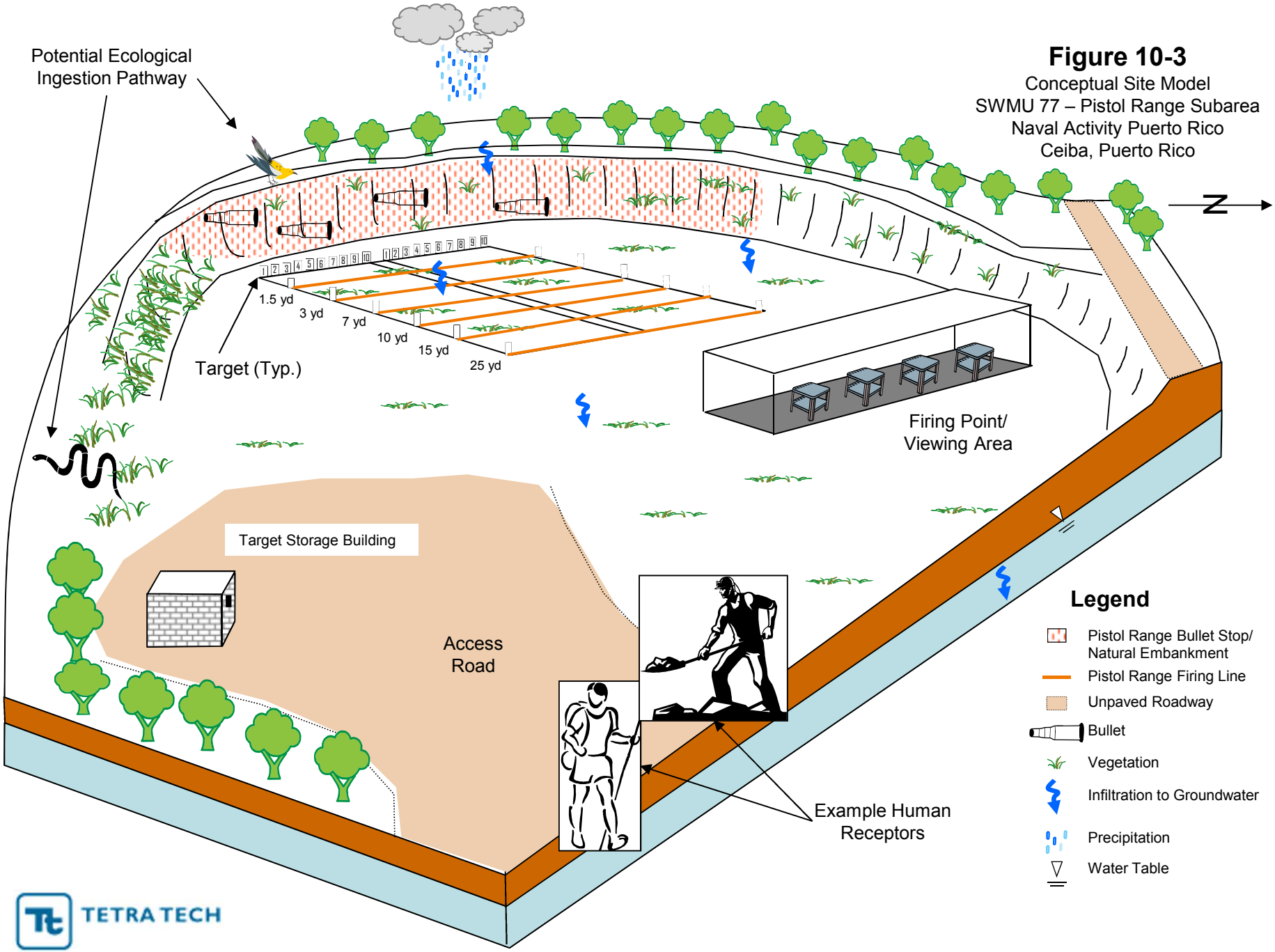


Figure 10-3
Conceptual Site Model
SWMU 77 – Pistol Range Subarea
Naval Activity Puerto Rico
Ceiba, Puerto Rico

FIGURE 10-4

MC EXPOSURE PATHWAY ANALYSIS
SWMU 77 - PISTOL RANGE SUBAREA
NAVAL ACTIVITY PUERTO RICO
CEIBA, PUERTO RICO

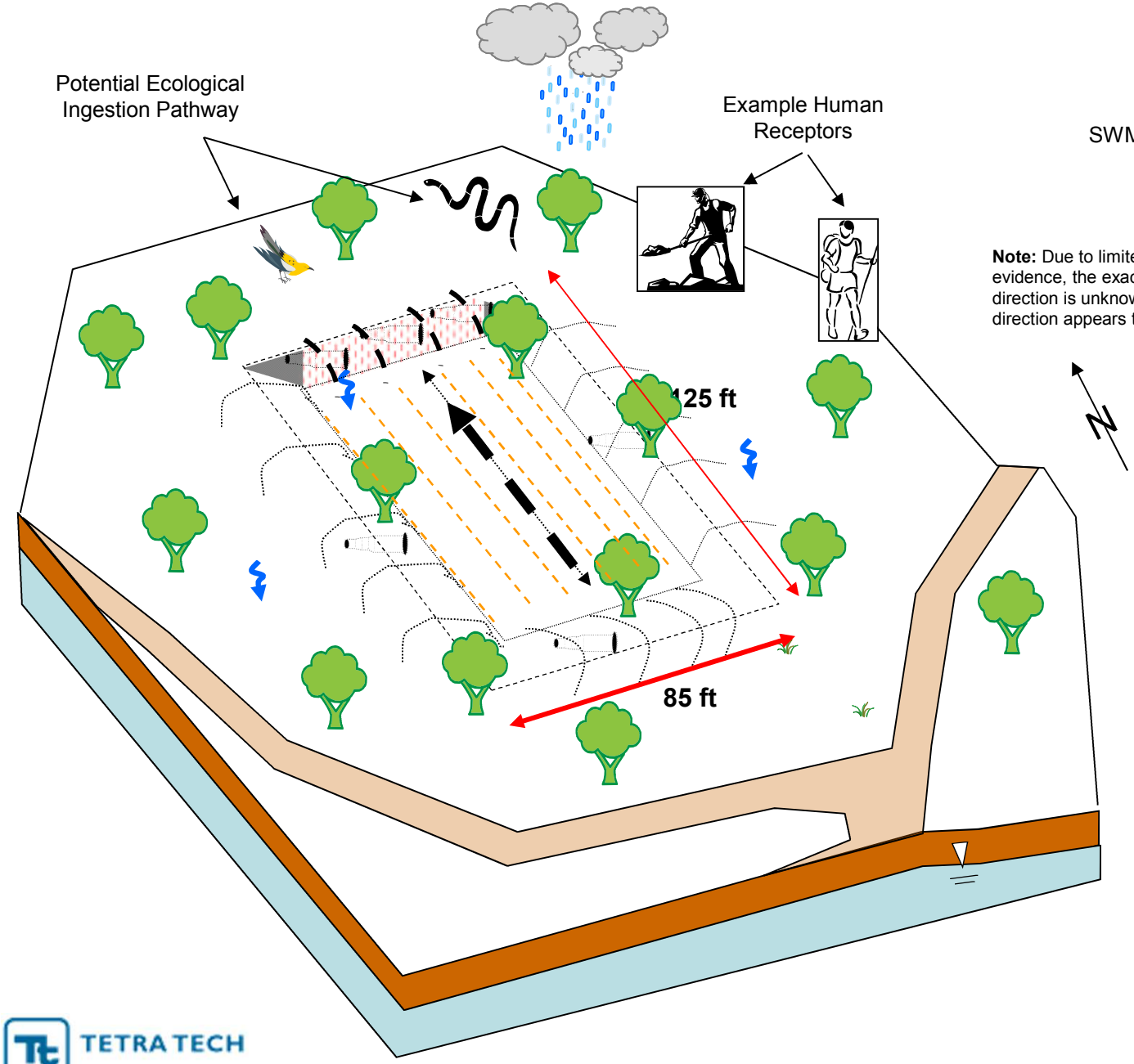
Source Area	Source Medium	Release Mechanisms	Exposure Medium	Exposure Routes	Receptors						
					Current or Future						
					Recreational	Commercial/ Industrial Workers	Outdoor Workers	Construction Workers	Trespassers	Biota/ Critical Habitat	Residents
Pistol Range Subarea	Soil	Plant/Animal Uptake	Food Chain	Vegetation	◐	◐	◐	◐	◐	●	◐
				Domestic Animals	○	○	○	○	○	○	◐
				Game/Fish/Prey	◐	◐	◐	◐	◐	●	◐
		Leaching	Groundwater	Ingestion	○	◐	◐	◐	○	○	◐
				Dermal Contact	○	◐	◐	◐	○	○	◐
				Inhalation (Vapor)	○	◐	◐	◐	○	○	◐
			Subsurface Soil (> 6 inches)	Ingestion	○	○	◐	◐	○	○	◐
				Dermal Contact	○	○	◐	◐	○	○	◐
				Inhalation (Dust)	○	○	◐	◐	○	○	◐
			Surface Soil (<6 inches)	Ingestion	●	●	●	●	●	●	●
				Dermal Contact	●	●	●	●	●	●	●
				Inhalation (Dust)	●	●	●	●	●	●	●
		Infiltration	Subsurface Soil (> 6 inches)	Ingestion	○	○	◐	◐	○	○	◐
				Dermal Contact	○	○	◐	◐	○	○	◐
				Inhalation (Dust)	○	○	◐	◐	○	○	◐
		Stormwater/ Erosion Runoff	Surface Soil (<6 inches)	Ingestion	○	○	○	○	○	○	○
				Dermal Contact	○	○	○	○	○	○	○
				Inhalation (Dust)	○	○	○	○	○	○	○

Note: Elevated metals contamination in surface soil encountered at berm area during Phase I RFI.
Subsurface soil contamination unknown.

●	Complete Pathway
○	Incomplete Pathway
◐	Potentially Complete Pathway
Φ	Potentially Complete Pathway but Contamination at Acceptable Risk Level

Figure 10-5

Conceptual Site Model
SWMU 77 – Former Pistol Range Subarea
Naval Activity Puerto Rico
Ceiba, Puerto Rico



Note: Due to limited historical information and lack of physical evidence, the exact location of the range berms and firing direction is unknown. However, based on the Phase 1 RFI direction appears to be to the north into the natural hillside.

N

Legend

- Probable Former Pistol Range Bullet Stop/ Natural Embankment
- Unpaved Roadway
- Apparent Range Extent
- Potential Pistol Range Firing Line (1.5, 3, 7, 10, 15, 25 yd)
- Potential Former Berm
- Potential Firing Direction
- Probable Former Berm
- Probable Firing Direction
- Potential Bullet
- Vegetation
- Infiltration to Groundwater
- Precipitation
- Water Table

TETRA TECH

FIGURE 10-6

MC EXPOSURE PATHWAY ANALYSIS
SWMU 77 - FORMER PISTOL RANGE SUBAREA
NAVAL ACTIVITY PUERTO RICO
CEIBA, PUERTO RICO

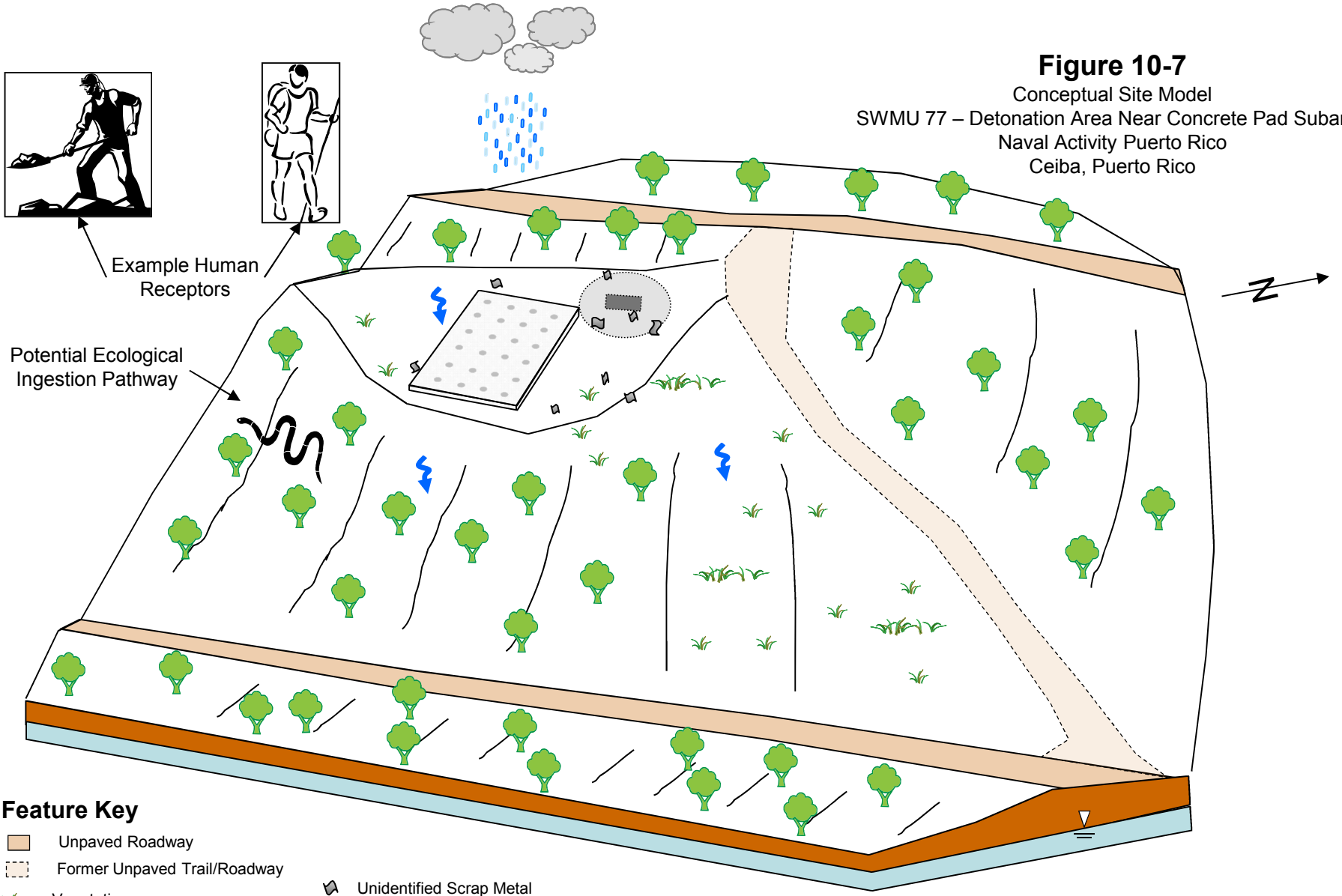
Source Area	Source Medium	Release Mechanisms	Exposure Medium	Exposure Routes	Receptors (Current or Future)						
					Recreational	Commercial/ Industrial Workers	Outdoor Workers	Construction Workers	Trespassers	Biota/ Critical Habitat	Residents
Former Pistol Range Subarea	Soil	Plant/Animal Uptake	Food Chain	Vegetation	◐	◐	◐	◐	◐	●	◐
				Domestic Animals	○	○	○	○	○	○	◐
				Game/Fish/Prey	◐	◐	◐	◐	◐	●	◐
		Leaching	Groundwater	Ingestion	○	◐	◐	◐	○	○	◐
				Dermal Contact	○	◐	◐	◐	○	○	◐
				Inhalation (Vapor)	○	◐	◐	◐	○	○	◐
			Subsurface Soil (6 inches - 4 feet)	Ingestion	○	○	◐	◐	○	○	◐
				Dermal Contact	○	○	◐	◐	○	○	◐
				Inhalation (Dust)	○	○	◐	◐	○	○	◐
			Surface Soil (<6 inches)	Ingestion	●	●	●	●	●	●	●
				Dermal Contact	●	●	●	●	●	●	●
				Inhalation (Dust)	●	●	●	●	●	●	●
		Infiltration	Subsurface Soil (6 inches - 4 feet)	Ingestion	○	○	◐	◐	○	○	◐
				Dermal Contact	○	○	◐	◐	○	○	◐
				Inhalation (Dust)	○	○	◐	◐	○	○	◐
		Stormwater/ Erosion Runoff	Surface Soil (<6 inches)	Ingestion	○	○	○	○	○	○	○
				Dermal Contact	○	○	○	○	○	○	○
				Inhalation (Dust)	○	○	○	○	○	○	○

Note: Moderately elevated metals contamination in surface soil present during Phase 1 RFI.
Subsurface soil contamination unknown.

●	Complete Pathway
○	Incomplete Pathway
◐	Potentially Complete Pathway
Φ	Potentially Complete Pathway but Contamination at Acceptable Risk Level

Figure 10-7

Conceptual Site Model
SWMU 77 – Detonation Area Near Concrete Pad Subarea
Naval Activity Puerto Rico
Ceiba, Puerto Rico



Feature Key

- Unpaved Roadway
- Former Unpaved Trail/Roadway
- Vegetation
- Infiltration to Groundwater
- Precipitation
- Unidentified Scrap Metal
- One-Time Detonation Pit
- Water Table

TETRA TECH

FIGURE 10-8

MC EXPOSURE PATHWAY ANALYSIS
SWMU 77 - DETONATION AREA NEAR CONCRETE PAD SUBAREA
NAVAL ACTIVITY PUERTO RICO
CEIBA, PUERTO RICO

Source Area	Source Medium	Release Mechanisms	Exposure Medium	Exposure Routes	Receptors						
					Current or Future						
					Recreational	Commercial/ Industrial Workers	Outdoor Workers	Construction Workers	Trespassers	Biota/ Critical Habitat	Residents
Detonation Area Near Concrete Pad Subarea	Soil	Plant/Animal Uptake	Food Chain	Vegetation	Φ	Φ	Φ	Φ	Φ	Φ	Φ
				Domestic Animals	○	○	○	○	○	○	Φ
				Game/Fish/Prey	Φ	Φ	Φ	Φ	Φ	Φ	Φ
		Leaching	Groundwater	Ingestion	○	Φ	Φ	Φ	○	○	Φ
				Dermal Contact	○	Φ	Φ	Φ	○	○	Φ
				Inhalation (Vapor)	○	Φ	Φ	Φ	○	○	Φ
			Subsurface Soil (6 inches - 4 feet)	Ingestion	○	○	Φ	Φ	○	○	Φ
				Dermal Contact	○	○	Φ	Φ	○	○	Φ
				Inhalation (Dust)	○	○	Φ	Φ	○	○	Φ
			Surface Soil (<6 inches)	Ingestion	Φ	Φ	Φ	Φ	Φ	Φ	Φ
				Dermal Contact	Φ	Φ	Φ	Φ	Φ	Φ	Φ
				Inhalation (Dust)	Φ	Φ	Φ	Φ	Φ	Φ	Φ
		Infiltration	Subsurface Soil (6 inches - 4 feet)	Ingestion	○	○	Φ	Φ	○	○	Φ
				Dermal Contact	○	○	Φ	Φ	○	○	Φ
				Inhalation (Dust)	○	○	Φ	Φ	○	○	Φ
		Stormwater/ Erosion Runoff	Surface Soil (<6 inches)	Ingestion	○	○	○	○	○	○	○
				Dermal Contact	○	○	○	○	○	○	○
				Inhalation (Dust)	○	○	○	○	○	○	○

Note: Only low level metals contamination present during Phase I RFI.
Although contamination is at acceptable risk levels based on Phase I RFI,
these samples, although at biased maximum concentration locations were
few in number and additional samples are warranted during the Full RFI to confirm.

●	Complete Pathway
○	Incomplete Pathway
◐	Potentially Complete Pathway
Φ	Potentially Complete Pathway but Contamination at Acceptable Risk Level

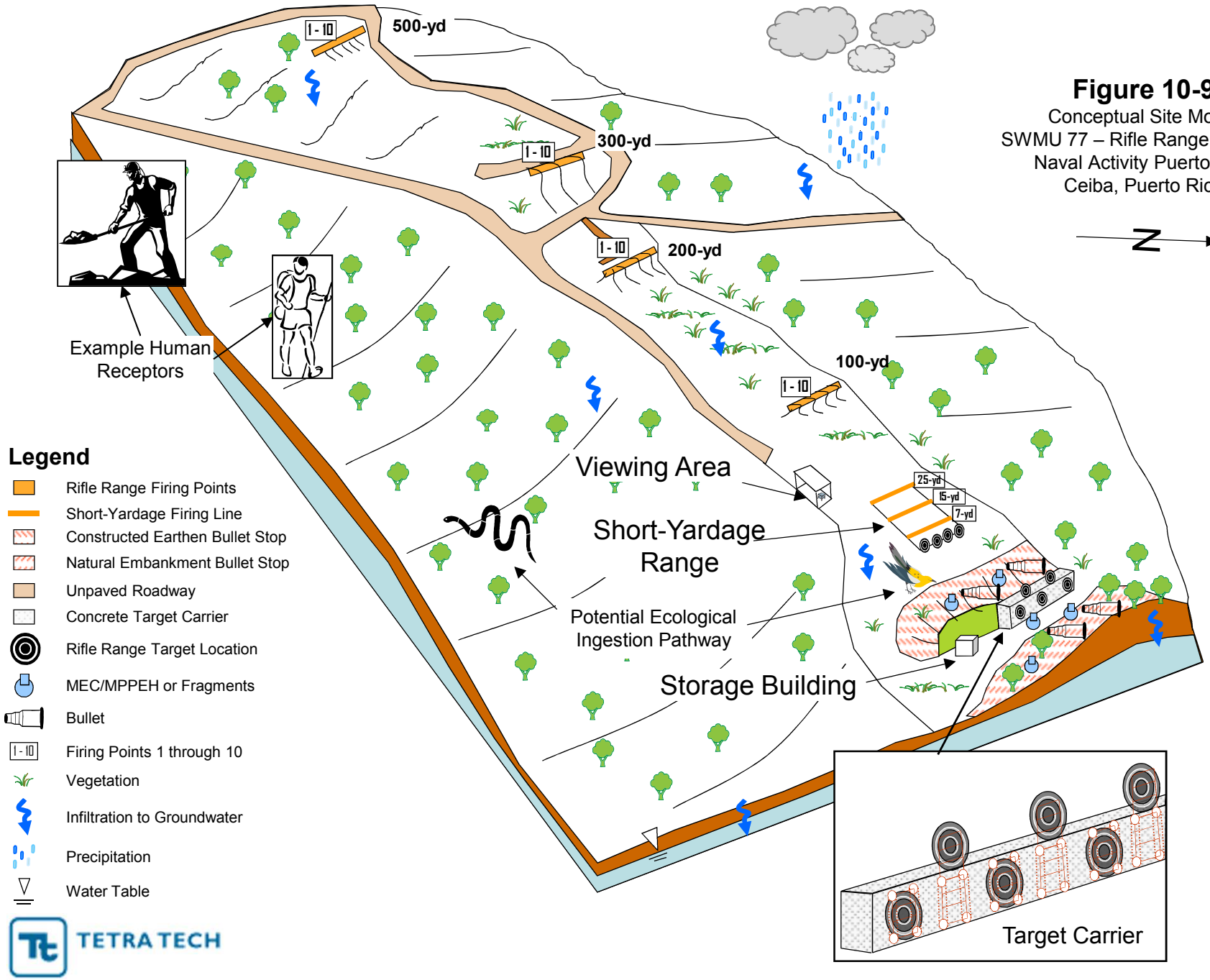


Figure 10-9
Conceptual Site Model
SWMU 77 – Rifle Range Subarea
Naval Activity Puerto Rico
Ceiba, Puerto Rico

FIGURE 10-10

MC EXPOSURE PATHWAY ANALYSIS
SWMU 77 - RIFLE RANGE SUBAREA
NAVAL ACTIVITY PUERTO RICO
CEIBA, PUERTO RICO

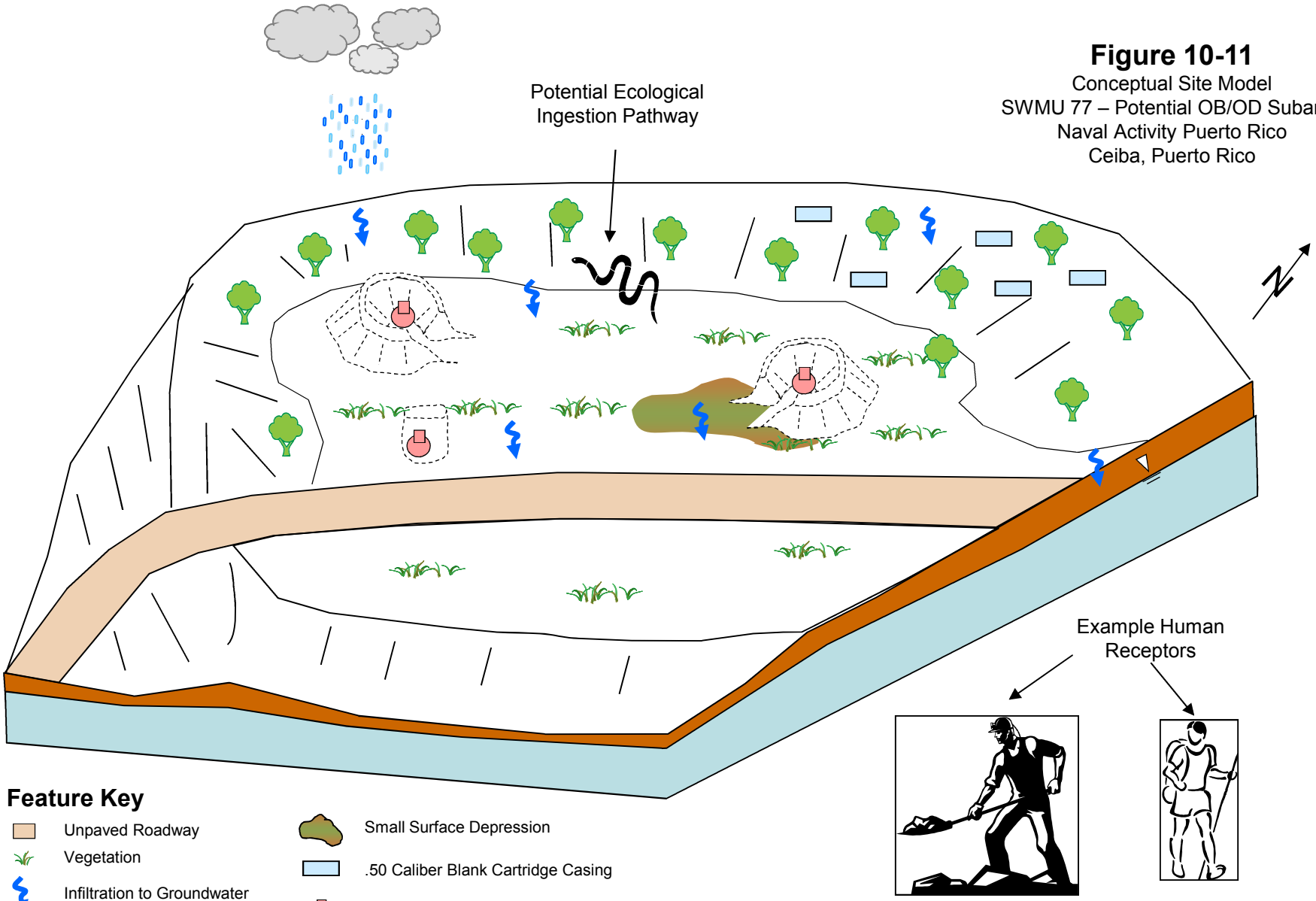
Source Area	Source Medium	Release Mechanisms	Exposure Medium	Exposure Routes	Receptors (Current or Future)						
					Recreational	Commercial/ Industrial Workers	Outdoor Workers	Construction Workers	Trespassers	Biota/ Critical Habitat	Residents
Rifle Range Subarea	Soil	Plant/Animal Uptake	Food Chain	Vegetation	◐	◐	◐	◐	◐	●	◐
				Domestic Animals	○	○	○	○	○	○	◐
				Game/Fish/Prey	◐	◐	◐	◐	◐	●	◐
		Leaching	Groundwater	Ingestion	○	◐	◐	◐	○	○	◐
				Dermal Contact	○	◐	◐	◐	○	○	◐
				Inhalation (Vapor)	○	◐	◐	◐	○	○	◐
			Subsurface Soil (> 6 inches)	Ingestion	○	○	◐	◐	○	○	◐
				Dermal Contact	○	○	◐	◐	○	○	◐
				Inhalation (Dust)	○	○	◐	◐	○	○	◐
			Surface Soil (<6 inches)	Ingestion	●	●	●	●	●	●	●
				Dermal Contact	●	●	●	●	●	●	●
				Inhalation (Dust)	●	●	●	●	●	●	●
		Infiltration	Subsurface Soil (> 6 inches)	Ingestion	○	○	◐	◐	○	○	◐
				Dermal Contact	○	○	◐	◐	○	○	◐
				Inhalation (Dust)	○	○	◐	◐	○	○	◐
		Stormwater/ Erosion Runoff	Surface Soil (<6 inches)	Ingestion	○	○	○	○	○	○	○
				Dermal Contact	○	○	○	○	○	○	○
				Inhalation (Dust)	○	○	○	○	○	○	○

Note: Elevated metals contamination in surface soil encountered at berm area and NG at 200-yard firing line during Phase I RFI.
Subsurface soil contamination unknown.

●	Complete Pathway
○	Incomplete Pathway
◐	Potentially Complete Pathway
Φ	Potentially Complete Pathway but Contamination at Acceptable Risk Level

Figure 10-11

Conceptual Site Model
SWMU 77 – Potential OB/OD Subarea
Naval Activity Puerto Rico
Ceiba, Puerto Rico



Feature Key

- Unpaved Roadway
- Vegetation
- Infiltration to Groundwater
- Precipitation
- Water Table
- Small Surface Depression
- .50 Caliber Blank Cartridge Casing
- Unknown Subsurface Potential MEC or MEC Fragment
- Potential Berm (Typ.)/Burn Pit

TETRA TECH

FIGURE 10-12

MC EXPOSURE PATHWAY ANALYSIS
SWMU 77 - POTENTIAL OPEN BURN/OPEN DETONATION SUBAREA
NAVAL ACTIVITY PUERTO RICO
CEIBA, PUERTO RICO

Source Area	Source Medium	Release Mechanisms	Exposure Medium	Exposure Routes	Receptors (Current or Future)						
					Recreational	Commercial/ Industrial Workers	Outdoor Workers	Construction Workers	Trespassers	Biota/ Critical Habitat	Residents
Potential OB/OD Subarea	Soil	Plant/Animal Uptake	Food Chain	Vegetation	◐	◐	◐	◐	◐	◐	◐
				Domestic Animals	○	○	○	○	○	○	◐
				Game/Fish/Prey	◐	◐	◐	◐	◐	◐	◐
		Leaching	Groundwater	Ingestion	○	◐	◐	◐	○	○	◐
				Dermal Contact	○	◐	◐	◐	○	○	◐
				Inhalation (Vapor)	○	◐	◐	◐	○	○	◐
			Subsurface Soil (> 6 inches	Ingestion	○	○	◐	◐	○	○	◐
				Dermal Contact	○	○	◐	◐	○	○	◐
				Inhalation (Dust)	○	○	◐	◐	○	○	◐
			Surface Soil (<6 inches)	Ingestion	Φ	Φ	Φ	Φ	Φ	Φ	Φ
				Dermal Contact	Φ	Φ	Φ	Φ	Φ	Φ	Φ
				Inhalation (Dust)	Φ	Φ	Φ	Φ	Φ	Φ	Φ
		Infiltration	Subsurface Soil (> 6 inches)	Ingestion	○	○	◐	◐	○	○	◐
				Dermal Contact	○	○	◐	◐	○	○	◐
				Inhalation (Dust)	○	○	◐	◐	○	○	◐
		Stormwater/ Erosion Runoff	Surface Soil (<6 inches)	Ingestion	○	○	○	○	○	○	○
				Dermal Contact	○	○	○	○	○	○	○
				Inhalation (Dust)	○	○	○	○	○	○	○

Note: Low lead contamination in surface soil encountered during Phase I RFI could present ecological risk. Although surface soil contamination is at relatively low risk levels based on Phase I RFI comparison with PALs, these samples, although at biased maximum concentration locations, were few in number and additional samples are warranted during the Full RFI to confirm.

●	Complete Pathway
○	Incomplete Pathway
◐	Potentially Complete Pathway ◐
Φ	Potentially Complete Pathway but Contamination at Acceptable Risk Level

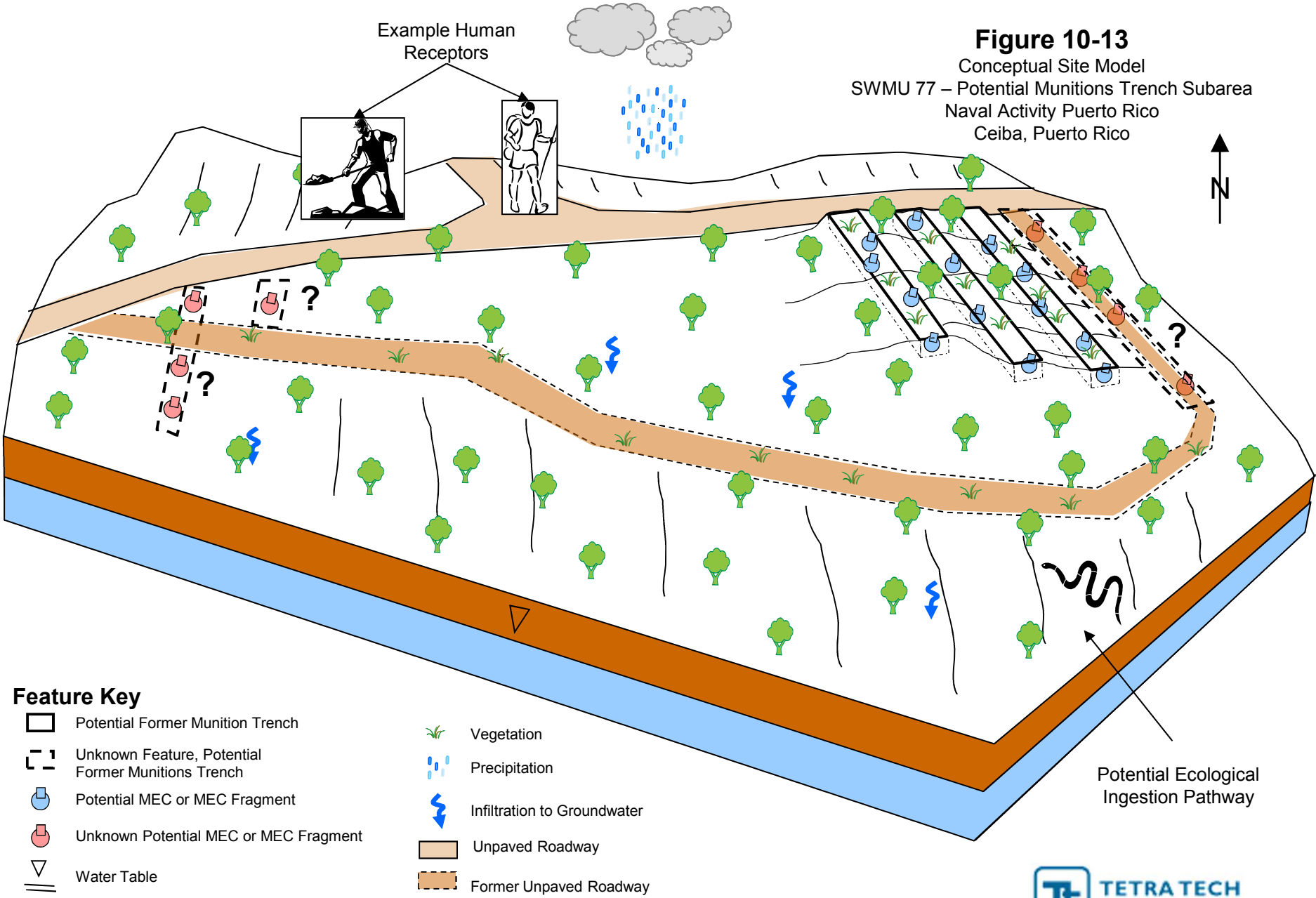


Figure 10-13
Conceptual Site Model
SWMU 77 – Potential Munitions Trench Subarea
Naval Activity Puerto Rico
Ceiba, Puerto Rico

TETRA TECH

FIGURE 10-14

MC EXPOSURE PATHWAY ANALYSIS
SWMU 77 - POTENTIAL MUNITIONS TRENCH SUBAREA
NAVAL ACTIVITY PUERTO RICO
CEIBA, PUERTO RICO

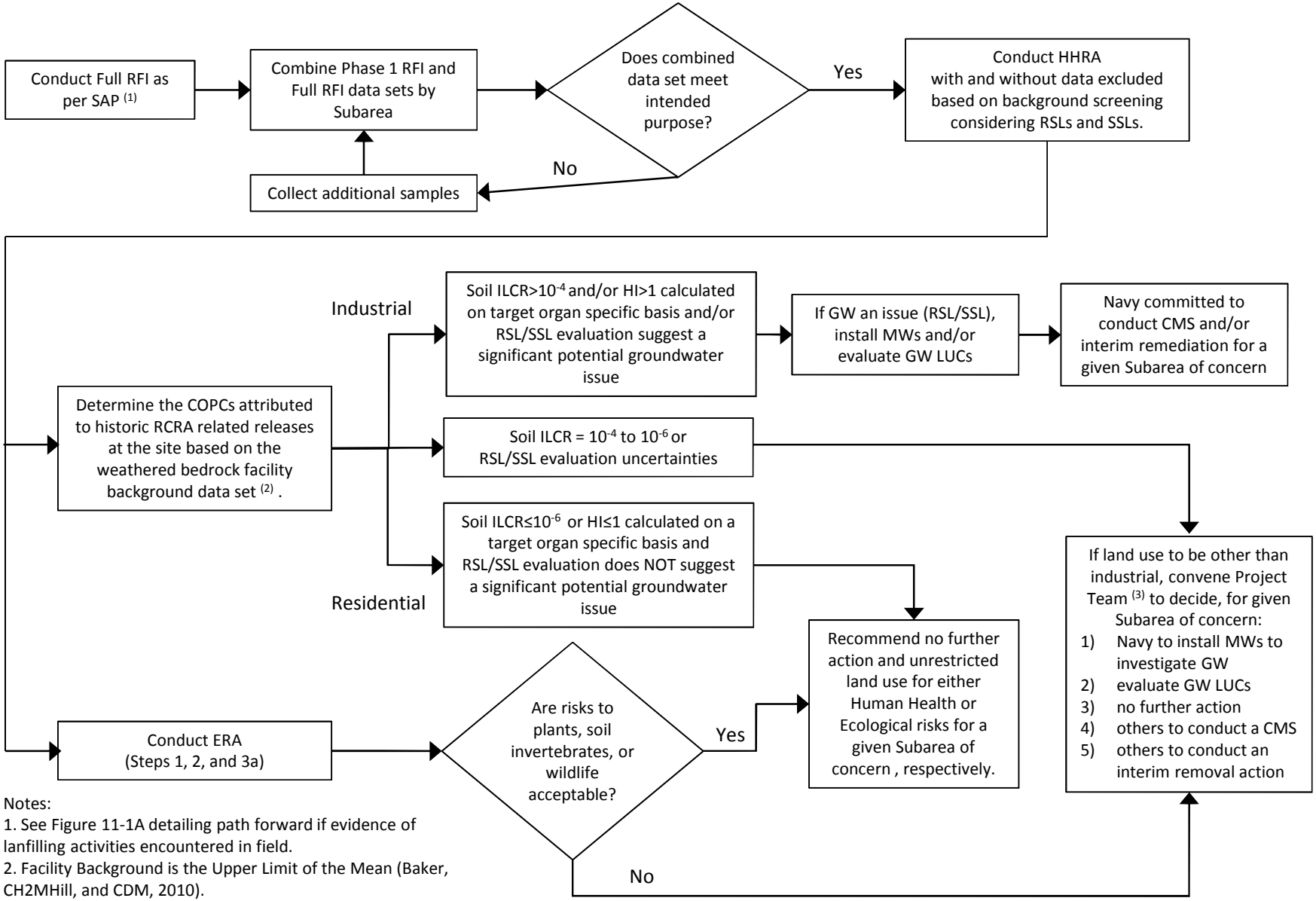
Source Area	Source Medium	Release Mechanisms	Exposure Medium	Exposure Routes	Receptors (Current or Future)						
					Recreational	Commercial/ Industrial Workers	Outdoor Workers	Construction Workers	Trespassers	Biota/ Critical Habitat	Residents
Potential Munitions Trench Subarea	Soil	Plant/Animal Uptake	Food Chain	Vegetation	Φ	Φ	Φ	Φ	Φ	Φ	Φ
				Domestic Animals	○	○	○	○	○	○	Φ
				Game/Fish/Prey	Φ	Φ	Φ	Φ	Φ	Φ	Φ
		Leaching	Groundwater	Ingestion	○	◐	◐	◐	○	○	◐
				Dermal Contact	○	◐	◐	◐	○	○	◐
				Inhalation (Vapor)	○	◐	◐	◐	○	○	◐
			Subsurface Soil (> 6 inches)	Ingestion	○	○	◐	◐	○	○	◐
				Dermal Contact	○	○	◐	◐	○	○	◐
				Inhalation (Dust)	○	○	◐	◐	○	○	◐
			Surface Soil (<6 inches)	Ingestion	Φ	Φ	Φ	Φ	Φ	Φ	Φ
				Dermal Contact	Φ	Φ	Φ	Φ	Φ	Φ	Φ
				Inhalation (Dust)	Φ	Φ	Φ	Φ	Φ	Φ	Φ
		Infiltration	Subsurface Soil (> 6 inches)	Ingestion	○	○	◐	◐	○	○	◐
				Dermal Contact	○	○	◐	◐	○	○	◐
				Inhalation (Dust)	○	○	◐	◐	○	○	◐
		Stormwater/ Erosion Runoff	Surface Soil (<6 inches)	Ingestion	○	○	○	○	○	○	○
				Dermal Contact	○	○	○	○	○	○	○
				Inhalation (Dust)	○	○	○	○	○	○	○

Note: Subsurface soil contamination unknown.

Although surface soil contamination is at acceptable risk levels based on Phase I RFI, these samples, although at biased maximum concentration locations, were few in number and additional samples are warranted during the Full RFI to confirm.

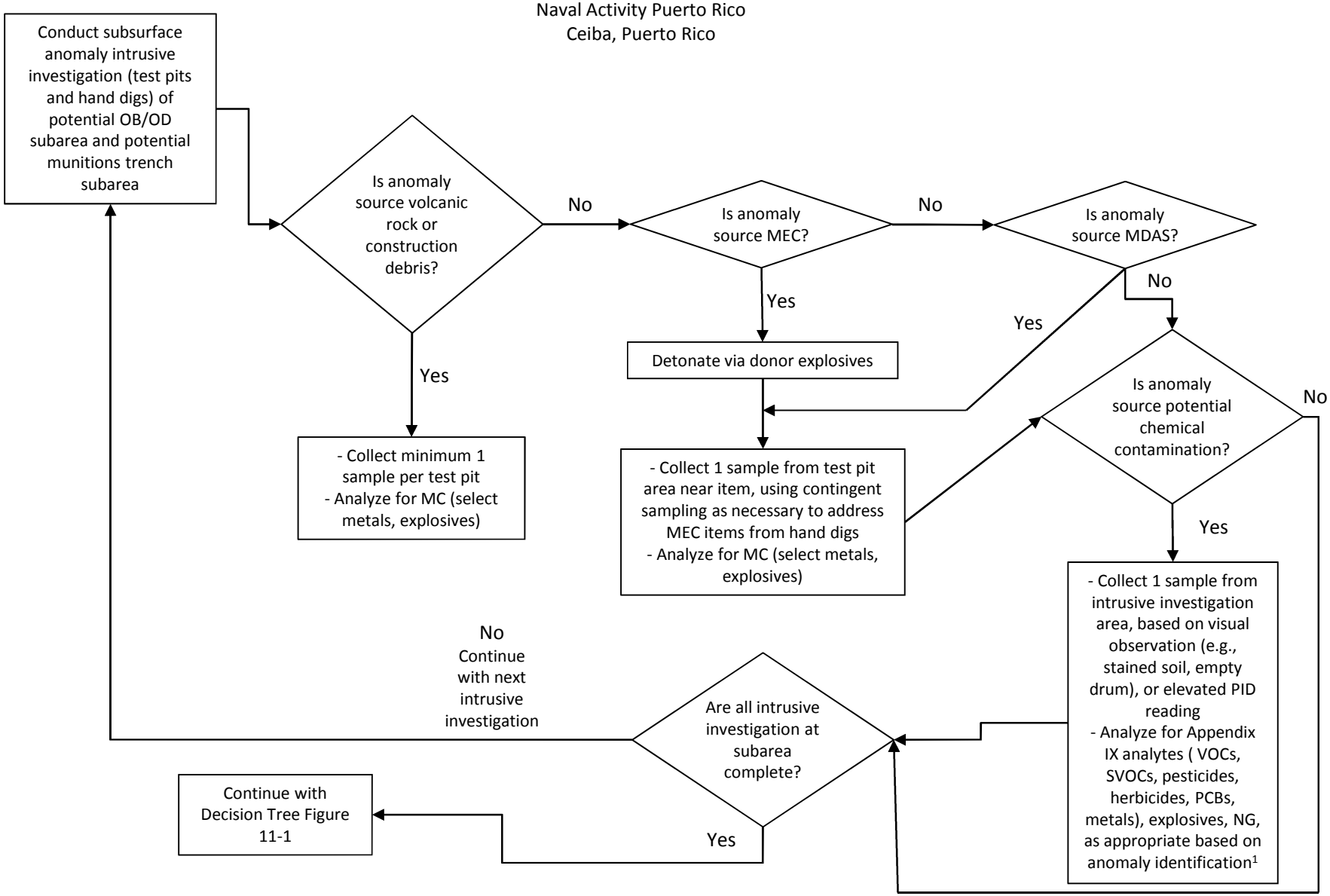
●	Complete Pathway
○	Incomplete Pathway
◐	Potentially Complete Pathway
Φ	Potentially Complete Pathway but Contamination at Acceptable Risk Level

Figure 11-1
SWMU 77 MC Decision Matrix
Naval Activity Puerto Rico
Ceiba, Puerto Rico



Notes:
1. See Figure 11-1A detailing path forward if evidence of lanfilling activities encountered in field.
2. Facility Background is the Upper Limit of the Mean (Baker, CH2MHill, and CDM, 2010).
3. Decision makers are the Navy, USEPA, and PREQB.

Figure 11-1A
SWMU 77 Decision Matrix – Sampling Path Forward if Landfilling Evidence at Potential OB/OD Subarea or Potential Munitions Trench Subarea During Anomaly Intrusive Investigation
Naval Activity Puerto Rico
Ceiba, Puerto Rico



1 If contamination is identifiable, e.g., drum of solvent, the Project Team will be consulted to determine if a reduced analyte set is appropriate. If unidentifiable, then samples will be analyzed for all analytes as listed.

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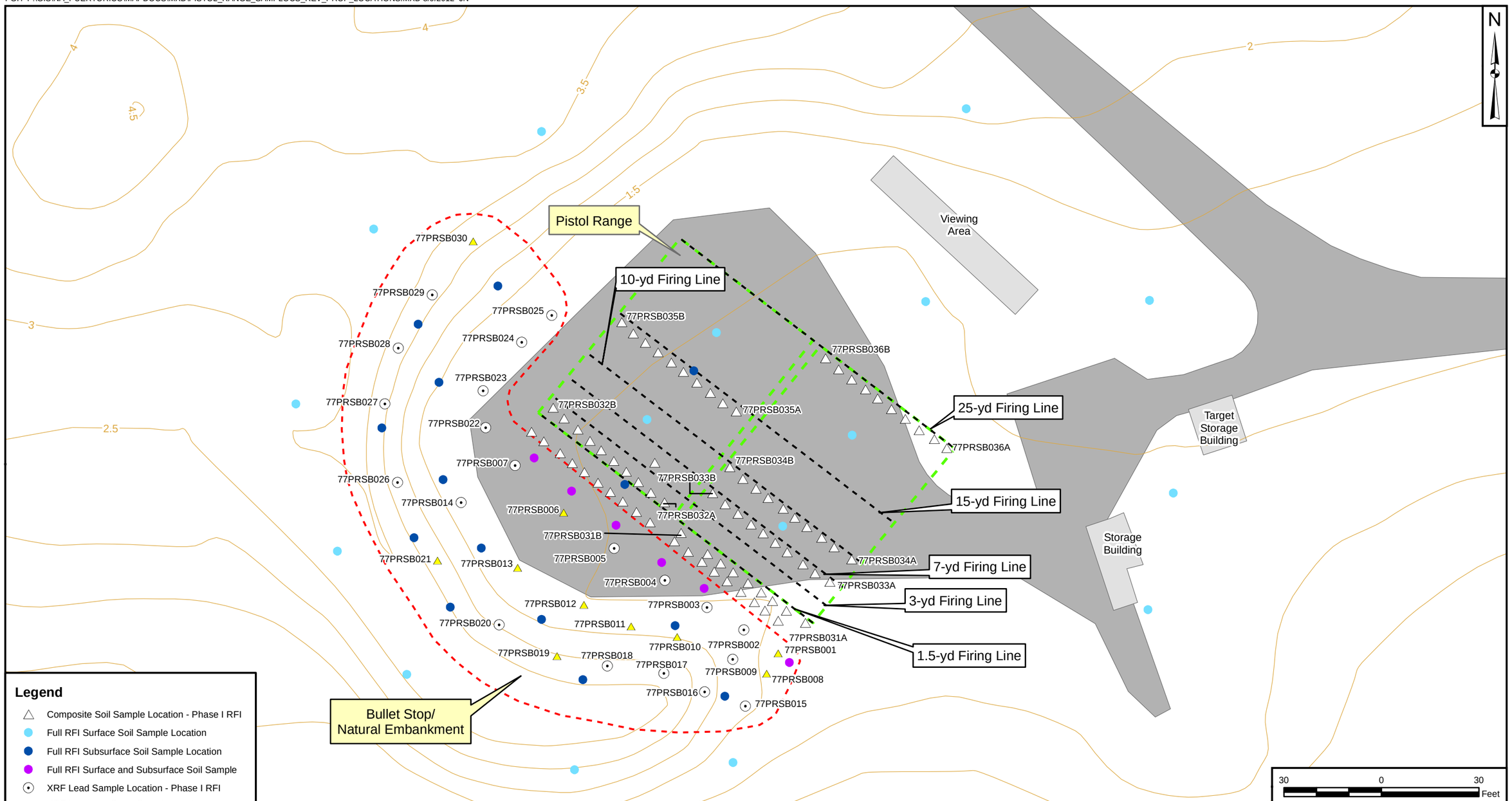

Legend

- Composite Soil Sample Location - Phase I RFI
- Full RFI Surface Soil Sample Location
- Full RFI Subsurface Soil Sample Location
- Full RFI Surface and Subsurface Soil Sample
- XRF Lead Sample Location - Phase I RFI
- XRF Lead and Fixed Base Laboratory Soil Sample Location - Phase I RFI
- Firing Lines
- Topographic Contour (0.5 m interval)
- Building
- Dirt Road

Note: XRF = X-ray Flourescence.

DRAWN BY T .WHEATON	DATE 07/19/10
CHECKED BY M. COFFMAN	DATE 08/09/12
REVISED BY J. NOVAK	DATE 08/09/12
SCALE AS NOTED	

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PROPOSED SOIL SAMPLE LOCATIONS
SWMU 77 - PISTOL RANGE SUBAREA
NAVAL ACTIVITY PUERTO RICO
CEIBA. PUERTO RICO

CONTRACT NUMBER 2226	CTO NUMBER JM04
APPROVED BY —	DATE —
APPROVED BY —	DATE —
FIGURE NO. FIGURE 17-1	REV 1

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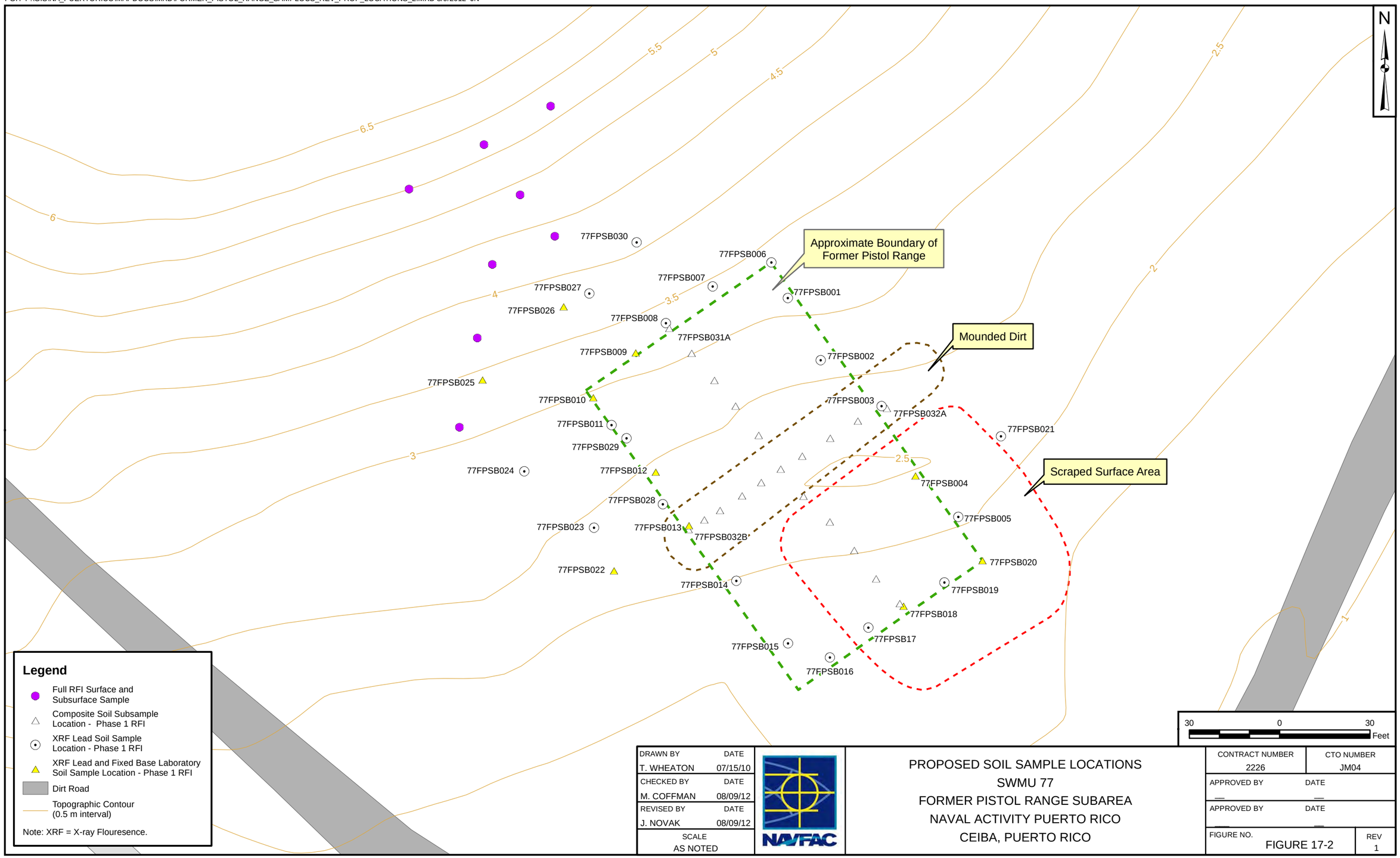

Legend

- Full RFI Surface and Subsurface Sample
- Composite Soil Subsample Location - Phase 1 RFI
- XRF Lead Soil Sample Location - Phase 1 RFI
- XRF Lead and Fixed Base Laboratory Soil Sample Location - Phase 1 RFI
- Dirt Road
- Topographic Contour (0.5 m interval)

Note: XRF = X-ray Flouresence.

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T. WHEATON	07/15/10
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M. COFFMAN	08/09/12
REVISED BY	DATE
J. NOVAK	08/09/12
SCALE	
AS NOTED	

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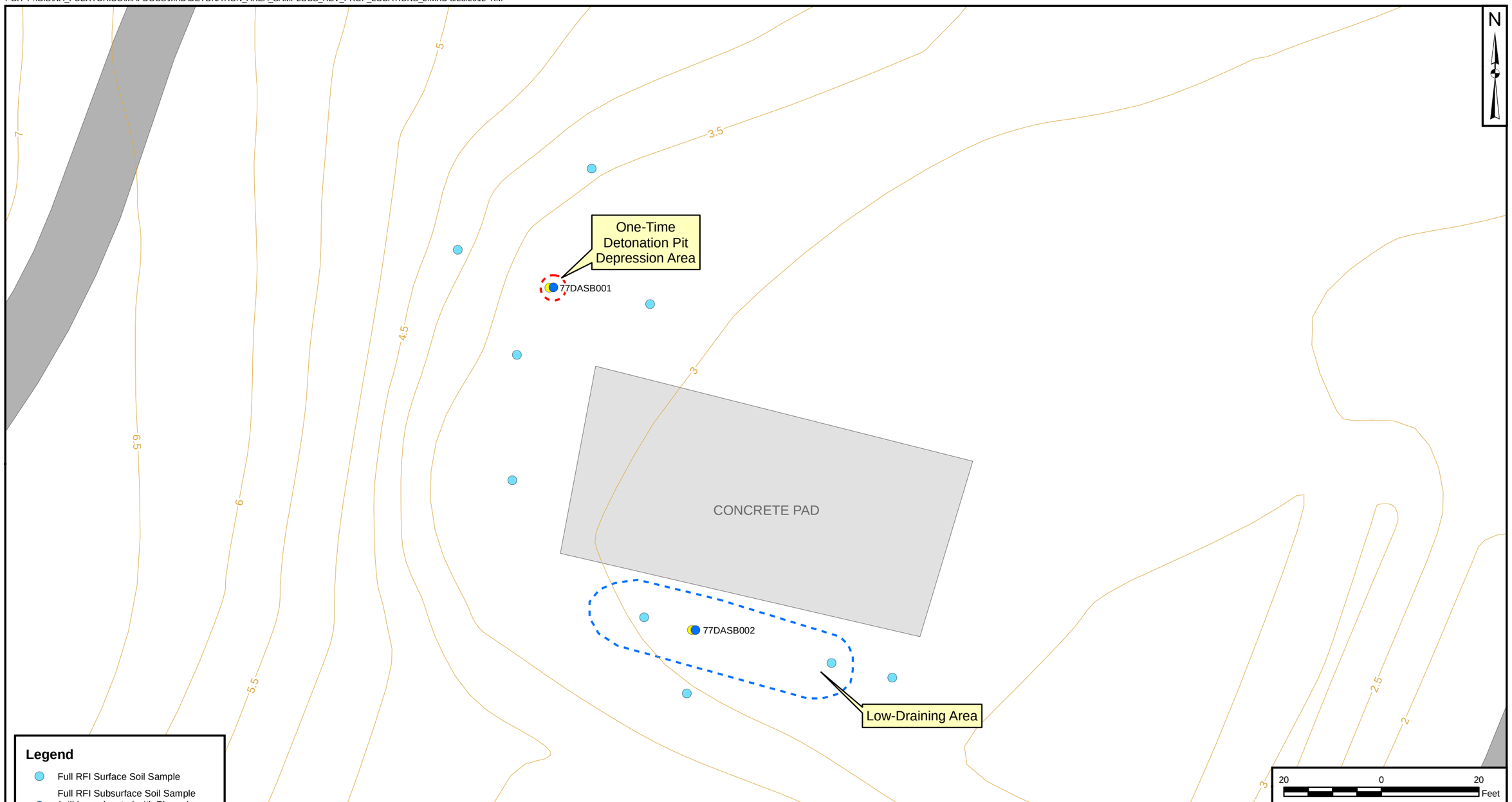
PROPOSED SOIL SAMPLE LOCATIONS
SWMU 77
FORMER PISTOL RANGE SUBAREA
NAVAL ACTIVITY PUERTO RICO
CEIBA, PUERTO RICO

CONTRACT NUMBER	CTO NUMBER
2226	JM04
APPROVED BY	DATE
—	—
APPROVED BY	DATE
—	—
FIGURE NO. FIGURE 17-2	REV 1

PGH P:\GIS\NA_PUERTORICO\MAPDOCS\MXD\DETONATION_AREA_SAMPLOCS_REV_PROP_LOCATIONS_2.MXD 8/28/2012 KM



Legend

- Full RFI Surface Soil Sample
- Full RFI Subsurface Soil Sample (will be co-located with Phase I RFI sample location)
- Soil Sampling Location - Phase I RFI
- Road
- Concrete Pad
- Topographic Contour (0.5 m interval)

DRAWN BY	DATE
J. ENGLISH	08/29/10
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L. KLINK	08/28/12
REVISED BY	DATE
K. MOORE	08/28/12
SCALE	
AS NOTED	

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PROPOSED SOIL SAMPLE LOCATIONS
SWMU 77 DETONATION AREA NEAR
CONCRETE PAD SUBAREA
NAVAL ACTIVITY PUERTO RICO
CEIBA, PUERTO RICO

CONTRACT NUMBER	CTO NUMBER
—	—
APPROVED BY	DATE
—	—
APPROVED BY	DATE
—	—
FIGURE NO. FIGURE 17-3	REV 1

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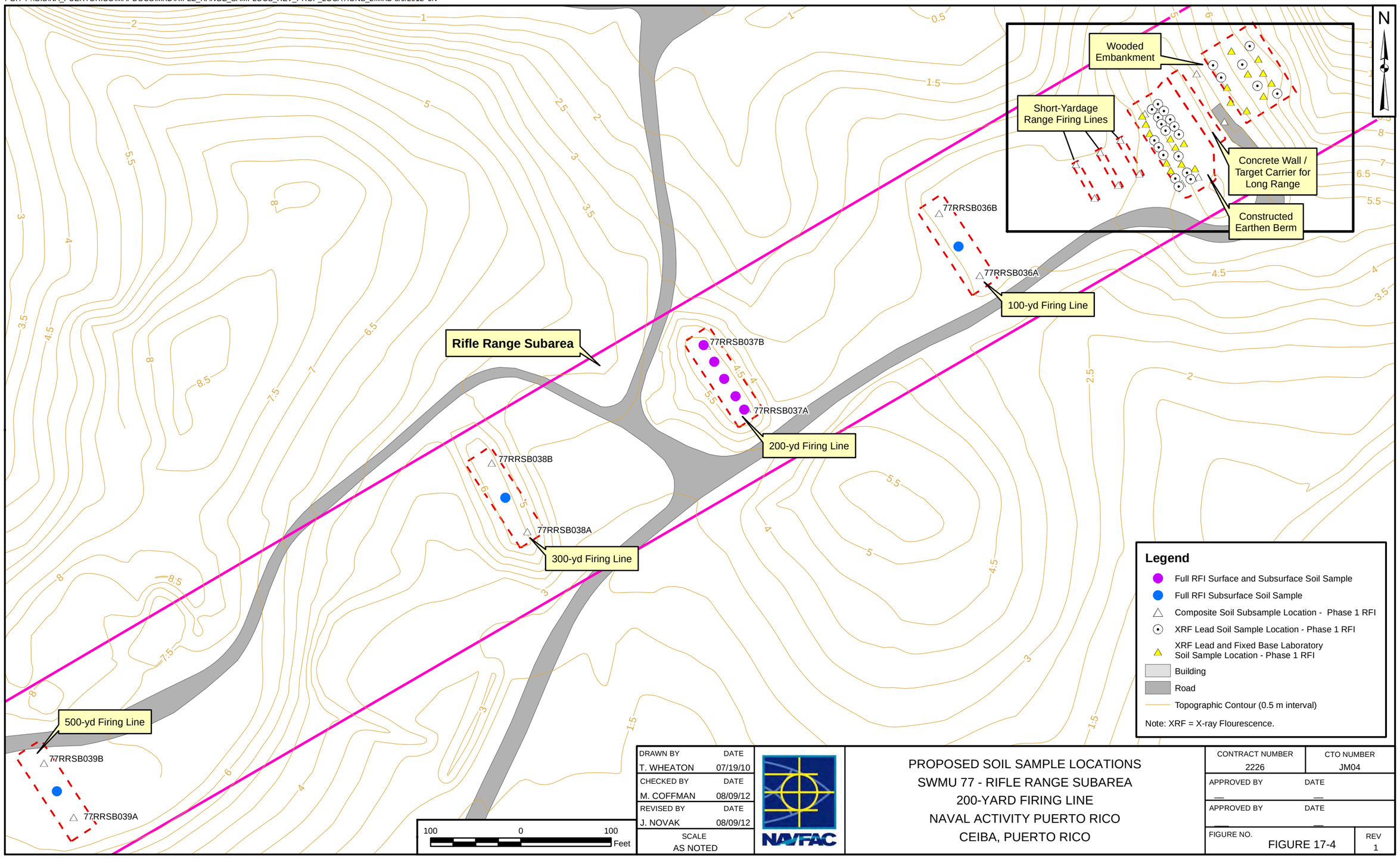

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M. COFFMAN	08/09/12
REVISED BY	DATE
J. NOVAK	08/09/12
SCALE	
AS NOTED	

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PROPOSED SOIL SAMPLE LOCATIONS
SWMU 77 - RIFLE RANGE SUBAREA
200-YARD FIRING LINE
NAVAL ACTIVITY PUERTO RICO
CEIBA, PUERTO RICO

CONTRACT NUMBER	CTO NUMBER
2226	JM04
APPROVED BY	DATE
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APPROVED BY	DATE
—	—
FIGURE NO.	REV
FIGURE 17-4	1

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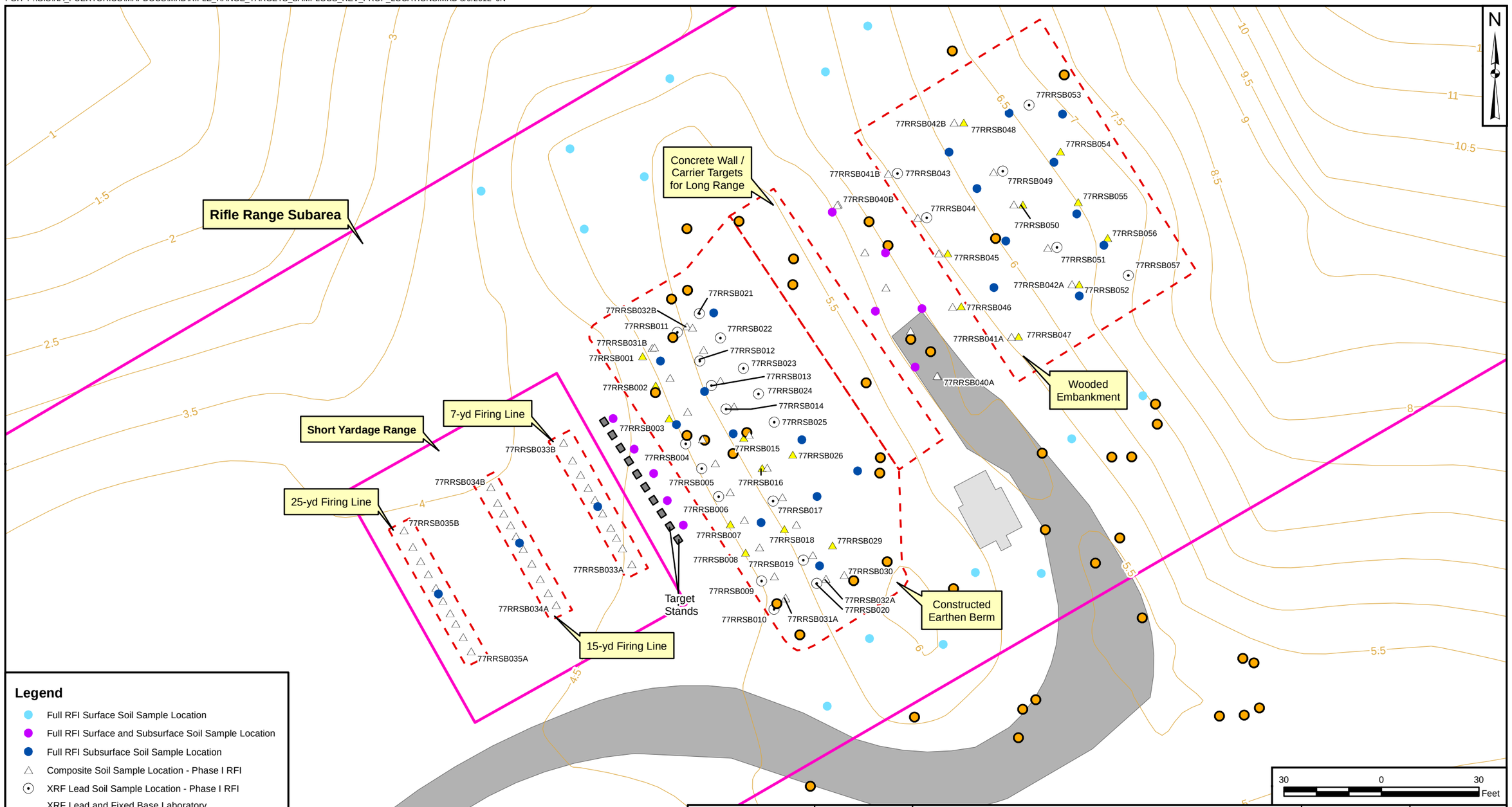

Legend

- Full RFI Surface Soil Sample Location
- Full RFI Surface and Subsurface Soil Sample Location
- Full RFI Subsurface Soil Sample Location
- Composite Soil Sample Location - Phase I RFI
- XRF Lead Soil Sample Location - Phase I RFI
- XRF Lead and Fixed Base Laboratory Soil Sample Location - Phase I RFI
- Subsurface Anomaly - Phase I RFI
- Building
- Road
- Topographic Contour (0.5 m interval)

Note: XRF = X-ray Flourescence.

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M. COFFMAN	08/09/12
REVISED BY	DATE
J. NOVAK	08/09/12
SCALE	
AS NOTED	

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PROPOSED SOIL SAMPLE LOCATIONS
SWMU 77 - RIFLE RANGE SUBAREA
ENLARGEMENT OF WOODED
EMBANKMENT TARGET AREA
NAVAL ACTIVITY PUERTO RICO
CEIBA, PUERTO RICO

CONTRACT NUMBER	CTO NUMBER
2226	JM04
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FIGURE NO.	REV
FIGURE 17-5	1

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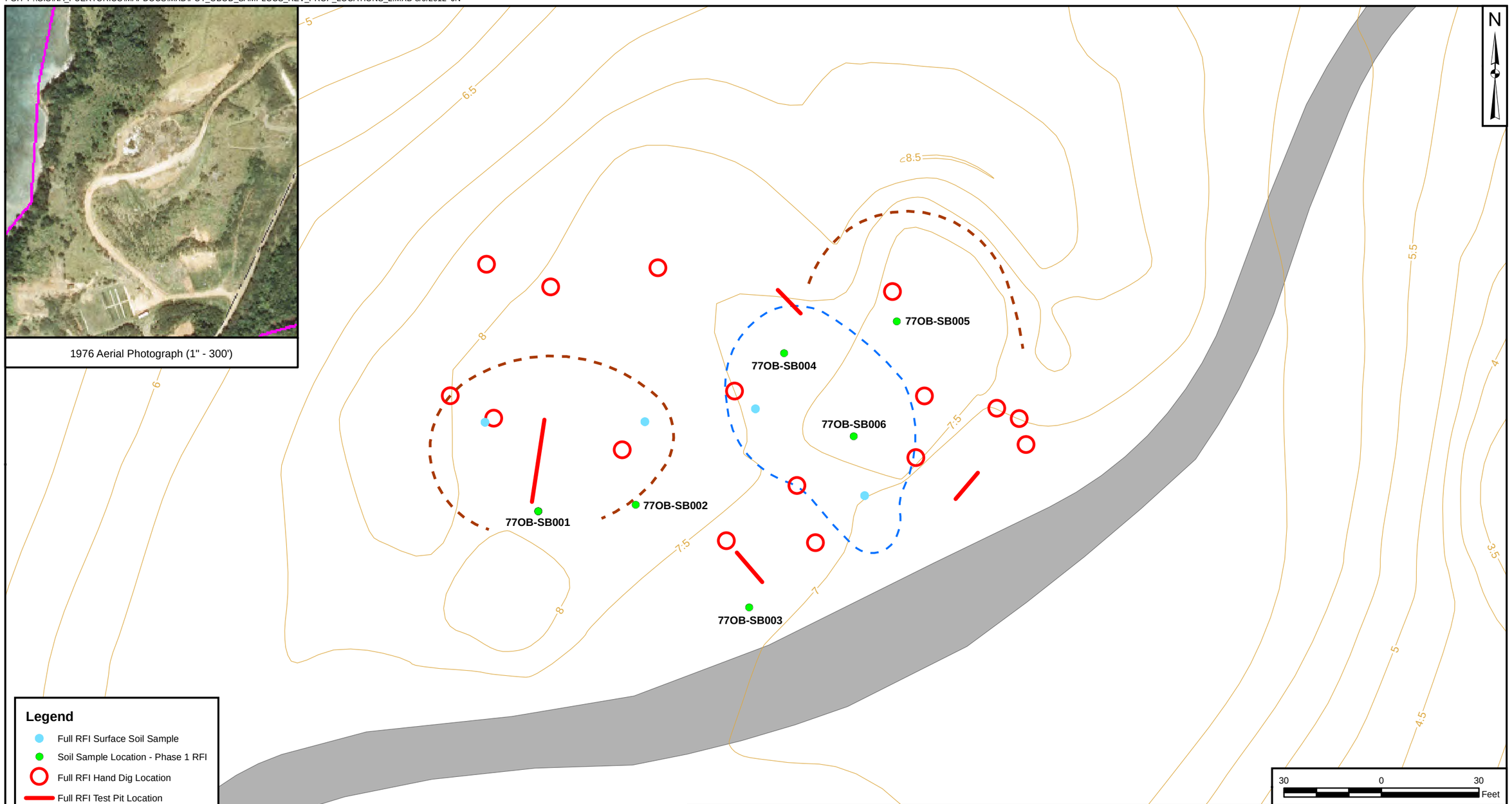
1976 Aerial Photograph (1" - 300')



Legend

- Full RFI Surface Soil Sample
- Soil Sample Location - Phase 1 RFI
- Full RFI Hand Dig Location
- Full RFI Test Pit Location
- Suspected Potential OB/OD Subarea Historic Berm
- Surface Depression Area with Standing Water
- Dirt Road
- Topographic Contour (0.5 m interval)

Notes:
1) If evidence of landfilling during intrusive investigations, also analyze for VOCs, SVOCs, pesticides, herbicides, PCBs, metals, and propellants.
2) Up to 10 subsurface soil samples will be collected at locations to be determined based on results of MEC intrusive investigations.

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SCALE	
AS NOTED	

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PROPOSED SOIL SAMPLE LOCATIONS
SWMU 77 - POTENTIAL OB/OD SUBAREA
NAVAL ACTIVITY PUERTO RICO
CEIBA, PUERTO RICO

CONTRACT NUMBER	CTO NUMBER
APPROVED BY	DATE
APPROVED BY	DATE
FIGURE NO. FIGURE 17-6	REV 1

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1958 Aerial Photograph (1" = 200')

N

77MTSB002

77MTSB003

77MTSB001

Scraped or Trenched Area

Suspected Scraped Area

Legend

- Full RFI Surface Soil Sample
- Full RFI Test Pit Location
- Sampling Locations - Phase 1 RFI
- Subsurface Anomaly Trend Line from Phase 1 RFI EM31 In Phase Response
- Approximate Transect from Phase 1 RFI
- Approximate Location of Potential Munitions Trenches
- Road
- Topographic Contour (0.5 m interval)

Notes:
1) If evidence of landfilling during intrusive investigations, also analyze for VOCs, SVOCs, pesticides, herbicides, PCBs, metals, and propellants.
2) Up to 12 subsurface soil samples will be collected at locations to be determined based on results of MEC intrusive investigations.

50 0 50 Feet

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T. WHEATON	07/19/10
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M. COFFMAN	08/09/12
REVISED BY	DATE
J. NOVAK	08/09/12
SCALE	
AS NOTED	

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PROPOSED SOIL SAMPLE LOCATIONS
SWMU 77
POTENTIAL MUNITIONS TRENCH SUBAREA
NAVAL ACTIVITY PUERTO RICO
CEIBA, PUERTO RICO

CONTRACT NUMBER	CTO NUMBER
2226	JM04
APPROVED BY	DATE
—	—
APPROVED BY	DATE
—	—
FIGURE NO.	REV
FIGURE 17-7	1

APPENDIX A

UFP-SAP FOR MEC

(FOUND IN VOLUME II)

FULL RCRA FACILITY INVESTIGATION SAMPLING AND ANALYSIS PLAN

(Field Sampling Plan and Quality Assurance Project Plan)

for

SWMU 77 – SMALL ARMS RANGE

Naval Activity Puerto Rico
Ceiba, Puerto Rico

Naval Facilities Engineering Command Southeast

Contract Number N62470-08-D-1001
Contract Task Order JM04

August 2012

Volume 2 of 2
Appendix A

SAP Worksheet #1 -- Title and Approval Page

FULL RCRA FACILITY INVESTIGATION
MUNITIONS AND EXPLOSIVES OF CONCERN
SAMPLING AND ANALYSIS PLAN
APPENDIX A, VOLUME 2

(Field Sampling Plan and Quality Assurance Project Plan)
August 2012

SWMU 77-Small Arms Range
Naval Activity Puerto Rico, Ceiba, Puerto Rico

Prepared for:
Naval Facilities Engineering Command Southeast
2155 Eagle Drive
North Charleston, South Carolina 29406

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Phone: 610-491-9688

Prepared under:
Contract Number N62470-08-D-1001
Contract Task Order JM04

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Tom Johnston
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T.E. Johnston Date: 8-28-12

Approval Signatures:

Mike Green
MRP Senior Technical Advisor
NAVFAC Atlantic

___See Attached_____Date:_____

Stacin Martin
Navy Remedial Project Manager
NAVFAC Atlantic

_____Date: 8/27/12

SAP Worksheet #1 -- Title and Approval Page

DRAFT
FULL RCRA FACILITY INVESTIGATION
MUNITIONS AND EXPLOSIVES OF CONCERN
SAMPLING AND ANALYSIS PLAN
APPENDIX A, VOLUME 2

(Field Sampling Plan and Quality Assurance Project Plan)
November 2011

SWMU 77-Small Arms Range
Naval Activity Puerto Rico, Ceiba, Puerto Rico

Prepared for:
Naval Facilities Engineering Command Southeast
2155 Eagle Drive
North Charleston, South Carolina 29406

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Prepared under:
Contract Number N62470-08-D-1001
Contract Task Order JM04

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Linda Klink Date: 11/18/11

Tom Johnston
Quality Assurance Manager
Tetra Tech NUS, Inc.

T.E. Johnston Date: 11-18-11

Approval Signatures:

Mike Green
MRP Senior Technical Advisor
NAVFAC Atlantic

GREEN.MICHAEL.DAVID.1042977876 Digitally signed by GREEN.MICHAEL.DAVID.1042977876 DN: c=US, o=U.S. Government, ou=DoD, ou=PKI, ou=USN, cn=GREEN.MICHAEL.DAVID.1042977876 Date: 2011.11.18 10:03:42 -05'00' Date:

Stacin Martin
Navy Remedial Project Manager
NAVFAC Atlantic

_____ Date: _____

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10-4 MEC Exposure Pathway Analysis - Rifle Range Subarea
10-5 Conceptual Site Model - Potential OB/OD Subarea
10-6 MEC Exposure Pathway Analysis - Potential OB/OD Subarea
10-7 Conceptual Site Model - Potential Munitions Trench Subarea
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11-1 Study Goal and Decision Rule Flow Chart

17-1 Proposed MEC Investigation for Bermed Areas – Rifle Range Subarea
17-2 Proposed MEC Investigation Area – Potential OB/OD Subarea
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17-4 Proposed MEC Investigation Area – Potential Munitions Trench Subarea (EM61 overlay)
17-5 IVS Survey Location

ATTACHMENTS

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- 1-1 Supplemental Historical Information
  - 1-1.1 – Site Environmental Setting
  - 1-1.2 – Range Records
  - 1-1.3 – Termination of Use Letter
  - 1-1.4 – Phase I RFI EOD Response
- 1-2 Historical Aerial Photographs
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  - 1-2.2 – Potential OB/OD Subarea Site Development
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- 1-3 Site Walk and Phase I RFI Photograph Logs
- 1-4 Phase I RFI Detector-Aided and Geophysical Survey Results Figures

Attachment 2: MRP Field Standard Operating Procedures and Field Forms

ACRONYMS

AFWTF	Atlantic Fleet Weapons Training Facility
APP	Accident Prevention Plan
ARAR	Applicable or Relevant and Appropriate Requirement
ATF	Bureau of Alcohol, Tobacco, Firearms, and Explosives
bgs	below ground surface
BIP	blow-in-place
BRAC	Base Realignment and Closure
CD	compact disk
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CLEAN	Comprehensive Long-Term Environmental Action Navy
CMS	Corrective Measures Study
CSM	Conceptual Site Model
CTO	Contract Task Order
CWM	chemical warfare materiel
CY	cubic yard
DDESB	Department of Defense Explosives Safety Board
DERP	Defense Environmental Restoration Program
DGM	Digital Geophysical Mapping
DID	Data Item Description
DNER	Department of Natural and Environmental Resources
DoD	Department of Defense
DQO	data quality objective
DRMO	Defense Reutilization Marketing Office
EM	Engineer Manual
EM CX	Environmental and Munitions Center of Expertise
EOD	Explosive Ordnance Disposal
ERP	Environmental Restoration Program
ESQD	Explosives Safety Quantity-Distance
ESS	Explosives Safety Submission
ESTCP	Environmental Security Technology Certification Program
EZ	exclusion zone
FCR	Field Change Request

GIS	Geographic Information System
GPS	Global Positioning System
GSV	Geophysical System Verification
HA	Hazard Assessment
HASP	Health and Safety Plan
HFD	Hazardous Fragmentation Distance
HSM	Health and Safety Manager
HDOP	Horizontal Dilution of Precision
HTRW	hazardous, toxic, or radiological waste
IHC	Interim Hazard Classification
ISO	Industry Standard Object
IVS	Instrument Verification Strip
lb	pound
LLRW	Low-Level Radioactive Waste
MC	Munitions Constituents
MDAS	Material Documented as Safe
MDEH	Material Documented as an Explosive Hazard
MEC	Munitions and Explosives of Concern
MFD	Maximum Fragment Distance
MGFD	Munition with the Greatest Fragmentation Distance
mg/kg	milligram per kilogram
mm	millimeter
MPPEH	Material Potentially Presenting an Explosive Hazard
MRP	Munitions Response Program
MSD	Minimum Separation Distance
mV	Millivolt
NA	not applicable
NAD	North American Datum
NAPR	Naval Activity Puerto Rico
NAVFAC	Naval Facilities Engineering Command
NAVSEA	Naval Sea System Command
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NEW	net explosive weight
NFA	no further action
NG	nitroglycerin
NIRIS	Naval Installation Restoration Information System

NOSSA	Naval Ordnance Safety and Security Activity
NRHP	National Register of Historic Places
NSRR	Naval Station Roosevelt Roads
OB/OD	Open Burn/Open Detonation
OIC	Officer in Charge
OP	Operations Pamphlet
OPNAVINST	Chief of Naval Operations Instruction
OSHA	Occupational Safety and Health Administration
PAL	project action limit
PM	Project Manager
PMO	Program Management Office
POC	point of contact
ppt	part per thousand
PQO	Project Quality Objective
PREQB	Puerto Rico Environmental Quality Board
QA	quality assurance
QAM	Quality Assurance Manager
QAPP	Quality Assurance Project Plan
QC	quality control
QRP	Qualified Recycling Program
RAGS	Risk Assessment Guidance for Superfund
RCRA	Resource Conservation and Recovery Act
RDX	cyclotrimethylenenitramine
RFI	RCRA Facility Investigation
RPM	Remedial Project Manager
SAP	Sampling and Analysis Plan
SCG	Storage Compatibility Group
SE	Southeast
SHPO	State Historic Preservation Office
SMCA	Singel Manager for Conventional Ammunition
SOP	Standard Operating Procedure
SSL	Soil Screening Level
SSO	Site Safety Officer
SUXOS	Senior UXO Supervisor
SWMU	Solid Waste Management Unit
TBD	to be determined

TDS	total dissolved solids
TP	Technical Paper
Tetra Tech	Tetra Tech, Inc.
UFP	Uniform Federal Policy
USACE	United States Army Corps of Engineers
USEPA	United States Environmental Protection Agency
USFWS	United States Fish and Wildlife Services
UXO	unexploded ordnance
UXOQCS	UXO Quality Control Specialist
UXOSO	UXO Safety Officer

EXECUTIVE SUMMARY

Tetra Tech, Inc. (Tetra Tech) has been retained by the United States Department of Navy, Naval Facilities Engineering Command (NAVFAC) Atlantic, to perform a Full Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI) at Naval Activity Puerto Rico (NAPR), Ceiba, Puerto Rico. The work is being conducted for Contract Task Order (CTO) JM04 under the Comprehensive Long-term Environmental Action Navy (CLEAN) Contract No. N62470-08-D-1001.

This document is Volume 2 of the Uniform Federal Policy (UFP) Sampling and Analysis Plan (SAP), which was prepared in accordance with the UFP for Quality Assurance Project Plans (UFP-QAPP) (USEPA, 2005) and United States Environmental Protection Agency (USEPA) Guidance for QAPPs (USEPA, 2002). Volume 1 of the UFP-SAP describes the work to be performed to investigate potential Munitions Constituents (MC) and Volume 2 describes the work to be performed to investigate potential Munitions and Explosives of Concern (MEC) in surface and subsurface soil (as applicable) at Solid Waste Management Unit (SMWU) 77. The worksheets presented in Volume II have been modified to accommodate the unique requirements of geophysical and intrusive investigations because the UFP-SAP worksheets were not originally designed for MEC investigations.

SWMU 77 is located on the Punta Medio Mundo on the northeastern boundary of NAPR, Ceiba, Puerto Rico. SWMU 77 contains six munitions subareas: Rifle Range Subarea, Potential Open Burn/Open Detonation (OB/OD) Subarea, Potential Munitions Trench Subarea, Detonation Area Near Concrete Pad Subarea, the Pistol Range Subarea, and Former Pistol Range Subarea. MEC will be investigated at three of these subareas, the Rifle Range Subarea, Potential OB/OD Subarea, and Potential Munitions Trench Subarea, as described briefly below.

The Rifle Range Subarea is a 500-yard narrow feature centrally located in the middle of SWMU 77 and orientated such that shots were fired toward the outer point of the peninsula. Construction of the range occurred sometime between 1940 and 1958. The range has 100-yard, 200-yard, 300-yard, and 500-yard elevated firing lines and a short-yardage range formerly used as a pistol range. The short-yardage range is located in front of a fixed target area. The target berm consists of a constructed earthen berm that served the short-yardage range, a concrete wall at the rear of the earthen berm equipped with a target carrier mechanism to raise and lower targets, and a natural steep wooded embankment beyond the earthen berm/concrete wall that served as the backstop for these elevated targets.

MEC/Material Potentially Presenting an Explosive Hazard (MPPEH) items were observed on the constructed earthen berm and grassy strip at the toe of the wooded embankment during site walks in support of Phase I RFI SAP planning. These items were removed when SWMU 77 was closed in January 2010, and no known MPPEH items remain on the ground surface in these areas. For the wooded embankment, eight munitions items were encountered during the meandering path analog detector-aided survey conducted during the Phase I RFI; one of the items, a CS M651 grenade, was classified as MEC. Those MEC/MPPEH items warranting detonation were turned over to Mayport Explosives Ordnance Disposal (EOD) detachment on August 19, 2010. The detector-aided survey of the wooded embankment included meandering pathways through thickly vegetated areas. The survey did not provide 100-percent coverage; therefore, there is a high probability that stray MEC/MPPEH items are still present in this area. More than 50 random subsurface anomalies were indicated during the Phase I RFI detector-aided survey of the earthen constructed berm area and wooded embankment. Although MEC/MPPEH items were not expected in the subsurface based on the conceptual site model (CSM), it is possible that the subsurface anomalies could be MEC/MPPEH based on the history of MEC/MPPEH in and around the area. (Tetra Tech, 2011, Phase results are presented in Attachment 1-4 of Volume II)

The Potential OB/OD Subarea is on the northern side of the unpaved road in the northwestern portion of the peninsula. Based on historical aerial photographs, operation of this subarea occurred possibly as early as 1961 and ended sometime prior to 1985. The subarea is level and grassy, with a small depression present in the middle of the grassy area. No evidence of OB/OD operations was apparent during June and August 2009 site visits or from historical records, other than the suspicious historical aerial photographs. The terrain inclines steeply beyond the level area, with scrubby brush and trees present on the hillside north of the subarea.

Nor were MEC/MPPEH items discovered on the ground surface during the Phase I RFI of the OB/OD Subarea. Subsurface anomalies were indicated during the analog detector-aided survey; the locations generally matched that of the electromagnetic geophysical surveys subsequently conducted. Electromagnetic geophysical data indicated numerous anomalies throughout the area. The source of anomalies is unknown and may be munitions related, non-munitions debris, or simply outcrops of volcanic bedrock present at SWMU 77. Weathered bedrock was exposed at the land surface, particularly at steep embankments. Additionally, bedrock was encountered at shallow depths during soil sampling. Although a limited subsurface investigation was conducted, bedrock was encountered consistently at shallow locations throughout the subarea; therefore, it is believed that if subsurface disposal occurred, it would have taken place in the shallow rather than deep subsurface. Surface OB/OD operations may have also occurred at this site, although not supported by the findings of the Phase I RFI. (Tetra Tech, 2011, results are presented in Attachment 1-4 of Volume II)

The Potential Munitions Trench Subarea is located between the 200-yard and 100-yard firing lines of the Rifle Range, and south of the existing unpaved road. Based on historical aerial photographs, operation of the Potential Munitions Trench Subarea occurred sometime prior to 1958 (possibly as early as 1940) until October 1961. No evidence of munitions operations was apparent during June and August 2009 site visits or from historical records, other than the suspicious historical aerial photographs. The area is heavily wooded except over the suspect potential trenches, which are covered with overgrown grasses.

Nor were surface MEC/MPPEH items discovered during the Phase I RFI of the Potential Munitions Trench Subarea. More than 70 subsurface anomalies were indicated during the detector-aided survey. The general locations matched that of the electromagnetic geophysical surveys subsequently conducted over the main suspect trench area in the eastern portion of the subarea. Geophysical survey data were collected for the EM-61 inphase response, EM-31 quadrature response, and EM-31 inphase response. For the northeastern side of the subarea, lines of anomalies were identified trending northwest to southeast, the same direction as the orientations of the suspect trenches shown on historical aerial photographs. For the western portion of the subarea, no subsurface anomalies were encountered during the detector-aided survey, and the area was too thickly wooded to conduct a geophysical survey. The source of the anomalies detected in the eastern portion of the subarea is unknown and cannot be determined from the geophysical survey alone. Moreover, anomalies are not necessarily indicative of buried metal but instead could be reflective of outcrops of naturally occurring volcanic bedrock present at SWMU 77. Weathered bedrock was exposed at the Potential Munitions Trench Subarea land surface, particularly at steep embankments, and moreover, bedrock refusal was encountered at shallow depths during soil boring. A limited subsurface investigation was conducted; however, it is unlikely that subsurface disposal would have been conducted if bedrock is encountered consistently at shallow locations throughout the subarea. (Tetra Tech, 2011, results are presented in and Attachment 1-4 of Volume II)

Table ES-1 summarizes the scope of the MEC UFP-SAP prepared for NAPR SWMU 77 Full RFI, which largely focuses on subsurface intrusive investigation of anomalies identified during the Phase I RFI, and supporting detector-aided surface surveys and geophysics, as necessary. If MEC/MPPEH is encountered, it will be properly addressed.

Table ES-1
Full RFI MEC Investigation Scope Summary (1)

Subarea	MEC Investigation		
	Detector-Aided Surface Survey	Digital Geophysics Survey of Subsurface	Intrusive Investigation
			Subsurface
Rifle Range	✓	--	✓
Potential OB/OD	✓	✓	✓
Potential Munitions Trench	✓	✓	✓

✓ = Planned

-- = Not Planned

1 Full RFI MC investigation scope summary is provided in Volume 1, MC UFP-SAP.

SAP Worksheet #2 -- SAP Identifying Information

(UFP-QAPP Manual Section 2.2.4)

Site Name/Number: Naval Activity Puerto Rico (NAPR) Solid Waste Management Unit (SWMU) 77
- Pistol Range Subarea*
- Former Pistol Range Subarea*
- Detonation Area Near Concrete Pad Subarea*
- Rifle Range Subarea
- Potential Open Burn/Open Detonation (OB/OD) Subarea
- Potential Munitions Trench Subarea

* No munitions and explosives of concern (MEC) investigation components

Operable Unit: Not applicable (NA)
Contractor Name: Tetra Tech, Inc. (Tetra Tech)
Contract Number: No. N62470-08-D-1001
Contract Title: Comprehensive Long-Term Environmental Action Navy (CLEAN)
Contract Task Order (CTO): JM04

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

2. Identify regulatory program: Department of Defense (DoD) Munitions Response Program (MRP), Resource Conservation and Recovery Act (RCRA) as per the January 29, 2007, Consent Order for NAPR and consistent with the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) and the processes established by the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980

3. This SAP is a project-specific SAP.

4. List dates of scoping sessions that were held:

Scoping Session	Date
Initial technical discussion meeting, scoping and data quality objective (DQO) development planning meeting with regulatory agencies, Navy, and Tetra Tech	September 2011

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

Title	Date
Phase 1 RCRA Facility Investigation, Sampling and Analysis Plan (Field Sampling Plan and Quality Assurance Project Plan) for SWMU 77 – Small Arms Range	March 2010

6. List organizational partners (stakeholders) and connection with lead organization: United States Environmental Protection Agency (USEPA) Region 2 – regulatory stakeholder overseeing RCRA Ceiba Environmental Restoration Program (ERP) implemented by lead organization
Puerto Rico Environmental Quality Board (PREQB) – regulatory stakeholder overseeing RCRA Ceiba ERP implemented by lead organization

7. Lead organization (see Worksheet #7 for detailed list of data users)
Naval Facilities Engineering Command (NAVFAC)

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

UFP-QAPP Worksheet #	Required Information	Crosswalk to Related Information
A. Project Management		
Documentation		
1	Title and Approval Page	NA
2	SAP Identifying Information	NA
3	Distribution List	NA
4	Project Personnel Sign-Off Sheet	NA
Project Organization		
5	Project Organizational Chart	NA
6	Communication Pathways	NA
7	Personnel Responsibilities and Qualifications Table	NA
8	Special Personnel Training Requirements Table	NA
Project Planning/Problem Definition		
9	Project Scoping Session Participants Sheet	NA
10	Problem Definition, Site History, and Background	NA
11	Project Quality Objectives/Systematic Planning Process Statements	NA
12	Measurement Performance Criteria Table	NA
13	Secondary Data Criteria and Limitations Table	NA
14	Summary of Project Tasks	NA
15	Reference Limits and Evaluation Table	Not used – no samples are proposed for collection/analysis during the MEC survey/investigation.
16	Project Schedule/Timeline Table	NA
B. Measurement Data Acquisition		
Sampling Tasks		
17	Project Design and Rationale	NA
18	Sampling Locations and Methods/Standard Operating Procedure (SOP) Requirements Table	Not used – no samples proposed for collection/analysis during MEC survey/ investigation
19	Analytical Methods/SOP Requirements Table	Not used – no samples are proposed for collection/analysis during the MEC survey/investigation.
20	Field Quality Control (QC) Sample Summary Table	NA

UFP-QAPP Worksheet #	Required Information	Crosswalk to Related Information
21	Project SOP References Table	NA
22	Field Equipment Calibration, Maintenance, Testing, and Inspection Table	NA
Analytical Tasks		
23	Analytical SOP References Table	Not used – no samples are proposed for collection/analysis during the MEC survey/investigation.
24	Analytical Instrument Calibration Table	Not used – no analytical instrument calibration data will be required to support MEC surveys/investigations.
25	Analytical Instrument and Equipment Maintenance, Testing, and Inspection Table	Not used – no analytical instrument equipment maintenance, testing, or inspections will be required to support MEC surveys/investigations.
Sample Collection		
26	Sample Handling System	NA
27	Sample Custody Requirements Table	Not used – no samples are proposed for collection/analysis during the MEC survey/investigation.
Quality Control Samples		
28	Laboratory QC Samples Table	Not used – no analytical laboratory QC sampling will be required to support MEC surveys/investigations.
Data Management Tasks		
29	Project Documents and Records Table	NA
30	Analytical Services Table	Not used – no analytical services will be required to support MEC surveys/investigations.
C. Assessment Oversight		
31	Planned Project Assessments Table	NA
32	Assessment Findings and Corrective Action Responses Table	NA
33	Quality Assurance (QA) Management Reports Table	NA

UFP-QAPP Worksheet #	Required Information	Crosswalk to Related Information
D. Data Review		
34	Verification (Step I) Process Table	NA
35	Validation (Steps IIa and IIb) Process Table	NA
36	Analytical Data Validation (Steps IIa and IIb) Summary Table	NA
37	Data Usability Assessment	NA

SAP Worksheet #3 -- Distribution List

(UFP-QAPP Manual Section 2.3.1

Name of SAP Recipient	Title/Role	Organization	Telephone Number	E-Mail Address or Mailing Address	Document Control Number
Stacin Martin (one shared with David Criswell)	Navy Remedial Project Manager (RPM)/Manages project activities for Navy	NAVFAC Atlantic	757.322.4780	stacin.martin@navy.mil	NA
David Criswell (one shared with Stacin Martin)	Navy Base Realignment and Closure (BRAC) Environmental Coordinator/Coordinates environmental projects for the Navy	BRAC Program Management Office (PMO) SE	843.743.2130	david.criswell@navy.mil	NA
Debbie Sanders (cover letters only)	NAVFAC SE/ BRAC PMO SE/ Supervised project activities for Navy	NAVFAC SE/ BRAC PMO SE	843.743.2145	debbie.sanders@navy.mil	NA
Mike Green (electronic upload)	NAVFAC MRP Senior Technical Advisor/Reviews UFP-SAP and QA documentation for Navy	NAVFAC Atlantic	757.322.8108	mike.green@navy.mil	NA
Commander Dan Kalal	NAPR Officer in Charge (OIC)/Manages site activities	NAPR	787.685.3450	kalald@napr.navy.mil	NA

Name of SAP Recipient	Title/Role	Organization	Telephone Number	E-Mail Address or Mailing Address	Document Control Number
Pedro Ruiz	NAPR Facility Contact/ Facility Point of Contact (POC)	NAPR/NAVFAC Atlantic	757.286.9139	Naval Activity Puerto Rico Building 2439 Ceiba, Puerto Rico 00735	NA
Bonnie Capito (final cover letter only)	Administrative Record Librarian/Manages Navy project records	NAVFAC Atlantic	757.322.4785	bonnie.capito@navy.mil	NA
J.Mentz [Compact Disk (CD) only]	Consultant Activity Manager/Maintains Administrative Records	Michael Baker	412-269-2000	jmentz@mbakercorp.com	
Phil Flax	USEPA Region 2 of the Resource Conservation and Special Projects Section/Manages Region 2 Programs	USEPA Region 2	212.637.1469	flax.phil@epa.gov	NA
Doug Pocze	USEPA Region 2 RPM/Provides USEPA regulatory input	USEPA Region 2	212.637.4432	pocze.doug@epa.gov	NA
Jose Font (CD only)	USEPA Caribbean Office Director/Director for USEPA Caribbean Office	USEPA Region 2 Caribbean Office	787.977.5870	NA	NA
Wilmarie Rivera	PREQB RPM/Provides Puerto Rico regulatory input	PREQB	787.767.8181 x6129	wilmarierivera@jca.pr.gov	NA

Name of SAP Recipient	Title/Role	Organization	Telephone Number	E-Mail Address or Mailing Address	Document Control Number
Gloria Toro-Agrait	PREQB Environmental Permits Officer/Provides Puerto Rico regulatory input	PREQB	787.767.8181 x3586	gloriatoro@jca.pr.gov	NA
Felix Lopez	United States Fish and Wildlife Service (USFWS)/Provides ecological project assistance for Puerto Rico	USFWS	787.851.7297 x226	P.O. Box 491 Road 301 Km 5.1 Boqueron, Puerto Rico 00622	NA
Jim Pastoric (if directed by PREQB, CD only)	PREQB Consultant/Provides unexploded ordnance (UXO) technical expertise to PREQB	UXO PRO	703.548.5300	jim@uxopro.com	NA
Connie Crossley (if directed by USEPA, CD only)	USEPA Consultant/Provides project assistance for USEPA	Booze Allen Hamilton	919.462.9004	1324 Queenssferry Road Cary, North Carolina 27511	NA
Katarina Rutkowski (if directed by PREQB, CD only)	PREQB Consultant/ Provides project assistance for PREQB	TRC Environmental	860.298.9692	21 Griffin Road North Windsor, Connecticut 06095	NA
John Trepanowski (letter only)	Program Manager/Manages the CLEAN Program	Tetra Tech	610.491.9688	john.trepanowski@tetratech.com	NA

Name of SAP Recipient	Title/Role	Organization	Telephone Number	E-Mail Address or Mailing Address	Document Control Number
Linda Klink	Project Manager (PM)/Manages project activities for Tetra Tech	Tetra Tech	412.921.8650	linda.klink@tetratech.com	NA
Ralph Brooks	UXO/MEC Manager/Manages corporate MEC hazards and risks	Tetra Tech	770.413.0965 x231	ralph.brooks@tetratech.com	NA
James Rossi	Project UXO Manager/Manages project MEC hazards and risks	Tetra Tech	770.413.0965 x233	james.rossi@tetratech.com	NA
Tom Johnston	Quality Assurance Manager (QAM)/Reviews SAP and manages QA for Tetra Tech	Tetra Tech	412.921.8615	tom.johnston@tetratech.com	NA
Matt Soltis (Health and Safety Plan [HASP] only)	Tetra Tech Health and Safety Manager (HSM)/Manages Corporate Health and Safety Program	Tetra Tech	412.921.8912	matt.soltis@tetratech.com	NA
Bill Randall	Project Geophysicist/Manages project geophysical surveys	Tetra Tech	412.921.8714	bill.randall@tetratech.com	NA
Jim Coffman	Site Geophysicist/Conducts on-site geophysical surveys	Tetra Tech	412.921.8244	jim.coffman@tetratech.com	NA

Name of SAP Recipient	Title/Role	Organization	Telephone Number	E-Mail Address or Mailing Address	Document Control Number
Glen Wagner	Adminstrative Record Manager/Maintains Adminstrative Record	Tetra Tech	412.920.8603	glen.wagner@tetratech.com	NA
To Be Determined (TBD)	UXO Safety Officer (UXOSO)/ Site Safety Officer (SSO)	Tetra Tech	TBD	TBD	NA
TBD	Senior UXO Supervisor (SUXOS)/UXO Technician III/Manages UXO activities on site	Tetra Tech	TBD	TBD	NA
TBD	UXO Quality Control Specialist (UXOQCS)/Managers project UXO QA/QC	Tetra Tech	TBD	TBD	NA
TBD	UXO Field Crew/Performs UXO field tasks	Tetra Tech	TBD	TBD	NA

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

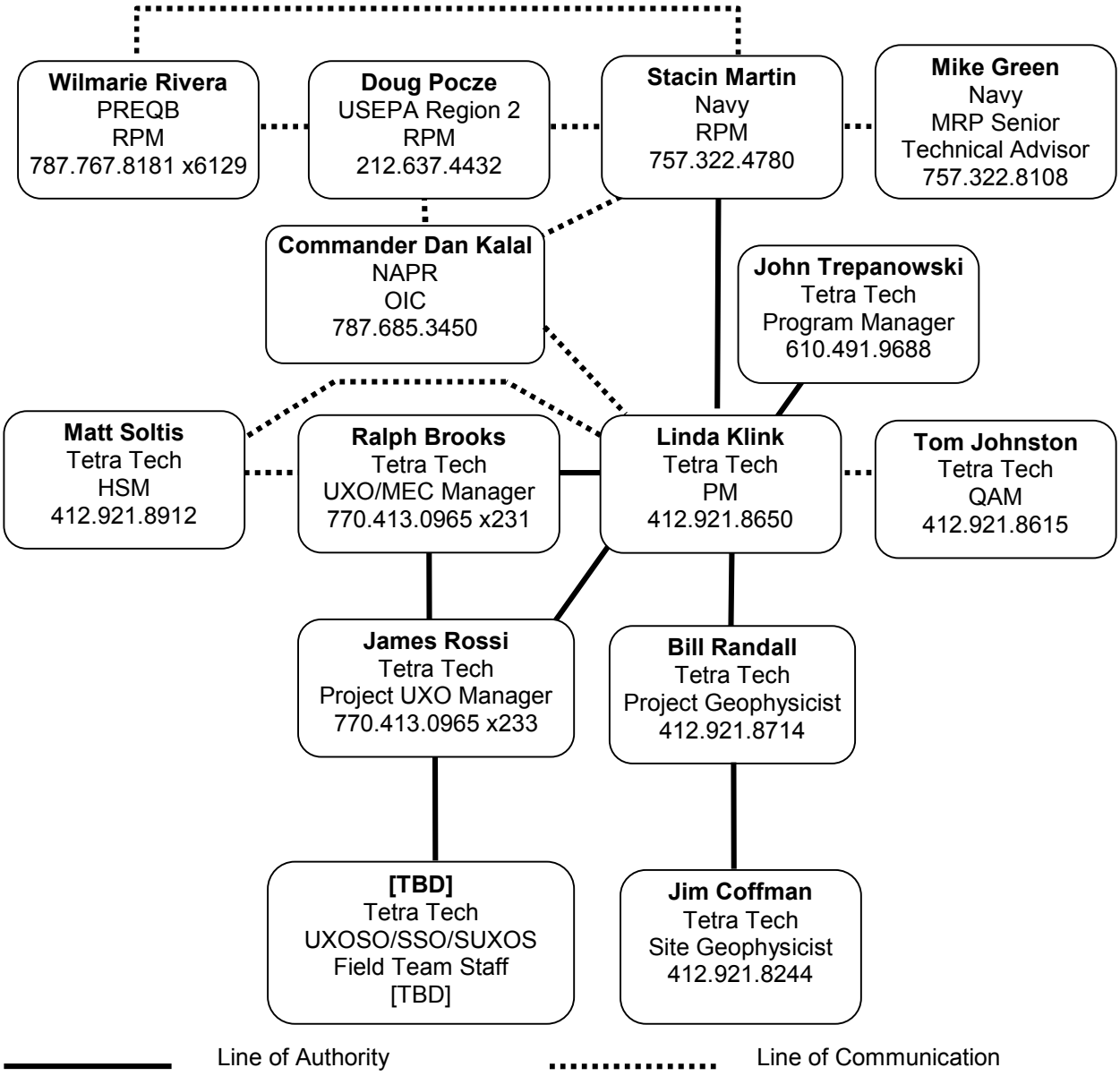
(UFP-QAPP Manual Section 2.3.2)

Name	Organization/Title/Role	Telephone Number	Signature/E-Mail Receipt	SAP Section Reviewed	Date SAP Read
Linda Klink	Tetra Tech PM/Manages project activities for Tetra Tech	412.921.8650	See title page signature	All	NA
Ralph Brooks	Tetra Tech UXO/MEC Manager/Manages corporate MEC hazards and risks	770.413.0965 x231		All except Worksheet #s 12, 14, 15, 19, 20, 23-28, 30, 34-37	
James Rossi	Tetra Tech Project UXO Manager/Manages project MEC hazards and risks	770.413.0965 x233		All except Worksheet #s 12, 14, 15, 19, 20, 23-28, 30, 34-37	
TBD	Tetra Tech SUXOS/Manages UXO activities on site	TBD		All MEC/Geophysicist	
Matt Soltis	Tetra Tech HSM/Manages Corporate Health and Safety Program	412.921.8912	See HASP signature page	HASP	NA
Tom Johnston	Tetra Tech QAM/Reviews SAP and manages QA for Tetra Tech	412.921.8615	See title page signature	Worksheet #s 12, 14, 15, 19, 20, 23-28, 30, 34-37	
Bill Randall	Tetra Tech Project Geophysicist/Manages project geophysical surveys	412.921.8714		All MEC/Geophysics	
Jim Coffman	Tetra Tech Site Geophysicist/Conducts on-site geophysical surveys	412.921.8244		All MEC/Geophysics	
TBD	UXOSO/Site Safety Officer (SSO)/Oversees site Health and Safety	TBD		All	

Name	Organization/Title/Role	Telephone Number	Signature/E-Mail Receipt	SAP Section Reviewed	Date SAP Read
TBD	UXOQCS/Manages Project UXO QA/QC	TBD		All	
TBD	UXO Field Crew/Performs UXO field tasks	TBD		All	

SAP Worksheet #5 -- Project Organizational Chart

(UFP-QAPP Manual Section 2.4.1)



SAP Worksheet # 6 -- Communication Pathways

(UFP-QAPP Manual Section 2.4.2)

Communication Driver	Responsible Affiliation	Name	Phone Number and/or E-Mail	Procedure
MEC find or other reportable find (i.e., hazardous waste source/dangerous item)	Tetra Tech SUXOS Tetra Tech Field Team Tetra Tech Site Geophysicist Tetra Tech Project UXO Manager Tetra Tech UXO/MEC Manager Tetra Tech PM Navy RPM NAPR OIC	TBD TBD Jim Coffman James Rossi Ralph Brooks Linda Klink Stacin Martin Dan Kalal	TBD TBD 412.921.8244 770.413.0965 x233 770.413.0965 x231 412.921.8650 757.322.4780 787.685.3450	Within 30 minutes of an MEC find, Tetra Tech UXO Technicians will notify field staff, secure area, and contact Tetra Tech UXO Manager. Tetra Tech UXO Manager will verbally inform Tetra Tech PM on the same day. Tetra Tech PM will notify Navy RPM and NAPR OIC on the same day. Navy RPM will make notifications as stated in the approved Explosives Safety Submission (ESS). Naval Ordnance Safety and Security Activity (NOSSA) will be informed on the same day as an MEC find if the Explosives Safety Quantity-Distance (ESQD) or net explosive weight (NEW) increases beyond those identified in the approved ESS or if other explosive safety concerns warrant.

Communication Driver	Responsible Affiliation	Name	Phone Number and/or E-Mail	Procedure
Field issues that require significant change in field tasks or scope of field work	Tetra Tech UXO/MEC Manager Tetra Tech Project UXO Manager Tetra Tech Project Geophysicist Tetra Tech Site Geophysicist Tetra Tech PM NAPR OIC Navy RPM USEPA POC PREQB POC	Ralph Brooks James Rossi Bill Randall Jim Coffman Linda Klink Dan Kalal Stacin Martin Doug Pocze Wilmarie Rivera	770.413.0965 x231 770.412.0965 x233 412.921.8714 412.921.8244 412.921.8650 787.685.3450 757.322.4780 212.637.4432 787.767.8181 x6129	The responsible person will inform Tetra Tech PM on the day the issue is discovered. Tetra Tech PM will inform Navy RPM and NAPR OIC within 1 business day. Navy RPM will issue scope change approval (via e-mail or verbally with follow-up e-mail or other documentation) if warranted. Scope change will be implemented and authorized by the Navy before work is executed. Tetra Tech will document via a Field Change Request (FCR) form within 2 days. Tetra Tech PM will inform USEPA POC and PREQB POC within 2 business days.
SAP amendments	Tetra Tech PM Navy RPM	Linda Klink Stacin Martin	412.921.8650 757.322.4780	Tetra Tech PM will notify Navy RPM via e-mail within 1 business day of recognizing a need for change and will also notify the Project Team. If amendment is minor (editorial or minor clarification), only notify Navy RPM and no need for SAP amendment.

Communication Driver	Responsible Affiliation	Name	Phone Number and/or E-Mail	Procedure
Field work schedule changes	Tetra Tech PM NAPR OIC	Linda Klink Dan Kalal	412.921.8650 787.685.3450	The Tetra Tech PM will verbally inform NAPR OIC on the day that schedule change is known and will document change in the monthly report. If report deliverable date is expected to be delayed as a result, Tetra Tech PM will document via schedule impact letter as soon as impact is realized.

Communication Driver	Responsible Affiliation	Name	Phone Number and/or E-Mail	Procedure
Recommendations to stop work and initiate work upon corrective action	Tetra Tech UXO/MEC Manager	Ralph Brooks	770.413.0965 x231	Within 1 hour, the UXO Manager (via e-mail or verbally with follow-up e-mail or other documentation) will inform Tetra Tech PM. Tetra Tech PM will inform (verbally or via e-mail) the listed Project Team members within 2 business days.
	Tetra Tech Project UXO Manager	James Rossi	770.413.0965 x233	
	Tetra Tech Project Geophysicist	Bill Randall	412.921.8714	
	Tetra Tech Site Geophysicist	Jim Coffman	412.921.8244	
	Tetra Tech UXOSO/SSO	TBD	TBD	
	Tetra Tech SUXOS	TBD	TBD	
	Tetra Tech PM	Linda Klink	412.921.8650	
	Tetra Tech QAM	Kelly Carper	412.921.7273	
	Tetra Tech HSM	Matt Soltis	412.921.8912	
	Navy RPM	Stacin Martin	757.322.4780	
	NAPR OIC	Dan Kalal	787.685.3450	
	USEPA POC	Doug Pocze	212.637.4432	
	PREQB POC	Wilmarie Rivera	787.767.8181 x6129	

Communication Driver	Responsible Affiliation	Name	Phone Number and/or E-Mail	Procedure
UXO survey data issues	Tetra Tech UXO/MEC Program Manager Tetra Tech PM Tetra Tech QAM	Ralph Brooks Linda Klink Tom Johnston	770.413.0965 x 231 404.661.4916 (cell) 412.921.8650 412.921.8615	UXO field team will notify Tetra Tech UXO/MEC Manager as soon as the impact is realized. Tetra Tech UXO/MEC Manager will notify Tetra Tech PM and QAM on the same day.
Geophysical data issues	Tetra Tech Project Geophysicist Tetra Tech Site Geophysicist Tetra Tech PM	Bill Randall Jim Coffman Linda Klink	412.921.8714 412.921.8244 412.921. 8650	Geophysical field team will notify (verbally or via e-mail) Tetra Tech Project Geophysicist within 1 hour. Tetra Tech Project Geophysicist will notify (verbally or via e-mail) Tetra Tech PM and QAM on the same day.
Corrective actions for field program	Tetra Tech QAM Tetra Tech PM Navy RPM	Tom Johnston Linda Klink Stacin Martin	412.921.8615 412.921.8650 757.322.4780	Tetra Tech QAM will notify Tetra Tech PM within 1 day that the corrective action has been completed. Tetra Tech PM will then notify Navy RPM within 1 day.

SAP Worksheet #7 -- Personnel Responsibilities and Qualifications Table

Name	Title/Role	Organizational Affiliation	Responsibilities	Education and/or Experience Qualifications (Optional)
John Trepanowski	Program Manager	Tetra Tech	Oversees NAVFAC CLEAN Program.	M.S., Mining Engineering, B.S., Mining Engineering, 27 years of engineering experience
Linda Klink	PM	Tetra Tech	Oversees project, financial, schedule, and technical day-to-day management of the project. • Ensures timely resolution of project-related technical, quality, and safety questions associated with Tetra Tech operations. • Functions as the primary Tetra Tech interface with the Navy RPM, NAPR OIC, Tetra Tech field and office personnel, and laboratory POC. • Ensures that Tetra Tech health and safety issues related to this project are communicated effectively to all personnel and off-site laboratory. • Monitors and evaluates all Tetra Tech subcontractor performance. • Coordinates and oversees work performed by Tetra Tech field and office technical staff (including data validation, data interpretation, and report preparation). • Coordinates and oversees maintenance of all Tetra Tech project records. • Coordinates and oversees review of Tetra Tech project deliverables. • Prepares and issues final Tetra Tech deliverables to the Navy.	M.S., Environmental Engineering (Water Resource); B.S., Chemical Engineering, 28 years of environmental engineering experience

Name	Title/Role	Organizational Affiliation	Responsibilities	Education and/or Experience Qualifications (Optional)
Stacin Martin	RPM	BRAC PMO SE	Oversees project scoping implementation including data review and evaluation and approves UFP-SAP.	Available Upon Request
David Criswell	BRAC Environmental Coordinator	BRAC PMO SE	Coordinates BRAC environmental projects for the Navy, participates in scoping meetings.	Available Upon Request
Mike Green	NAVFAC MRP Senior Technical Advisor	NAVFAC Atlantic	Reviews and approves the MEC portion of the UFP-SAP (Volume II).	Available Upon Request
Wilmarie Rivera	RPM	PREQB	Participates in scoping, data review, and evaluation and approves the UFP-SAP.	Available Upon Request
Gloria Toro-Agrait	Environmental Permits Officer	PREQB	Participates in scoping meetings, provides regulator support.	Available Upon Request
Felix Lopez	USFWS	USFWS	Provides ecological project assistance for Puerto Rico.	Available Upon Request
Dan Kalal	OIC	NAPR	Oversees site activities and participates in scoping, data review, and evaluation.	Available Upon Request
Pedro Ruiz	POC	NAPR/NAVFAC Atlantic	Participates in scoping, NAPR point of contact during field activities.	Available Upon Request
Doug Pocze	RPM	USEPA Region 2	Participates in scoping, data review, and evaluation and approves UFP-SAP.	Available Upon Request
Phil Flax	Resource Conservation and Special Programs Section	USEPA Region 2	Oversees programs for USEPA Region 2.	Available Upon Request

Name	Title/Role	Organizational Affiliation	Responsibilities	Education and/or Experience Qualifications (Optional)
Jose Font	USEPA Caribbean Office Director	USEPA Region 2 Caribbean Office	Provided regulator guidance.	Available Upon Request
James Rossi	Project UXO Manager	Tetra Tech	Oversees implementation of daily UXO-related activities.	Graduate, Navy Explosive Ordnance Disposal (EOD) School – Indian Head, 20+ years of military EOD experience
J.Mentz	Consultant Activity Manager	Michael Baker	Maintains NAPR Administrative Record, including upload of UFP-SAP.	Available Upon Request
Ralph Brooks	UXO/MEC Manager	Tetra Tech	Oversees selection of qualified UXO personnel, establishes overall QC program for UXO activities, and addresses UXO-related issues as identified by field personnel.	Graduate, Navy EOD School – Indian Head, 26 years of military EOD experience
TBD	UXO Technician III/(SUXOS)	Tetra Tech	• Supervises the conduct of all on-site UXO-related operations. • Prepares daily reports of field activities. • Conducts daily site safety briefings. • Escorts non-UXO personnel in suspect MEC areas. • Determines location and identification of suspect MEC. • Conducts detector-aided surface sweep.	Minimum of 8 years of prior military EOD and or commercial UXO experience in munitions response actions or range clearance activities [Department of Defense Explosives Safety Board (DDESB) Technical Paper (TP) 18].

Name	Title/Role	Organizational Affiliation	Responsibilities	Education and/or Experience Qualifications (Optional)
TBD	UXOSO (1)	Tetra Tech	• Ensures that initial site-specific training is delivered for all field personnel before field activities begin and that all safety control measures have been established. • Ensures that all UXO-specific certifications are filed on-site and are available for Navy inspection. • Enforces personnel limits and safety exclusion zones (EZ). • Conducts, documents, and reports safety inspections.	Minimum of 8 years of prior military EOD and or commercial UXO experience in munitions response actions or range clearance activities and applicable safety standards (DDESB TP 18).
TBD	UXOQCS (1)	Tetra Tech	• Conducts QC audits. • Identifies, documents, and reports corrective actions.	Minimum of 8 years of prior military EOD and or commercial UXO experience in munitions response actions or range clearance activities and the transportation, handling, and storage of munitions and commercial explosives (DDESB TP 18).

Name	Title/Role	Organizational Affiliation	Responsibilities	Education and/or Experience Qualifications (Optional)
Tom Johnston	QAM	Tetra Tech	Reviews SAP, oversees preparation of laboratory scope, coordinates with laboratory, and conducts data quality reviews. Ensures quality aspects of the CLEAN program. • Develops, maintains, and monitors QA policies and procedures. • Provides training to Tetra Tech staff in QA/QC policies and procedures. • Conducts systems and performance audits to monitor compliance with environmental regulations, contractual requirements, SAP requirements, and corporate policies and procedures. • Audits project records. • Monitors subcontractor quality controls and records. • Assists in the development of corrective action plans and ensuring correction of non-conformances reported in internal or external audits. • Ensures that this SAP meets Tetra Tech, Navy, and PREQB requirements. • Prepares QA reports for management.	Ph.D, Analytical Chemistry, 31 years of experience
Bill Randall	Project Geophysicist	Tetra Tech	• Overall responsibility for design, implementation, and management of all geophysical investigations required for the work effort but may not necessarily be on site full time. • Project Geophysicist of Record.	B.S., Geology, M.S., Geology, 23 years of geophysical experience
Jim Coffman	Site Geophysicist	Tetra Tech	Field responsibility for implementation of all geophysical investigations required for the work effort and will be on site full time.	B.S., Geology, M.S., Geophysics, 13 years of geophysical experience

Name	Title/Role	Organizational Affiliation	Responsibilities	Education and/or Experience Qualifications (Optional)
Matt Soltis	HSM	Tetra Tech	Oversees CLEAN Program Health and Safety Program • Provides technical advice to the Tetra Tech PM on matters of health and safety. • Oversees the development and review of the HASP. • Conducts health and safety audits. • Prepares health and safety reports for management.	B.S., Industrial Safety Sciences, 24 years of environmental experience

In some cases, one person may be designated responsibilities for more than one position.
1 For this project, the UXOSO will also be responsible for UXOQCS duties.

SAP Worksheet #8 -- Special Personnel Training Requirements Table

(UFP-QAPP Manual Section 2.4.4)

Project Function	Specialized Training by Title or Description of Course	Training Provider/ Verifier	Training Date	Personnel/ Groups Receiving Training	Personnel Titles/ Organizational Affiliation	Location of Training Records/Certificates
Project Operations	Site Orientation, Ethics Training, and UXO Avoidance	SUXOS	Upon arrival at NAPR	All personnel	Tetra Tech	Documentation of special training requirements will be maintained on site. After the field investigation is complete, special training documentation will be maintained in the permanent project file.
	Accident Prevention and First Aid	SSO				
	Overview of Project Plans	SUXOS				
QA/QC	Tetra Tech Corporate Quality Assurance Program Training	Tetra Tech	Mandatory biennial training; received prior to participation in field activities	UXOQCS		
Site Supervisor	Formal Supervisor Training	Tetra Tech	Current	SUXOS		
Safety	Formal Safety Training	Tetra Tech	Current	UXOSO		
Munitions Response	MEC Safety Training	UXOSO SUXOS	Training will have been received prior to participation in field activities	Personnel entering EZ		
Grid/Transect Layout, Surface Surveying	Use of Hand-Held Global Positioning System (GPS)	SUXOS		UXO Team		
MEC Data Collection	Surface Survey and MEC Management and Accountability SOPs	SUXOS		UXO Team		

Each site worker will be required to have completed appropriate Hazardous Waste Operations and Emergency Response training specified in Occupational Safety and Health Administration (OSHA) 29 Code of Federal Regulations (CFR) 1910.120(e). Project-specific safety requirements are addressed in greater detail in the site-specific HASP (provided under separate cover).

SAP Worksheet #9 -- Project Scoping Session Participants Sheet

(UFP-QAPP Manual Section 2.5.1)

Project Name: Full RFI, SWMU 77 **Projected Date(s) of Sampling:** April/May 2012 **Project Manager:** Linda Klink	**Site Name:** SWMU 77 – Pistol Range Subarea, Former Pistol Range Subarea, Detonation Area Near Concrete Pad Subarea, Rifle Range Subarea, Potential OB/OD Subarea, Potential Munitions Trench Subarea **Site Location:** NAPR, Ceiba, Puerto Rico

Date of Session: September 29, 2011
Scoping Session Purpose: The purpose of the meeting was to discuss a general project approach and overall schedule, obtain other relevant supplemental information available to support update of the Conceptual Site Model (CSM), develop the Full RFI field sampling program, and revise project DQOs.

Name	Title	Affiliation	Phone Number	E-Mail Address	Project Role
Stacin Martin	RPM	NAVFAC Atlantic	757.322.4780	stacin.martin@ navy.mil	RPM
Mark Davidson	BEC	BRAC PMO SE	843.743.2124	mark.e.davidson@ navy.mil	BEC
Gloria M. Toro-Agrait	RPM	PREQB	787.767.8181 x3586	gloriatoro@ jca.pr.gov	State Regulator
Wilmarie Rivera	RPM	PREQB	787.767.8181 x6129	wilmarie.rivera@ jca.pr.gov	State Regulator
Linda Klink	PM	Tetra Tech	412.921.8650	linda.klink@ tetratech.com	PM
Pedro Ruiz	NA	NAPR/ NAVFAC Atlantic	757.286.9139	NA	NAPR POC
Jamie Butler*	PM	CH2MHill	NA	jamie.butler@CH2M. com	Consultant
Mark Kimes*	Activity Manager	Michael Baker	412.269.2009	mkimes@ mbakercorp.com	Consultant
Scott Moffit*	PM	Michael Baker	NA	smoffit@mbakercorp .com	Consultant
Timothy Gordon	RPM	USEPA Region 2	212.637.4167	gordon.timothy@ epa.gov	RPM
Michelle Coffman	Munitions Scientist	Tetra Tech	412.921.8549	michelle.coffman@ tetratech.com	Technical Support
Commander Dan Kalal	OIC	NAPR	787.685.3450	kalald@ napr.navy.mil	NAPR OIC
Cathy Dare (via phone)	USEPA Consultant	TechLaw	NA	NA	USEPA Consultant
Travis Kline (via phone)	USEPA Consultant	TechLaw	NA	NA	USEPA Consultant
Tom Hall (via phone)	USEPA Consultant	TechLaw	NA	NA	USEPA Consultant

* Present at meeting for other NAPR sites under discussion.

Comments/Discussions:

Pertinent to all SAPs under discussion at the meeting, groundwater needs to be addresses consistently and consider non-potability. After a groundwater evaluation paper/memo is developed to address this topic, it can be used to assess SWMU 77 (when groundwater is evaluated for this SWMU). If groundwater samples are collected at SWMU 77 and if the SWMU 77 data meet the criteria, this site may be evaluated as a non-potable/non-usable groundwater source and for industrial land use. Puerto Rico Water Quality Standards are an applicable or relevant and appropriate requirement (ARAR).

Tetra Tech completed the Phase I RFI for SWMU 77. The Full RFI UFP-SAP will address data gaps and unresolved comments on the Phase I RFI. The Phase I RFI data will be combined with the Full RFI data for evaluation. Both human health and ecological risk assessments will be conducted as part of the Full RFI. (Tetra Tech, 2011, Phase I results are presented in Appendix B-3 of Volume I and Attachment 1-4 of Volume II)

A Tier II UFP-SAP is in preparation for the MC portion of the SWMU 77 Full RFI. Stacin Martin informed the team that Tier II UFP-SAPs are streamlined versions of full UFP-SAPs. The Navy will provide the regulators with the Navy's requirements/guidance for Tier II SAPs, and the regulators will make a decision as to whether this is acceptable. [The Navy independently decided after the meeting to convert the Tier II SAP in progress to a Tier I SAP so as not to hold up progress on the project.]

The team discussed how groundwater should be evaluated during the Full RFI and the placement of monitoring wells in terms of topography, subarea placement, and access to subareas. It was suggested and discussed by the team that because the munitions and soil investigations might be conducted during this phase of investigation and that groundwater could be investigated in another phase, it may be premature to determine monitoring well locations at this point. It was agreed by the team that groundwater will be evaluated after the munitions and soil results are known, and, if necessary, the groundwater investigation can be handled via an addendum to the Full RFI UFP-SAP for munitions and soil. Further, it was suggested that the Navy consider evaluating the SWMU 77 area/peninsula to see if there are discharges or seeps into the surface water body that surrounds SWMU 77 on three sides (a similar type of investigation was conducted at Vieques Island). Where would there be exposure to groundwater, what receptors would be exposed to groundwater? Most likely exposure would be to ecological receptors as a result of groundwater discharge to surface water. However, upon further discussion, it was agreed that discharges, if any, would likely be low in concentration and subsequently greatly diluted by the sea. SWMU 77 future land use will be as an ecotourism area (e.g., camping activities), and human exposure to groundwater under this land use is unlikely.

Facility background soil concentrations were discussed in regards to SWMU 77. It was determined that facility background levels would be applicable for use at SWMU 77; most likely the weathered bedrock soil levels would be appropriate for SWMU 77. Because facility-wide background concentrations are applicable to this area, site-specific background samples do not need to be collected for SWMU 77. Those site-specific background samples proposed in the seed package handout will be deleted from the Full RFI.

The Full RFI UFP-SAP will need to explain the phased approach to the field investigation, i.e., the munitions investigations will be conducted and then the soil investigation at subareas where both are proposed. After these phases of investigation are complete, the need for a groundwater investigation will be evaluated.

The overall investigative approach for the SWMU 77 Full RFI, as presented in the seed package handout, was reviewed, and the following items were noted:

- Samples will be analyzed for additional suites of analytes (Appendix IX), as necessary, depending on the results of the intrusive investigations at the Potential OB/OD Subarea and Potential Munitions Trench Subarea.

- Former Pistol Range Subarea: Soil sample locations will be revised to reflect a “cross” pattern rather than placing soil samples in two rows as shown in the seed package handout.

- Rifle Range Subarea: The Phase I detector-aided survey area for the wooded embankment will be expanded during the Full RFI. Four transects, approximately 50 feet apart, will be added running north-northeast beginning at the edge of the Phase I RFI meandering path survey area (Tetra Tech, 2011, results are presented in Attachment 1-4 of Volume II).

- Potential OB/OD Subarea and Potential Munitions Trench Subarea: The regulators had questions about some of the proposed MEC intrusive hand-dig locations and whether some need to be moved or if some need to be added to the southwestern cluster area. Hand digs will continue to a maximum depth of 2 feet below ground surface (bgs), and test pits (mechanical excavation) will continue to a maximum depth of 4 feet bgs unless bedrock is encountered. Hand digs and test pits will terminate if bedrock is reached prior to achieving the depths listed above. The UFP-SAP will contain decisions/a decision tree to determine if landfill activity has occurred in an area and how to decide if additional analytical parameters are warranted.

- Potential Munitions Trench Subarea: Test pits (mechanical excavation) will continue to a maximum depth of 4 feet bgs. If no munitions-related items or evidence of landfilling is found to this depth, a magnetometer will be used to survey the bottom of the trench to determine if any anomalies are present at deeper depths. This information will be used during evaluation of remedial actions as part of the Corrective Measures Study (CMS). Subsurface soil samples will be collected from each test pit in biased locations dependent on the results of the intrusive investigations. A minimum of one subsurface soil sample will be collected from each of the proposed test pits.

USEPA requested an interim report/memorandum so that the team can address groundwater and munitions characterization of the hillside at the Rifle Range Subarea. An interim review of results and recommendations should be included in this report. A full risk assessment does not need to be included, but the CSM should be refined in the report to assess exposure pathways. The format of this report will be presented in the Full RFI UFP-SAP.

Consensus Decisions:

1. Soil Potential to Impact Groundwater: All contractors should include the Protection of Groundwater Soil Screening Levels (SSLs) when screening soil concentrations for their subject SAPs to assess leaching potential for contaminants found in soil.

2. It was agreed to continue to call SWMU 77 the “Small Arms Range” rather that the name provided in the RCRA permit.

3. SWMU 77 groundwater will be deferred to a later phase of investigation, after the munitions and soil results are known, if determined to be necessary after evaluation of these results.

4. Background: The upper limit of the mean concentration from the Baker background report will be used in the risk assessment, as previously agreed (Baker (CH2MHill & CDM), 2010). Risk assessment will use this value and often the maximum concentration as well. A Revised Final Background Study Report with Addendum has been issued by Baker. Facility background levels are applicable for use at SWMU 77 and can be used in evaluating background risk versus total risk. Therefore, site-specific background samples will not be collected at SWMU 77 during the Full RFI.

5. Risk Assessment: Risk assessment should use the Risk Assessment Guidance for Superfund (RAGS) tables (tables for total risk, site background/anthropogenic risk, site-related risk) (USEPA,

2001). An unrestricted use scenario and an industrial scenario will need to be evaluated for those sites where industrial land use is appropriate. The team discussed risk assessment levels and determined the following thresholds:

- 10^{-4} should be used for industrial land use.
- 10^{-6} should be used for residential land use.
- If calculated risks are at/greater than 10^{-6}, then it becomes a risk management question for the team to discuss.

6. Potential Groundwater Use: Sites should be evaluated on an individual basis to determine whether groundwater at the site is non-potable/non-usable. Data to be evaluated may include total dissolved solids (TDS) and salinity levels and groundwater yields from wells. After the groundwater evaluation paper/memo is developed, if groundwater is sampled at SWMU 77 and if the SWMU 77 data meet the criteria, the site may be evaluated as a non-potable/non-usable groundwater source and for industrial land use. The Navy and their contractors will develop criteria and rationale to be used across NAPR to determine whether groundwater is non-potable/non-usable. A report/memo will be developed that will explain how to evaluate the usability of groundwater at NAPR. Note that since the meeting the subject report/memo has been developed but the issue has not yet been resolved. Regardless, Puerto Rico Water Quality Standards are an ARAR.

Action Items:

1. Mark Kimes (Michael Baker Jr., Inc [Baker]) will send a link for the Revised Final Background Report with Addendum (Baker and CH2MHill, 2010), to all team members.

2. Stacin Martin (NAVFAC Atlantic) will send a copy of the Navy guidance on Tier II UFP-SAPs to the team for review, and the team will make a decision on whether the document will be a Tier I or Tier II SAP. [The Navy independently decided after the meeting to convert the Tier II SAP in progress to a Tier I SAP so as not to hold up progress on the project.]

3. Stacin Martin (NAVFAC Atlantic) will e-mail USEPA revised document submittal dates for their concurrence and will follow up with the formal request to change document submittal dates.

4. The Navy and its contractors will prepare a paper/memo concerning evaluation of groundwater (non-potable/non-usable) at NAPR that will be sent to the regulators by October 28, 2011, for review. The paper/memo will develop criteria and rationale to be used across NAPR to determine whether

groundwater is non-potable/non-usable. Note that since the meeting the subject report/memo has been developed but the issue has not yet been resolved. Regardless, Puerto Rico Water Quality Standards are an ARAR.

5. The Tetra Tech Project Geophysicist will review the test pit and hand-dig locations at the Potential OB/OD Subarea southwestern area cluster to determine if additional hand digs should be added and/or if some test pit or hand-dig locations should be moved.

SAP Worksheet #10 – Conceptual Site Model

(UFP-QAPP Manual Section 2.5.2)

10.1 GENERAL FACILITY AND SITE BACKGROUND

NAPR, formerly known as Naval Station Roosevelt Roads (NSRR), is located on the eastern coast of Puerto Rico in the municipality of Ceiba, approximately 33 miles southeast of San Juan (Figure 10-1). The nearest major town is Fajardo, which is 10 miles north of the station. The facility occupies approximately 8,600 acres, and except for two adjacent unpopulated islands (Pineros and Cabeza de Perro) off the northeastern coast of the facility, it is bordered on the north, south, and east by the marine waters of the Atlantic Ocean, Caribbean Sea, and Vieques Passage.

The property was acquired by the Navy between 1941 and 1945. In 1941, Fort Bundy was established in the southwestern portion of the property as the United States Army headquarters for coastal artillery emplacements. In 1943, the northeastern portion of NSRR was commissioned as a Naval Operating Base to provide training to the Atlantic Fleet Operations in the Caribbean. Both areas remained active until the end of World War II. Between the end of World War II and 1957, Fort Bundy and NSRR were deactivated and reactivated several times. In 1957, NSRR was reactivated as home of the new Atlantic Fleet Guided Missile Training Operations Center, which provided missile support to facilities and missile training to the Atlantic Fleet's submarine units (NAVFAC Atlantic, 2005).

In 1963, the Atlantic Fleet Weapons Training Facility (AFWTF) was commissioned to support communications and weapons technology, maintenance and operation of weapons testing and exercises, and military maneuvers training. The administrative functions of AFWTF, which were carried out from NSRR property, peaked in 1969 and declined significantly thereafter.

NSRR was officially closed on March 31, 2004; the Navy established NAPR to serve as the caretaker of the property associated with NSRR and to assist in the transfer of the property (NAVFAC Atlantic, 2005).

10.2 SITE BACKGROUND AND PHYSICAL SETTING

10.2.1 Site History

SWMU 77 covers approximately 66 acres and is located on the peninsula of Punta Medio Mundo at the northeastern boundary of the facility (Figure 10-2). Historical records and interviews indicate that SWMU 77 was used as a small arms range and, additionally, solely based on analysis of aerial photographs, potentially for munitions disposal or detonation.

Analysis of aerial photographs from 1936 to 1999 aided in identifying some of the SWMU 77 Subareas and aided in estimating periods of operation for each. The historical aerial photographs and associated analysis are included in Attachment 1 of the SAP. Additional supplemental historical information is also presented in Attachment 1. Estimated operational periods for each SWMU 77 subarea where MEC were identified during Phase I of the RFI are presented below.

Table 10-1
Subarea Estimated Dates of Operation

SWMU 77 Subarea	Estimated Dates of Operation	
	Start (1)	End
Rifle Range Subarea (Including short-yardage pistol range)	By 1958 and as early as 1940 (1985)	January 1, 2010 (2)
Potential OB/OD Subarea	Unknown. By 1976 or as early as 1961	Unknown. 1985
Potential Munitions Trench Subarea	By 1958 and as early as 1940	By 1961

1 The earliest start date is based on the facility military use start date of 1940.
2 See letter documentation provided in Attachment 1.

10.2.2 Location and Setting

SWMU 77 has been divided into six subareas, three of which may have MEC contamination based on historical site literature and project team experience on similar sites. Specifically, SWMU 77 subareas include the Pistol Range, Former Pistol Range, Rifle Range (including a short-yardage range formerly used as a pistol range), Potential OB/OD, Potential Munitions Trench, and Detonation Area Near Concrete Pad (apparently used for a one-time detonation event) (Figure 10-2).

10.2.3 Current Land Use and Anticipated Future Land Use

The SWMU 77 Small Arms Range, including the recently active Rifle Range Subarea, was closed on January 1, 2010. The remaining two SWMU 77 MEC subareas became inactive prior to closure of the Small Arms Range. The subareas are no longer maintained. According to the Supplemental Environmental Assessment, SWMU 77 is located in Zone 5, designated as an Environmental Retreat and the anticipated future use as an environmental retreat area includes hostels, cabanas and campsites (Navy, 2011).

10.3 SITE ENVIRONMENTAL CHARACTERISTICS

The following sections summarize the most pertinent information related to site physical and environmental characteristics. Much of the information discussed is summarized from the Phase I/II Environmental Condition of Property Report (NAVFAC Atlantic, 2005), and associated key figures are presented in Attachment 1.

10.3.1 Climate

NAPR has a tropical-marine climate characterized by minimal temperature fluctuations, relatively moderate humidity, and frequent rain showers. The rainy season is typically defined as May through November. Hurricane season is from June 1 through November 30.

10.3.2 Topography and Hydrology

Ground surface elevations within NAPR range from 0 to 131 feet above mean sea level. At SWMU 77, the access road entrance area is low lying, but otherwise SWMU 77 is hilly and vegetated, except where areas have been cleared and leveled for operational purposes. Vegetative cover limits the amount of erosion that occurs at the site. No floodplains or significant surface water bodies including lakes, ponds, streams, or creeks are present within SWMU 77. However, the site is a peninsula bordered by water on all sides except the west.

10.3.3 Geology

Except for tidal swamp soils associated with the access road entrance area, SWMU 77 consists of Descalabrado and Guyana soils, which consist of shallow, well-drained, moderately permeable soils that formed in moderately fine-textured residuum derived from volcanic rock. Slopes are steep, ranging from 5 to 60 percent. These soils have no value as cropland and are suited only for low-intensity grazing or wildlife habitat. The underlying geology of NAPR is predominantly volcanic, composed of lava and tuff, as well as sedimentary rocks derived from discontinuous beds of limestone (NAVFAC Atlantic, 2005).

10.3.4 Vegetation

The three primary vegetative cover types found at NAPR include upland forest, mangrove, and beach strand associations. At SWMU 77, upland forests generally consist of stands of relatively small trees, with grasses and shrubs prevalent. The upland forest vegetation has minimal commercial value but does provide valuable watershed protection by preventing erosion and promoting groundwater recharge.

SWMU 77 mangrove areas are limited to the access road entrance area consisting of low-lying tidal swamps. Three species of mangroves occur at the facility, the black (*Avicennia germinans*), red (*Rhizophora mangle)*, and white (*Laguncularia racemosa*) mangrove. The red mangrove flourishes in areas of high salinity and is generally found in pure stands on the seaward edge of a mangrove forest. The black mangrove is usually found just landward of the pure red mangrove stands. The white mangrove is found in upland areas that are rarely subject to inundation by the sea. Beach strand ecosystems are limited to the fringe area of SWMU 77 and are outside of the subareas under investigation.

10.3.5 Hydrogeology

Although no groundwater information is available, the nearby marine waters suggest that salt-water intrusion may have occurred on the peninsula. No drinking water wells have been installed at the facility.

10.3.6 Ecology and Natural Resources

10.3.6.1 Endangered and Special Status Species

The facility supports one plant (*Cobana negra*) that was classified as threatened in 1990 by the USFWS. The black mangrove (*Avicennia germinans)* is classified as threatened under federal law. Because the mangrove areas are considered wetlands, they are conservation zones protected under federal law and are critical habitat for the endangered yellow-shouldered blackbird (*Agelaius xanthomus*).

Because of its island ecosystem, abundant and diverse species of terrestrial vertebrates are not found on Puerto Rico. The facility supports a variety of wildlife that have been listed by either the federal or Commonwealth governments as threatened, endangered, or vulnerable (Commonwealth only), including: five sea turtle species [green (*Chelonia mydas)*, loggerhead (*Agelaius xanthomus)*, hawksbill (*Eretmochelys imbricate*), leatherback (*Dermochelys coriacea)*, and olive ridley (Lepidochelys olivacea)], one snake [Puerto Rican boa constrictor (*Epicrates inornatus)*], 12 birds [including the yellow-shouldered blackbird and brown pelican (*Pelecanus occidentalis occidentalis)]*; and one mammal [West Indian manatee (*Trichechus manatus*)]. The species observed at the facility that are classified as endangered under federal law, any of which could be present within the boundary of SWMU 77, include hawksbill and leatherback sea turtles, Puerto Rican boa, yellow-shouldered blackbird, brown pelican, and West Indian Manatee.

The major mammal population in and near NAPR consists of introduced species such a stray dogs and cats, Norway and gray-bellied rats, mice, and mongooses. The reptile population (especially snakes) has been significantly reduced because of the large mongoose population.

Thirteen species of bats are known to occur on Puerto Rico. None of the bats found on Puerto Rico are exclusive to the island, nor are they listed under provisions of the Endangered Species Act of 1973. The bat species known to occur on Puerto Rico include the following:

- Fruit-eating bats: Jamaican fruit bat (Artibeus jamaicensis), Antillean fruit bat (*Brachyphylla cavernarum*), and red fig-eating bat (*Stenoderma rufum*).

- Nectivorous bats: brown flower bat (*Erophylla sezekoni bombifrons*) and greater Antillean long-tongued bat (*Monophyllus redmani*).

- Insectivorous bats: Antillean ghost-faced bat (*Mormoops blainvillii*), Parnell's mustached bat (*Pteronotus parnellii*), sooty mustached bat (*Pteronotus quadridens*), big brown bat (*Eptesicus fuscus*), red bat (*Lasiurus borealis*), velvety free-tailed bat (*Molossus molossus*), and Brazilian free-tailed bat (*Tadarida brasiliensis*).

- Piscivorous bats: Mexican bulldog bat (*Noctilio leporinus*).

10.3.6.2 Wetlands

According to the USFWS, three primary types of wetlands occur at NAPR. Wetlands are limited to the outer fringes of SWMU 77 and do not occur within any of the subareas under investigation but are discussed because they are inside the boundaries of the SWMU.

The wetland classification M1AB3L describes the coastal wetlands surrounding the eastern, northern, and western borders of SWMU 77. These wetlands are marine systems with high-energy coastlines and salinities exceeding 30 parts per thousand (ppt). The habitats are permanently flooded with tidal water and include plants that grow principally on or below the surface of the water, including vascular species commonly referred to as grass flats.

Wetlands with the classification of E2FO3N occur slightly inland from the coast around the southeastern and northwestern portions of the site. These wetlands are deepwater tidal habitats and adjacent tidal wetlands that are influenced by water runoff and often semi-enclosed in land. Plants consist of woody

vegetation that is at least 6 meters tall, including angiosperms with relatively wide flat leaves that generally remain green.

A third type of wetland with a classification of M2US2P occurs on the northern tip of the site. These wetland habitats have unconsolidated substrates with less than 75 percent areal cover of stones, boulders, or bedrock and less than 30 percent areal vegetation coverage. The unconsolidated particles that are smaller than stones are predominantly sand. Tidal waters flood the land less often than daily.

10.3.7 Cultural and Natural Resources

Three locations (RR-9, RR-10, and RR-11) within SWMU 77 have previously been identified as archeological sites and have been under investigation. These locations are not shown on figures to safeguard the locations from looters, but maps have been provided to the field team to ensure that the areas are not disturbed as part of the Full RFI work effort. The Puerto Rico State Historic Preservation Officer (SHPO) has concurred with the Navy's findings that RR-9 is eligible for the National Register of Historic Places (NRHP) and that RR-10 and RR-11 are not eligible for the NRHP.

10.3.8 Water Resources

The available groundwater on NAPR is generally acceptable for most industrial and commercial uses. The groundwater has predominance of calcium, bicarbonate and magnesium ions but at concentrations within normally acceptable ranges. As the depths of wells increase and distances to the sea decrease, the levels of salt-water intrusion rise. No wells have been developed on the station. Several wells were once developed upgradient of NAPR in Ceiba but were later abandoned due to high levels of salinity. Under a 1942 agreement, NAPR gets raw water from the Rio Blanco watershed.

10.4 PREVIOUS ENVIRONMENTAL INVESTIGATIONS

Phase I RFI (Tetra Tech, 2011) (Tetra Tech, 2011, Phase I results are presented in Appendix B-3 of Volume I and Attachment 1-4 of Volume II)

A Phase I RFI was conducted at SWMU 77 in 2010. The Phase I RFI approach included the use of surface and subsurface geophysical equipment to locate metallic items that could be suspect MEC, material potentially presenting an explosive hazard (MPPEH), or non-munitions related debris. Initially, visual and UXO detector-aided surface surveys were performed at four subareas to investigate the presence of surface items. Following these analog detector-aided surveys, a digital geophysical mapping (DGM) survey was completed at two of the subareas where subsurface operations/disposal was of

concern to identify potential subsurface anomalies. Analysis of surface and subsurface survey results guided the positioning of munitions constituent (MC) soil sampling locations. The MC soil sampling effort followed the analog detector-aided surface surveys and the digital geophysical investigations, and included collection of environmental samples (surface soil and subsurface soil) in areas most likely to have been impacted by munitions-related activities at all subareas. Finally, areas surrounding each of the subareas were walked to observe whether any additional suspect areas were evident at SWMU 77. The recommendation of the Phase I RFI was to move forward to a Full RFI for all of the subareas at SWMU 77.

Subarea specific MEC results are discussed below and in the CSM in Section 10.5. SWMU 77 site visit and Phase I RFI photographs are also presented in Attachment 1.

Rifle Range Subarea

MPPEH items previously observed on the constructed earthen berm and the grassy strip at the toe of the wooded embankment during site walks in support of Phase I RFI SAP planning were removed when SWMU 77 was closed in January 2010; no MPPEH items remain on the ground surface in this area. For the wooded embankment, eight munitions items were encountered during the meandering path analog detector aided survey of the Phase I RFI; one of the items, a CS M651 grenade, was classified as MEC. Those MEC/MPPEH items warranting detonation were addressed by Mayport EOD on August 19, 2010 (EOD Report presented in Attachment 1). The detector-aided survey of the wooded embankment entailed meandering pathways through thickly vegetated areas did not provide 100 percent coverage; therefore, MEC/MPPEH items may still be present in this area. The Phase I RFI information was determined to be adequate to recommend a path forward for surface MEC/MPPEH at the wooded embankment without additional investigation during the Full RFI.

More than 50 random subsurface anomalies were identified during the detector-aided survey of the earthen constructed berm area and wooded embankment. Although MEC/MPPEH is not expected in the subsurface, there is a probability that the subsurface anomalies could be MEC/MPPEH considering the history of MEC/MPPEH in and around the area. A Full RFI was recommended to include intrusive investigation to determine the source of the subsurface anomalies.

Potential OB/OD Subarea

No MEC/MPPEH was discovered on the ground surface during the Phase I RFI of the OB/OD Subarea. Subsurface anomalies were indicated during the analog detector-aided survey; the locations generally

matched that of the electromagnetic (EM) geophysical surveys subsequently conducted. For the OB/OD Subarea, EM geophysical data was collected (EM-61 inphase response, EM-31 quadrature response, and EM-31 inphase response). The EM-61 results were most instructive of shallow anomalies; 58 anomalies were identified and most were indicative of individual items, although four clusters of anomalies were identified. The EM-31 data was more instructive of potential deeper anomalies. The source of the anomalies is unknown and may be munitions related, non-munitions debris, or simply outcrops of volcanic bedrock present at SWMU 77. Weathered bedrock was exposed at the land surface, particularly at steep embankments and, moreover, refusal due to bedrock during soil boring occurred at shallow depths. Although a limited subsurface investigation was conducted, bedrock was encountered consistently at shallow locations throughout the subarea; therefore, it is believed that if subsurface disposal occurred, it would have taken place at shallow rather than deep subsurface. There is also a possibility that land filling activities may have occurred at the subarea. Surface OB/OD operations may have also occurred at this site, although not supported by the findings of the Phase I RFI.

A Full RFI was recommended to include intrusive investigation of the subsurface anomalies encountered during the Phase I RFI to determine the source of the anomalies. The intrusive investigation should focus on, but not be limited to, the four clusters of anomalies encountered.

Potential Munitions Trench Subarea

No surface MEC/MPPEH was discovered during the Phase I RFI of the Potential Munitions Trench Subarea. More than 70 subsurface anomalies were encountered during the detector-aided survey. The general locations matched that of the EM geophysical surveys subsequently conducted over the main suspect trench area in the eastern portion of the subarea. Geophysical survey data were collected for the EM-61 inphase response, EM-31 quadrature response, and EM-31 inphase response. For the northeastern side of the subarea, lines of anomalies were identified trending northwest to southeast, aligned in the same direction as the orientation of the suspect trenches shown on the historical aerial photographs. For the western portion of the subarea, no subsurface anomalies were encountered during the detector-aided survey and the area was too thickly wooded to conduct a geophysical survey. The source of the anomalies detected cannot be determined from the geophysical survey alone. Moreover, anomalies are not necessarily indicative of buried metal but instead could be reflective of outcrops of naturally occurring volcanic bedrock present at SWMU 77. Weathered bedrock was exposed at the Potential Munitions Trench Subarea land surface, particularly at steep embankments and, moreover, refusal due to bedrock during soil boring occurred at shallow depths. A limited subsurface investigation was conducted; however, it is unlikely that subsurface disposal would have been conducted if bedrock is encountered consistently at shallow locations throughout the subarea.

A Full RFI was recommended to include intrusive investigation to determine the source of the anomalies. The intrusive investigation should focus on, but not be limited to, the six linear anomaly lines identified, recognizing the anomalies may be wider than they appear considering the geophysical survey did not extend out into the wooded areas.

10.5 CSM SUMMARY FOR SWMU 77 – ALL SUBAREAS

The following presents the CSM for the three subareas with potential MEC contamination at SWMU 77. Figures 10-3 through 10-8 present the subarea-specific graphical CSM and MEC exposure pathway analysis figures, respectively, for those sites where MEC investigations are planned, Rifle Range Subarea, Potential OB/OD Subarea, and Potential Munitions Trench Subarea.

Profile Type	Information Needs	Findings
Range/Site Profile	Installation Name	NAPR, SWMU 77-Small Arms Range
	Installation Location	NAPR, formerly known as Naval Station Roosevelt Roads, is located on the eastern coast of Puerto Rico in the municipality of Ceiba, approximately 33 miles southeast of San Juan. The nearest major town is Fajardo, which is 10 miles north of the station. The facility occupies approximately 8,600 acres and except for two adjacent unpopulated islands (Pineros and Cabeza de Perro) off the northeastern coast of the facility, it is bordered on the north, south, and east by the marine waters of the Atlantic Ocean, Caribbean Sea, and Vieques Passage.
	Installation History	The facility was used as a military base from 1940 until 2004 and included a port facility and major airfield complex. The facility ceased operation as an active Naval Station on March 31, 2004, at which point it was designated NAPR.
	Site (and Subarea) Descriptions	SWMU 77 was historically used for small arms operations; however, potential munitions disposal or detonation operations are suspected based solely on historical aerial photographs. Operations were conducted at SWMU 77 from 1940 to January 1, 2010. The SWMU 77 subareas with MEC concerns are described as follows: **The Rifle Range Subarea** was used for rifle practice from 1940 to January 1, 2010. **The Potential OB/OD Subarea** is suspected of OB/OD use solely based on historical aerial photographs that indicate potential activity (two bermed areas) as early as 1961 and ending sometime prior to 1985. There is also the possibility that landfilling activities may have occurred in this area. No other documentation is available. **The Potential Munitions Trench Subarea** is suspected of disposal use solely based on historical aerial photographs that indicated potential activity (trenches) sometime prior to 1958 (possibly as early as 1940) until October 1961. There is also the possibility that landfilling activities may have occurred in this area. No other documentation is available.
	Site Layout	SWMU 77 Small Arms Range is approximately 66 acres and is located on the peninsula at Punta Medio Mundo on the northeastern boundary of the facility, and the SWMU 77 subareas with potential MEC contamination are situated as follows: **The Rifle Range Subarea** is a 500-yard narrow feature centrally located in SWMU 77 and orientated such that shots were fired toward the outer point of the peninsula. **The Potential OB/OD Subarea** is on the northern side of the unpaved road on the northwestern portion of the peninsula. **The Potential Munitions Trench Subarea** is between the 200- and 100-yard Rifle Range firing lines, south of the unpaved road.

Profile Type	Information Needs	Findings
	Range/Site Structures	SWMU 77 site structures are encompassed within the associated site subareas as follows. As observed during an August 2011 site visit, now that range operations have ceased, vegetation has become overgrown in areas where maintenance once occurred at the Pistol Range Subarea and Rifle Range Subarea, and the unpaved roads are now eroded and impassible. **The Rifle Range Subarea** has 100-, 200-, 300-, and 500-yard elevated firing lines and a short-yardage range formerly used as a pistol range. The short-yardage range is located just in front of a fixed target berm. The target berm consists of a constructed earthen berm that served the short-yardage range, a concrete wall at the rear of the berm equipped with a target carrier mechanism to raise (and lower) targets, and a natural steep wooded hillside beyond the earthen berm/concrete wall that served as the backstop for these elevated targets. The range was maintained via grass and vegetation cutting until it was closed. **The Potential OB/OD Subarea** is flat and grass covered. A small depression is present in the middle of the grassy area, but there is no evidence of OB/OD operations. The terrain inclines steeply beyond the level area, with scrubby brush and trees present on the northern hillside. **The Potential Munitions Trench Subarea** is heavily wooded and covered with overgrown grasses, except on the potential trenches.
	Range/Site Boundaries	SWMU 77 is bordered by the Atlantic Ocean on all sides excluding the southwestern portion, which connects the peninsula to NAPR.
	Range/Site Security	Security clearance is required for gated access to NAPR. Security patrols include SWMU 77; otherwise SWMU 77 has been unsecured since the gate at the entrance of SWMU 77 was removed at or near the time of range closure on January 1, 2010. Also, access to the peninsula is unsecured from the water side.
Munitions/ Release Profile	Munitions Types	Expended items identified in available range records (from 2003 through 2009) included shotgun, ball, linked, and blank cartridges (more than 400,000), hand smoke grenades (six), and 40-millimeter (mm) training smoke grenades (55). MEC/MPPEH items added to the list after discovery during the Phase I RFI within the wooded embankment at the rear of the subarea included 40-mm CS M651 grenades (four), 37mm CS grenade (one), Han-Ball CS 1902 grenade (one), and 40-mm practice grenades (two). Items discovered during the Phase I RFI were either left in place or Mayport EOD consolidated and detonated on site on August 19, 2010. In addition, two expended blasting caps were encountered in January 2010 during an archeological investigation near Site RR9. (Tetra Tech, 2011, Phase I results are presented in Appendix B-3 of Volume I and Attachment 1-4 of Volume II)
	Maximum Probability Penetration Depth	MEC/MPPEH were identified during the Phase I RFI in the surface and are expected on the surface of areas not surveyed during the Phase I RFI at the **Rifle Range Subarea**. Subsurface anomalies encountered at this subarea during the analog detector-aided surveys are expected to be expended bullets or metallic debris and not MEC/MPPEH. Intrusive investigations need to be conducted at the **Rifle Range Subarea** to determine the source of the anomalies. At the **Potential OB/OD Subarea**, MEC/MPPEH may be present in the surface and/or subsurface at depths extending to 4 feet bgs. At the **Potential Munitions Trench Subarea**, MEC/MPPEH may be present in the surface and/or subsurface from approximately 1 foot bgs (assuming 1 foot of cover material at the top of the trench) extending up to 10 feet bgs (assuming typical backhoe reach). However, based on site-specific conditions as identified during the Phase I RFI (auger refusal was encountered at all of the soil boring locations at 0.5 foot bgs), actual burial

Profile Type	Information Needs	Findings
		depths are expected to be much less and are not anticipated to be greater than 4 feet bgs. During the Phase I RFI, weathered bedrock was exposed at the land surface in many areas on site, particularly at steep embankments at the **Potential Munitions Trench Subarea**. Digital geophysical survey results during the Phase I RFI confirmed subsurface anomalies at the **Potential OB/OD Subarea** and **Potential Munitions Trench Subarea**. Additionally, analog survey results from the Phase I RFI indicated suspect subsurface anomalies at the **Rifle Range Subarea**. Because intrusive investigation of the subsurface was not included during the Phase I RFI, the anomaly sources are unknown and may be MEC/MPPEH and/or volcanic rock observed as outcrops and during soil boring refusal. Depth to any buried items is likely shallower than originally anticipated based on the shallow depth to bedrock during the Phase I RFI and remains unknown until subsurface intrusive investigation is conducted. During the Phase I RFI, MEC/MPPEH was not found on the surface nor were subsurface anomalies present within the depression area at the **Detonation Area Near Concrete Pad Subarea**. (Tetra Tech, 2011, Phase I results are presented in Appendix B-3 of Volume I and Attachment 1-4 of Volume II)
	MEC Density	At the ground surface, MEC/MPPEH was found at the **Rifle Range Subarea** only. Items previously encountered on the constructed earthen berm and grassy strip at the toe of the wooded embankment during site walks in support of Phase I RFI SAP planning were removed when SWMU 77 was closed in January 2010, and no known MEC/MPPEH items remain in this area. At the wooded embankment, eight MEC/MPPEH munitions items were encountered during the meandering path analog detector-aided survey conducted during the Phase I RFI. Three items warranting detonation were addressed by Mayport EOD on August 19, 2010. The survey did not cover 100 percent of the wooded embankment, which was heavily wooded and difficult to traverse; therefore, MEC/MPPEH items may still be present in this area. MEC/MPPEH could be present at the **Potential OB/OD Subarea** and **Potential Munitions Trench Subarea** based on Phase I RFI geophysical survey results, but their presence remains unknown until subsurface intrusive investigation is conducted. (Tetra Tech, 2011, Phase I results are presented in Appendix B-3 of Volume I and Attachment 1-4 of Volume II)
	Munitions Scrap/ Fragments/ MDAS	Munitions scrap/fragments/material documented as safe (MDAS) were only encountered at the **Rifle Range Subarea**, where training grenade fragments (blue pieces) at the earthen berm were observed, and several of the eight munitions items were identified as MDAS at the wooded embankment. In addition, two expended blasting caps were encountered in January 2010 during an archeological investigation near Site RR9. At the **Rifle Range Subarea** earthen constructed berm, a high density of expended bullets were observed during the Phase I RFI; moreover, high densities of bullets are suspected at the **Rifle Range Subarea** wooded embankment, where thick ground cover prevented visual observation. (Tetra Tech, 2011, Phase I results are presented in Appendix B-3 of Volume I and Attachment 1-4 of Volume II)
	Associated MC	**The Rifle Range Subarea**: Nitroglycerin (NG), metals (antimony, arsenic, copper, lead, and zinc), and explosives were investigated during the Phase 1 RFI. Based on Phase I RFI results for surface soil samples from the firing lines and berm areas, NG was only a potential risk concern at the 200-yard firing line for the Rifle Range. For the earthen constructed berm area/wooded embankment, metals, primarily lead, were present at elevated concentrations. Maximum lead concentrations in samples from the constructed earthen berm and wooded embankment were 89,000 and 118,000 milligram per kilogram (mg/kg), respectively. A high density of bullets was observed on the constructed earthen berm and is suspected on the wooded embankment. The only explosive detected,

Profile Type	Information Needs	Findings
		cyclotrimethylenetrinitramine (RDX), was detected at concentrations less than the project action level (PAL). **<u>The Potential OB/OD Subarea</u>**: NG, metals (antimony, arsenic, copper, lead, and zinc), and explosives were investigated. Based on Phase I RFI surface and subsurface soil results, only lead was of potential ecological concern based on evaluation of analytical results. The PAL for lead was the facility background concentration, and although lead was not highly elevated at the OB/OD Subarea (74 mg/kg maximum), it could present an ecological risk. The data are inconclusive until intrusive subsurface investigation is conducted. **<u>The Potential Munitions Trench Subarea</u>**: NG, metals (antimony, arsenic, copper, lead, and zinc), explosives, and non-MC contaminants were investigated. Based on Phase I RFI results for the few surface soil samples collected, no PALs were exceeded. The data are inconclusive until intrusive subsurface investigation is conducted. (Tetra Tech, 2011, Phase I results are presented in Appendix B-3 of Volume I and Attachment 1-4 of Volume II)
	Migration Routes/ Release Mechanisms	Soil at the SWMU 77 subareas is expected to be moderately well drained, and contaminants could migrate from surface to subsurface soil via infiltrating precipitation, or released directly to subsurface soil, and leach into groundwater, thus causing groundwater to become contaminated. The stormwater/erosion runoff migration pathway is not expected to be significant due to the well-vegetated terrain and lack of drainage ditches or surface water bodies. Potentially complete exposure pathways are also present that could result in unacceptable adverse environmental impacts to ecological receptors (biota and/or critical habitat), either through contact with/ingestion of contaminated soil and/or contact with contaminants through the food chain when ingesting vegetation such as grass at the site. Direct ingestion of bullets or bullet fragments by birds may also present a concern because of lead toxicity. In addition, MC contaminants may bioaccumulate in animals over time.
Physical Profile	Climate	NAPR has a tropical-marine climate characterized by minimal temperature fluctuations, relatively moderate humidity, and frequent rain showers. The rainy season is typically defined as May through November. Hurricane season is from June 1 through November 30.
	Topography	Ground surface elevations within NAPR ranges from 0 to 131 feet above mean sea level. At SWMU 77, the access road entrance area is low lying, but otherwise SWMU 77 is hilly and vegetated, except where areas have been cleared and leveled for operational purposes. Vegetative cover limits the amount of erosion that occurs at the site.
	Geology	The underlying geology of NAPR is predominantly volcanic, composed of lava and tuff, as well as sedimentary rocks derived from discontinuous beds of limestone.
	Soil	Except for tidal swamp soils associated with the access road entrance area, SWMU 77 consists of Descalabrado and Guyana soils. Descalabrado and Guyana soils are shallow, well-drained, moderately permeable soils that formed in moderately fine-textured residuum derived from volcanic rock. Slopes are steep, ranging from 5 to 60 percent. These soils have no value as cropland and are suited only for low-intensity grazing or wildlife habitat.

Profile Type	Information Needs	Findings
	Hydrogeology	Although no groundwater information is available, the nearby marine waters suggest that salt-water intrusion has occurred on the peninsula. No drinking water wells have been developed at the facility.
	Hydrology	No floodplains or significant surface water features are present within SWMU 77; however, the site is a peninsula bordered on all sides but the southwest by water.
	Vegetation	Vegetative cover types at SWMU 77 includes largely upland forest (consisting of stands of relatively small trees with grasses and shrubs) where all the subareas are located. As observed during an August 2011 site visit, now that range operations have ceased, vegetation has become overgrown in areas where maintenance once occurred at the Pistol Range Subarea and Rifle Range Subarea. A mangrove area exists, limited to the SWMU 77 access road entrance area, and beach strand associations are limited to the fringe areas of SWMU 77.
Land Use and Exposure Profile	Current Land Use	SWMU 77 is currently not in use.
	Current Human Receptors	Current human receptors include Navy personnel (military and civilians), contractors, and trespassers.
	Current Activities	SWMU 77 is currently not in use.
	Potential Future Land Use	The future use of the SWMU 77 site and the individual subareas is unknown at this time; however, according to the Supplemental Environmental Assessment, SWMU 77 is located in Zone 5, designated as an Environmental Retreat and the anticipated future use as an environmental retreat area includes hostels, cabanas and campsites (Navy, 2011).
	Potential Future Human Receptors	Potential future human receptors include Navy personnel (military and civilians), residents, contractors and trespassers. These receptors would include construction workers (if intrusive work is necessary) and maintenance and operations workers.
	Potential Future Land Use Related Activities	The future use of the SWMU 77 site and the individual subareas is unknown at this time; however, according to the Supplemental Environmental Assessment, SWMU 77 is located in Zone 5, designated as an Environmental Retreat and the anticipated future use as an environmental retreat area includes hostels, cabanas and campsites (Navy, 2011).
	Zoning/Land Use Restrictions	There are no site-specific restrictions at this time pending the outcome of the subject Full RFI.
	Demographics/ Zoning	Puerto Rico is the easternmost island in the Greater Antilles chain separating the Caribbean Sea from the Atlantic Ocean; the island is approximately 110 miles long by 35 miles wide. NAPR is bordered by the municipalities of Ceiba to the west and north and Naguabo to the southwest. The nearest major town, Fajardo, with a population of nearly 42,000, is approximately 8 miles north of NAPR.
	Beneficial Resources	Protected habitats and protected/endangered animals are present at NAPR, including the SWMU 77 location.

Profile Type	Information Needs	Findings
Ecological Profile	Habitat Type	There are three primary habitats located on SWMU 77, upland forest, mangrove, and beach strand types. SWMU 77 subareas are all identified as upland forest.
	Degree of Disturbance	Conservation zones were established to preserve critical habitats at NAPR. The only designated critical habitat associated with SWMU 77 is the mangrove stands (present at the entrance of SWMU 77) for the yellow-shouldered blackbird.
	Ecological Receptors and Species of Special Concern	The major mammal population in and near NAPR consists of introduced species such as stray dogs and cats, Norway and gray-bellied rats, mice, and mongooses. The reptile population (especially snakes) has been significantly reduced because of the large mongoose population. Thirteen species of bats, none listed under the Endangered Species Act, are known to occur on Puerto Rico, including fruit-eating, nectivorous, insectivorous, and piscivorous bats. The species observed at the facility that are classified as endangered under federal law, any of which could be present within the overall boundaries of SWMU 77 include sea turtles (hawksbill [*Eretmochelys imbricate*] and leatherback [*Dermochelys coriacea*]) one snake (Puerto Rican boa constrictor [*Epicrates inornatus*]), birds (yellow-shouldered blackbird and brown pelican *[Pelecanus occidentalis occidentalis]*), and one mammal (West Indian Manatee [*Trichechus manatus*]). Three species of vegetation of concern include are the black (*Avicennia germinans*), red (*Rhizophora mangle)*, and white (*Laguncularia racemosa*) mangrove. The black mangrove (*Avicennia germinans)* is classified as threatened under federal law. Because the mangrove areas are considered wetlands, they are protected under federal law and are critical habitat for the yellow shouldered blackbird (*Agelaius xanthomus*). Of note, NAPR supports one plant (*Cobana negra*) classified as threatened in 1990 by USFWS.
General Exposure Profile	Relationship of MC Sources to Habitat and Potential Receptors	Uptake of MC sources, in particular elevated metals concentrations encountered at the **Rifle Range Subarea** during the Phase I RFI, could result in unacceptable adverse impacts to ecological receptors (biota and/or critical habitat), either through contact with/ingestion of contaminated soil and/or contact with contaminants through the food chain when ingesting vegetation such as grass. In addition, MC contaminants may bioaccumulate in animals over time. Direct ingestion of bullets or bullet fragments by birds may also present a concern because of lead toxicity; high densities of expended bullets were encountered during the Phase I RFI at the **Rifle Range Subarea** constructed earthen berm (and a high density of bullets is suspected at the **Rifle Range Subarea** wooded embankment where thick ground cover prevented visual observation). (Tetra Tech, 2011, Phase I results are presented in Appendix B-3 of Volume I and Attachment 1-4 of Volume II)

10.6 PROBLEM STATEMENT

During the Phase I RFI, surface MEC/MPPEH and subsurface anomalies were identified (Tetra Tech, 2011, Phase I results are presented in Attachment 1-4 of Volume II). Therefore, depending on the specific subarea, additional MEC/MPPEH may be present at the surface and unidentified MEC/MPPEH may be present in the subsurface at SWMU 77. MEC/MPPEH, if present, could be a safety hazard to humans. A Full RFI must be conducted to determine whether additional MEC/MPPEH are present on the surface and in the subsurface.

- Rifle Range Subarea:
  - MEC/MPPEH may be present on the surface north-northeast of the bermed area which is beyond the investigation boundary of the Phase I RFI; through detector-aided surveys, determine whether or not this is the case. MEC/MPPEH may be present in the subsurface; through intrusive investigation determine the source of Phase I RFI subsurface anomalies and any additional anomalies that may be discovered during the Full RFI (Tetra Tech, 2011, Phase I results are presented in Attachment 1-4 of Volume II).

- Potential OB/OD Subarea:
  - MEC/MPPEH may be present in the subsurface; through intrusive investigation determine the source of Phase I RFI subsurface anomalies (Tetra Tech, 2011, Phase I results are presented in Attachment 1-4 of Volume II).
  - There is no record or evidence of hazardous waste activity at this subarea; however, all site personnel should be aware of the possibility that hazardous waste may be present in the subsurface because of potential landfill activities.

- Potential Munitions Trench Subarea:
  - MEC/MPPEH may be present in the subsurface; through intrusive investigation determine the source of Phase I RFI subsurface anomalies (Tetra Tech, 2011, Phase I results are presented in Attachment 1-4 of Volume II).
  - Confirm Phase I RFI findings that detector-aided surface survey anomalies are not present at the potential former trench areas located in the western portion of the site (Tetra Tech, 2011, Phase I results are presented in Attachment 1-4 of Volume II).
  - There is no record or evidence of hazardous waste activity at this subarea; however, all site personnel should be aware of the possibility that hazardous waste may be present in the subsurface because of potential landfill activities.

Upon receipt of the results and recommendations of the Full RFI Report, the project team will evaluate the need for further investigation or remedial action.

SAP Worksheet #11 - Project Quality Objectives/Systematic Planning Process Statements for SWMU 77 Full RFI

(UFP-QAPP Manual Section 2.6.1)

The three SWMU 77 subareas that will be investigated for MEC include the Rifle Range Subarea, Potential OB/OD Subarea, and Potential Munitions Trench Subarea. Figures 11-1 provides the supporting decision tree for determining the scope of the Full RFI for MEC and the path forward upon evaluation of investigation results.

11.1 GOAL OF THE STUDY

The primary goal of the MEC portion of the Full RFI is to determine whether the sources of subsurface anomalies identified during the Phase I RFI, and any anomalies identified during Full RFI surveys, are due to MEC/MPPEH, munitions-related debris, non-munitions-related debris (which may be landfill related), or naturally occurring volcanic rock, and to determine the extent of any identified MEC or MEC-related items (Tetra Tech, 2011, Phase I results are presented in Attachment 1-4 of Volume II). UXO Technicians will use manual and mechanical excavation techniques to unearth and examine items that are the sources of the anomalies. This information will be used to refine the CSM and to evaluate potential risk to site users from exposure to these items for presentation in the Full RFI Report. The data gathered during the Full RFI will be used by the project team to evaluate remedial alternatives in a CMS, if deemed necessary.

11.2 INFORMATION INPUTS

1. UXO Detector-Aided Surface Surveys: Data will be gathered from detector-aided surface surveys that will be performed over select previously-surveyed portions of the three subareas where geophysics and/or intrusive investigations are planned. Additionally, new areas for Full RFI survey transects at the Rifle Range Subarea will require detector-aided surveys. Meandering paths will be used when portions of the subareas are inaccessible, such as wooded areas. UXO Technicians will use hand-held metal detectors such as a Schonstedt GA-52Cx and White's Spectrum XLT to locate metallic items on the surface at each of the subareas. Items located on the surface will be visually examined to determine whether they are suspect MEC/MPPEH, and all associated data will be recorded in field logbooks and on an MEC tracking form. For the Rifle Range Subarea, any shallow subsurface anomalies (i.e., responses from the metal detector where no surface metals are found) indicated during the UXO surface surveys will be flagged and intrusively investigated (the other two subareas will rely on geophysics instead as described below).

2. Geophysical Survey: Land-based geophysical surveys will be conducted in select areas at the Potential OB/OD Subarea and Potential Munitions Trench Subarea. The Phase I RFI results will serve as a guide as to where anomalies are located; however, rather than reacquiring previous anomalies, anomaly identification will be "redone" real time (Tetra Tech, 2011, Phase I results are presented in Attachment 1-4 of Volume II). Two all-metals detectors (a hand-held Geonics EM-61 MK2 and a Geonics EM-61 MK2 with standard coil) will be used for the survey at each of the two subareas. Geophysical surveys will also be conducted at potential former trench areas located on the western side of the subarea at the Potential Munitions Trench Subarea to confirm Phase I RFI detector-aided surface survey findings that no anomalies are present (Tetra Tech, 2011, Phase I results are presented in Attachment 1-4 of Volume II).

3. In clear areas where vegetation does not interfere with signal reception, GPS data will be gathered to map the UXO detector-aided surface survey and geophysical survey areas and any suspect MEC locations. In areas where tree canopy precludes use of a GPS unit, locations will be established using a tape measure and compass measurements from a known location(s).

4. Intrusive Investigation Results: The results will be used for decision making as described in 11.4.
   - Rifle Range Subarea: Results of the MEC intrusive investigation of all anomalies identified during the Phase I RFI and Full RFI (Tetra Tech, 2011, Phase I results are presented in and Attachment 1-4 of Volume II).

   - Potential OB/OD Subarea:
     - Results of MEC intrusive investigation of four large high-intensity anomaly areas using mechanical excavation equipment to dig test pits.
     - Results of MEC intrusive investigation of up to 16 small anomaly areas using manual excavation techniques.

   - Potential Munitions Trench Subarea:
     - Results of MEC intrusive investigation of anomaly areas on the eastern side of the subarea using mechanical excavation equipment to dig test pits. Two to three locations per each of the five suspect trench disposal areas in the eastern portion of the site will be intrusively investigated.
     - If anomalies, which appear to be indicative of trenches, are identified at potential former trench areas located on the western side of the subarea, intrusive investigation via hand digs or mechanical investigation will be conducted.

11.3 DEFINE THE BOUNDARIES OF THE STUDY

Three of the SWMU 77 subareas will be investigated for the presence and extent of MEC/MPPEH, and each subarea has particular study areas of interest. These study areas include areas that are likely to include MEC, areas where MEC has been identified, and areas where subsurface anomalies have been identified. The table below describes the study areas within each subarea of SWMU 77 that will be investigated for MEC. The study areas within each subarea are presented in Figures 10-3, 10-6, 10-7, and 10-8. The study areas shown below represent the horizontal boundary for the investigation within each subarea.

SWMU 77 Subarea	Study Area
Rifle Range (Figure 10-3)	- Target berm area (constructed earthen berm) - Woods behind target berm area (wooded earth embankment)
Potential OB/OD (Figure 10-6)	- Potential OB/OD berms identified in historical aerial photographs - Potential former pits in open clearing adjacent to road
Potential Munitions Trench (Figure 10-7)	- Area of multiple apparent disposal trenches, as shown in historical aerial photographs - Surrounding area within existing and historical road

The Rifle Range Subarea, Potential OB/OD Subarea, and Potential Munitions Trench Subarea contain either known or suspected areas of MEC and/or MEC debris. MEC/MPPEH may be present in the surface and/or subsurface at these subareas at depths extending to 2 feet bgs at the Rifle Range Subarea and to 4 feet bgs at the Potential OB/OD Subarea. For the Potential Munitions Trench Subarea, MEC/MPPEH may be present in the surface and/or subsurface at a depth interval from approximately 1 foot bgs (assuming 1 foot of cover material at the top of the trench) extending up to 4 feet bgs, assumed based on bedrock present at shallow depths. The EM-61 MK2 HH has a maximum depth capability of 3 to 5 feet bgs, and the maximum depth capability for the EM-61 MK2 with standard coil is 10 feet bgs.

Any alterations to the proposed outer boundaries of a given subarea will be recorded and documented in an FCR.

11.4 DEVELOP THE ANALYTIC APPROACH

The full rationale behind the MEC investigation program at the subareas is included in Worksheet #17, and the decisions to be made for each subarea are presented in the DQO decision tree presented as Figure 11-1, in accordance with the general study goals discussed below. All subareas will be investigated for the presence of MC regardless of the outcome of the MEC investigation. Additionally, if

evidence of landfilling is observed at either the Potential OB/OD Subarea or the Potential Munitions Trench Subarea, samples for chemical analysis of hazardous or toxic waste will be collected.

The study goals for the SWMU 77 MEC areas are as follows:

All MEC Subareas:

Determine whether MEC/MPPEH are present in conditions, or quantities that present an immediate human health safety hazard and require an immediate action. If this is the case, then initiate an appropriate remedial response. Otherwise, take no immediate action.

Rifle Range Subarea:

Investigate the subarea for the presence, types, and quantities of MEC/MPPEH on the ground surface within the designated survey areas. If MEC/MPPEH encountered on the surface, then define the quantities and extent of MEC. Intrusively investigate, using manual investigative techniques, designated subsurface anomalies identified during the Phase I RFI and Full RFI (Tetra Tech, 2011, Phase I results are presented in Attachment 1-4 of Volume II). If MEC/MPPEH are encountered in the subsurface, then define the quantities and extent of MEC and complete an MEC Hazard Assessment (HA) for the subarea. If hazard level category is 1, 2, or 3, proceed to a CMS. If no MEC/MPPEH are encountered during the Full RFI, still move forward to a focused CMS considering the known MEC concern for the wooded embankment.

Potential OB/OD Subarea and Potential Munitions Trench Subarea:

Investigate each subarea for the presence, types, and quantities of MEC/MPPEH in the subsurface within the designated intrusive investigation locations. Intrusively investigate, using manual investigative and mechanical techniques, designated subsurface anomalies identified during the Phase I RFI and confirmed during the Full RFI (Tetra Tech, 2011, Phase I results are presented in Attachment 1-4 of Volume II). If MEC/MPPEH are encountered in the subsurface, then define the quantities and extent of MEC and complete an MEC Hazard Assessment (HA) for the subarea. If hazard level category is 1, 2, or 3, proceed to a CMS. If no MEC/MPPEH are encountered, then recommend no further action (NFA) for MEC at the subarea.

11.5 SPECIFY PERFORMANCE OR ACCEPTANCE CRITERIA

The criteria for the detector-aided surface surveys will be the results of a go/no go test performed by determining whether the instrument responds to metallic objects at the Instrument Verification Strip (IVS).

The measurement performance criteria for the IVS are described in Worksheet #12.

The project team will review the results of the investigations (surface MEC/MPPEH findings and intrusive investigation of subsurface anomalies which may be munitions related items or non-munitions related debris) to verify that all proposed data were collected and that the data quality specifications and the overall data quality are sufficient to support attainment of the project objectives. This will involve a review of anomaly patterns and identified items by the project team to determine if the data are representative of suspected MEC/MPPEH. The project team will review the geophysical survey results and ensure that all stakeholder concerns are included in decision-making.

11.6 DEVELOP THE PLAN FOR OBTAINING DATA

The sampling plan and rationale for the MEC investigation are presented in Worksheet #17.

SAP Worksheet #12 – Measurement Performance Criteria Table

(UFP-QAPP Manual Section 2.6.2)

Definable Feature of Work/Data Type	Geophysical Anomaly Measurement/ Data Quality Indicator	QC Sample and/or Activity to Assess Measurement Performance	Measurement Performance Criteria	Frequency
Site Preparation (including mobilization)	Completeness	Verify that approved project plans are reviewed and signed.	Approved project plans reviewed and signed.	Once.
		Verify that equipment needed is on site.	All equipment needed is on site.	Once.
		Verify personnel qualifications.	All field personnel qualifications were reviewed and found to be acceptable.	Once.
		Verify that communications needed are on site and working.	Communications checked.	Once.
		Verify emergency services.	Emergency services checked.	Once.
		Verify site-specific training.	Site-specific training completed.	Once.
		Verify appropriate UXO personnel designated in writing by NAVFAC Commanding Officer as qualified and authorized to inspect MPPEH and document as MDAS or material documented as an explosive hazard (MDEH).	Personnel designated in writing by NAVFAC Commanding Officer as qualified and authorized to sort and document MPPEH.	Once.

Definable Feature of Work/Data Type	Geophysical Anomaly Measurement/ Data Quality Indicator	QC Sample and/or Activity to Assess Measurement Performance	Measurement Performance Criteria	Frequency
Site Surveying	Accuracy	QC audit of positioning system. Verify that site boundaries have been established. Verify that survey transects and grids have been established in accordance with MRP SOP 05.	GPS positional error at known location less than 1 meter. Site boundaries have been established. Survey transects have been established in accordance with MRP SOP 05.	Daily. Once. Transect ends will be marked using Phase I RFI coordinates and recollected using the GPS (Tetra Tech, 2011, Phase I results are presented in Attachment 1-4 of Volume II).
Vegetation Management	Completeness	Verify that vegetation has been removed from working areas of the site (transects, excavation areas, equipment laydown areas, and access pathways) in accordance with MRP SOP 06.	Vegetation cut to between 6 to 12 inches above the ground surface. No trees larger than 2 inches in diameter will be cut.	As needed.
IVS	Sensitivity	Detection capabilities test of representative seed items.	Detector-Aided Survey: 100% vertical detection of industry standard objects (ISO) at specified depth. Geophysical Survey: Detection and Instrument Response Levels of ISOs within the response curve.	Daily.

Definable Feature of Work/Data Type	Geophysical Anomaly Measurement/ Data Quality Indicator	QC Sample and/or Activity to Assess Measurement Performance	Measurement Performance Criteria	Frequency
GPS Positional Data Collection	Real-Time Accuracy	Horizontal Dilution of Precision (HDOP) and number of satellites.	HDOP less than three, number of satellites at least four.	Ongoing.
	Accuracy	GPS positioning - comparison with two known locations.	Sub-meter accuracy.	Twice daily.
Detector-Aided Survey	Precision	Blind seeds items.	Discover and record all blind seeds placed in transect.	Blind seed items will be placed on the surface into the surface vegetation, or if surface vegetation is not present, covered with surface vegetation from another location, at locations along each transect prior to surface survey operations. At least one blind seed item, and no more than six, will be placed for each lot of work. If any transect does not pass QC, UXO team will resurvey entire transect, and another QC check will be performed.
Geophysical Equipment Calibration, Maintenance, Testing and Inspection	Completeness and Accuracy	Instrument setup and testing.	Confirm that equipment calibration, inspection, and testing results are within specified criteria (Worksheet #22).	Daily.
Digital Geophysical Mapping	Completeness	Data capture.	Minimize data dropouts and unusable data. 90% minimum of usable data per survey line.	Daily.

Definable Feature of Work/Data Type	Geophysical Anomaly Measurement/ Data Quality Indicator	QC Sample and/or Activity to Assess Measurement Performance	Measurement Performance Criteria	Frequency
Geophysical Data Processing and Interpretation	Completeness and Accuracy	Verify that data are usable and accurate for the site.	Minimize data dropouts and unusable data. 90% minimum of usable data per survey line.	Daily.
Anomaly Informal Reacquisition	Accuracy	Search radius for reacquiring geophysical anomalies.	Along-line accuracy of geophysical anomalies are within 2 meters of reacquired location.	Daily.
Manual Anomaly Intrusive Investigations (Hand Digs)	Completeness	Blind seed items. QC of intrusive investigation locations.	Detect all blind seeds and all MEC/MPPEH 20 millimeter (mm) or larger.	Each occurrence. The UXOQCS will place blind seeds at the rate of 1 to 6 per daily lot of work, within 2 feet of pen flags marking anomaly locations. Any failed locations will be cleared again by the UXO team, and the UXOQCS will then perform 100% survey of each failed target location. Process will repeat until all targets pass QC.
		QC audit of anomaly identification forms.	Anomaly identification forms completely and correctly filled out for each anomaly.	Daily.

Definable Feature of Work/Data Type	Geophysical Anomaly Measurement/ Data Quality Indicator	QC Sample and/or Activity to Assess Measurement Performance	Measurement Performance Criteria	Frequency
Mechanized Anomaly Intrusive Investigation (Test Pits)	Completeness	Blind seed items. QC of intrusive investigation location.	Detect all MEC/MPPEH 20 mm or larger.	Each occurrence. Blind seeds will be placed along the trench line prior to excavation at the rate of 1 to 6 per daily lot of work. Failure will be non-detection of a seed item. After any failed test pit or soils will be cleared again by the UXO team, and the UXOQCS will then perform survey of each failed test pit or portion of soil. Process will repeat until all targets pass QC.
		QC audit of anomaly identification forms	Anomaly identification forms completely and correctly filled out for each anomaly.	Daily.
Donor Explosives Handling	Accuracy	Proper placarding, warning signs, flagging, and firefighting equipment present and correctly posted. Receipt, usage, and inventory control completed per Operations Pamphlet (OP) 5/Bureau of Alcohol, Tobacco, Firearms and Explosives (ATF) requirements. Compliance with explosive handling and transportation requirements.	Explosives handling performed in compliance with OP 5 and ATF regulations.	Daily/weekly/each occurrence.
MEC Management - Treatment	Completeness	Verify that treatment is conducted per MRP SOP 07.	Treatment conducted per MRP SOP 07.	Each occurrence.

Definable Feature of Work/Data Type	Geophysical Anomaly Measurement/ Data Quality Indicator	QC Sample and/or Activity to Assess Measurement Performance	Measurement Performance Criteria	Frequency
MPPEH Management - Inspection	Accuracy	Verify that inspection is per MRP SOP 02 and OP 5.	Each MPPEH item inspected and segregated as MDAS or MDEH.	Daily/each occurrence.
MPPEH Management - Certification	Accuracy	Verify that certification is per MRP SOP 02 and OP 5.	MPPEH is certified as MDAS or MDEH.	Daily/each occurrence.
MPPEH Management - Disposal	Completeness	Verify that disposal is conducted per MRP SOPs 02 and 07.	Disposal is conducted per MRP SOPs 02 and 07.	Daily/each occurrence.
Demobilization	Completeness	Verify that sites have been restored and that all equipment is inspected, packaged, and shipped to appropriate locations.	Temporary markers are removed and instrument IVS seed holes are filled. All equipment is off site and has arrived at appropriate location.	Once at the end of field operations.
Site-Specific Final Report Preparation and Approval Interim Report/Memorandum (1)	Completeness	QC of MEC Tracking Log and Daily Field Reports. Verify that all required project documentation is included in the report, that reviews were performed by project, senior technical and program teams, and that final report approval is given.	Tabulation of MEC items discovered during the Full RFI is included in the MEC Tracking Log. Daily Field Reports are complete and accurate. MEC HA complete. All required project documentation has been reviewed and provided in the report, and the final report was approved.	Once at the end of field operations prior to demobilization.

1 See Volume 1, MC UFP-SAP for information.
Explanations for criteria listed above explained in Worksheet #22. Field forms and SOPs are included in Attachment 2.

SAP Worksheet #13 – Secondary Use of Data Criteria and Limitations Table

(UFP-QAPP Manual Section 2.7)

Secondary Data	Data Source (originating organization, report title and date)	Data Generator(s) (originating organization, data types, data generation/collection dates)	How Data Will Be Used	Limitations on Data Use
Phase I RCRA Facility Investigation	Phase I RCRA Facility Investigation for SWMU 77 – Small Arms Range, Naval Activity Puerto Rico, Ceiba, Puerto Rico. April 2011	Tetra Tech	Basis of UFP-SAP for Full RFI	The information is quantitative and site specific. The information was used to establish the field work program and identify data gaps.

SAP Worksheet #14 – Summary of Project Tasks

(UFP-QAPP Manual Section 2.8.1)

Implementation of the Full RFI has been divided into definable features of work and the tasks required to be completed for the work identified. Procedures for these tasks, including recording data, forms and checklists (Attachment 2), data generation, QC checks, data management, and information management, are defined in the SOPs for the project, which are provided in Attachment 2 and indexed in Worksheet #21.

Definable Feature of Work	Tasks
Site Preparation (including mobilization)	• Project Plan Preparation (SAP, ESS, and HASP/Accident Prevention Plan [APP] review, Geographic Information System [GIS] setup, document and data management procedures, approved SAP, and schedule is confirmed) • Verify personnel qualifications • Coordination with local authorities and establish communication logistics • Set-up administrative offices • Conduct initial orientation and training (including safety and emergency response) • Equipment setup and checkout • Remove surface non-munitions-related debris, as applicable • Verify certification from NAVFAC Commander Officer of UXO Technician(s) to certify MDEH/MDAS
Site Surveying	• Survey site boundaries with GPS or conventional means • Survey transect end points with GPS or conventional means
Vegetation Management	• Inspect equipment • Set cutting height to between 6 and 12 inches above ground surface • Cut vegetation to proper height
IVS	• Install IVS • Perform IVS • Report results of IVS • Obtain approval of initial IVS results

Definable Feature of Work	Tasks
GPS Positional Data Collection	• Load GPS with coordinates of site boundaries, transect end points, grid corner points, intrusive investigation areas, etc. • Collect blind seed locations • Twice daily comparison with two known reference locations • Continually monitor HDOP parameters • Collect MEC/MPPEH location GPS data (surface and shallow subsurface); use alternative means if GPS is not effective due to tree canopy • Back up GPS data • Transfer GPS data to Tetra Tech GIS website
Detector-Aided Survey	• Installation of blind seeds • Surface survey to locate MEC/MPPEH • Record locations (GPS and photograph) of MEC/MPPEH found on surface and in subsurface hand-dig locations, then treat thermally or remove as appropriate • Conduct UXO escort duties
Geophysical Equipment Calibration, Maintenance, Testing and Inspection	• Set up and test geophysical instruments
Digital Geophysical Mapping	• Geophysical survey • Data download and review • Data upload
Geophysical Data Processing and Interpretation	• Data processing • Initial target selection • Peer QC • Final target selection
Anomaly Informal Reacquisition	• Reacquire shallow subsurface anomalies
Manual Anomaly Intrusive Investigation (Hand Digs)	• Remove non-munitions-related debris entirely on the surface, as applicable • All anomalies will be investigated in real time using manual techniques in accordance with Worksheet #17 • Excavate and investigate designated subsurface anomalies to a maximum depth of 2 feet and a maximum radius of 2 feet around the location of the subsurface anomaly • Record location (GPS and photograph) of each MEC or MPPEH item discovered, then treat or remove as appropriate • Report MEC in accordance with Worksheet #6 • Leave excavation open for QC confirmation of excavation dimensions and presence/absence of items at sidewalls and floor of the excavation • Refill excavation after QC complete

Definable Feature of Work	Tasks
Mechanized Anomaly Intrusive Investigation (Test Pits)	• Remove non-munitions-related debris entirely on the surface, as applicable • Excavate test pit and place soils to the side • Perform detector-aided survey of spoils and bottom of trench • Record location (GPS and photograph) of each MEC or MPPEH item discovered, then treat thermally or remove as appropriate • Report MEC in accordance with Worksheet #6 • Leave excavation open for QC confirmation of excavation dimensions and presence/absence of items at sidewalls and floor of the excavation • Refill excavation after QC complete
Donor Explosives Handling	• Properly place placarding, warning signs, flagging, and firefighting equipment • Complete receipt, usage, and inventory control per Naval Sea System Command (NAVSEA) OP 5/ATF requirements • Comply with explosive handling and transportation requirements • Order on call explosives from Alpha Aggregate
MEC Management - Treatment	• Establish EZ per ESS requirements • Prepare site for thermal treatment via donor explosives • Prepare and apply donor charge • Check results of thermal treatment
MPPEH Management - Inspection	• Inspect MPPEH • Separate MPPEH into MDEH and MDAS • Secure MDEH items and treat as MEC
MPPEH Management – Certification	• Secure MDAS in a locked container and certify to ensure that no energetic material remains • Mechanical demilitarization • Update MDAS form and attach to container • Certify MDAS
MPPEH Management - Disposal	• Dispose of MDAS as per OP 5 • Treat MDEH with donor change as MEC
Demobilization	• Remove IVS • Remove temporary survey markers and verify site restoration • Complete all field forms • Close out field logbooks • Return equipment • Provide all field documentation to PM (verify requirements established in the SAP)
Site-Specific Final Report Preparation and Approval (1)	• Close out MEC tracking log • Collect all documentation from the field activities • Prepare site-specific final report • Address comments • Receive approval of final report

1 See Volume 1, MC UFP-SAP for information on the Interim Report/Memorandum.

SAP Worksheet #15 – Reference Limits and Evaluation Table

(UFP-QAPP Manual Section 2.8.1)

☑ **Worksheet Not Applicable**

This worksheet applies to chemical analysis and reporting and is not applicable to this UFP-SAP for MEC investigation.

SAP Worksheet #16 – Project Schedule/Timeline Table

(UFP-QAPP Manual Section 2.8.2)

Activity	Organization	Dates (MM/YYYY)	
		Anticipated Date(s) of Initiation	Anticipated Date of Completion
Prepare Draft Full RFI SAP	Tetra Tech/Navy	08/2011	12/2011
Submit Draft Full RFI SAP	Tetra Tech	12/2011	12/2011
Review	USEPA, PREQB	12/2011	02/2012
Receive Comments/Comment Resolution	Tetra Tech, Navy, USEPA, PREQB	02/2012	03/2012
Prepare Final Full RFI SAP	Tetra Tech	02/2012	08/2012
Submit Final RI/RFI SAP	Tetra Tech	08/2012	08/2012
Field Investigation	Tetra Tech	09/2012	09/2012
Prepare Pre-Draft Full RFI Report	Tetra Tech	10/2012	03/2013
Submit Pre-Draft Full RFI Report	Tetra Tech	03/2013	03/2013
Review	Navy	03/2013	04/2013
Receive Comments/Comment Resolution	Tetra Tech, Navy	04/2013	05/2013
Prepare Draft Full RFI Report	Tetra Tech	04/2013	05/2013
Submit Draft Full RFI Report	Tetra Tech	05/2013	05/2013
Review	USEPA, PREQB	05/2012	07/2013
Receive Comments/Comment Resolution	Tetra Tech, Navy, USEPA, PREQB	07/2013	08/2013
Prepare Final Full RFI Report	Tetra Tech	07/2013	09/2013
Submit Final Full RFI Report	Tetra Tech	09/2013	09/2013

SAP Worksheet #17 – Project Design and Rationale

(UFP-QAPP Manual Section 3.1.1)

17.1 PROJECT DESIGN AND RATIONALE

This section describes in detail the approach, methods, and operational procedures Tetra Tech will use to conduct surface and subsurface detector-aided and geophysical surveys, intrusively investigate anomalies for potential MEC/MPPEH, and manage/treat MEC/MPPEH. The data will be used to evaluate suspected anomalies in the Rifle Range Subarea, Potential OB/OD Subarea, and Potential Munitions Trench Subarea of SWMU 77, by developing hand excavation locations and test pitting locations for target anomalies. Associated equipment and personnel that will be used to meet the site-specific project performance goals presented in Worksheet #11 of this SAP.

Definable Feature of Work	SOP (1)	Supporting Document
Site Preparation (including mobilization)	MRP SOP 01 MRP SOP 03 MRP SOP 08	UFP-SAP
Site Surveying	MRP SOP 05	UFP-SAP
Vegetation Management	MRP SOP 06	UFP-SAP
IVS	MRP SOP 03 MRP SOP 05	UFP-SAP
GPS Positional Data Collection	MRP SOP 05	UFP-SAP
Detector-Aided Survey	MRP SOP 01 MRP SOP 02 MRP SOP 05	UFP-SAP
Geophysical Equipment Calibration, Maintenance, Testing and Inspection	MRP SOP 03	UFP-SAP
Digital Geophysical Mapping	MRP SOP 03 MRP SOP 05	UFP-SAP
Geophysical Data Processing and Interpretation	MRP SOP 04 MRP SOP 05	UFP-SAP
Anomaly Informal Reacquisition	MRP SOP 01 MRP SOP 02 MRP SOP 03 MRP SOP 05	UFP-SAP
Manual Anomaly Intrusive Investigation (Hand Digs)	MRP SOP 01 MRP SOP 02 MRP SOP 03 MRP SOP 05 MRP SOP 07 MRP SOP 09	UFP-SAP

Definable Feature of Work	SOP (1)	Supporting Document
Mechanized Anomaly Intrusive Investigation (Test Pits)	MRP SOP 01 MRP SOP 02 MRP SOP 03 MRP SOP 05 MRP SOP 07 MRP SOP 09	UFP-SAP
Donor Explosives Handling	MRP SOP 07	UFP-SAP
MEC Management - Treatment	MRP SOP 07	UFP-SAP
MPPEH Management - Inspection	MRP SOP 09	UFP-SAP
MPPEH Management - Certification	MRP SOP 09	UFP-SAP
MPPEH Management - Disposal	MRP SOP 09	UFP-SAP
Demobilization	NA	UFP-SAP
Site-Specific Final Report Preparation and Approval (2)	NA	UFP-SAP

1 Field forms and SOPs are provided in Attachment 2.
2 See Volume 1, MC UFP-SAP for information on the Interim Report/Memorandum.

17.2 SITE PREPARATION INCLUDING MOBILIZATION

17.2.1 Mobilization, Setup, and Preliminary Activities

Tetra Tech will schedule the arrival of the workforce in a manner that is most effective and designed to allow for immediate productivity. All personnel mobilized to the site will meet the OSHA training and medical surveillance requirements specified in the HASP. The UXO Technicians will have the appropriate level of training and experience as stated in DDESB TP-18 and NAVSEA OP-5. As part of the mobilization process, site-specific training for all on-site personnel will be performed, and each person will sign Worksheet #4. The purpose of this training is to ensure that personnel fully understand the operational procedures and methods to be used at NAPR, including individual duties and responsibilities, and all safety and environmental concerns associated with these operations. The training will include, but is not limited to, a review of the final version of this MEC SAP, and HASP/APP and the ESS (provided under separate cover). Any personnel arriving at the site after this initial training session will be trained when they arrive and will sign Worksheet #4. A UXO Technician III will conduct training.

Project equipment for the UXO and geophysical surveys and intrusive investigations will come from Tetra Tech sources and local leases/purchases. All equipment, regardless of source, will be checked to ensure its completeness and operational readiness. Any equipment found damaged or defective will be returned to the point of origin, and a replacement will be secured. All instruments and equipment that require routine maintenance and/or calibration will be checked initially upon arrival and then prior to use each day. This system of checks ensures that the equipment is functioning properly. If an equipment check

indicates that any piece of equipment is not operating correctly and field repair cannot be made, the equipment will be tagged and removed from service, and a request for replacement equipment will be placed immediately. Replacement equipment will meet the same specifications for accuracy and precision as the equipment removed from service.

17.2.2 Site Accessibility and Traffic Control

NAPR is a controlled area accessible only through an access gate. Safety requires that an active EZ be established at the site and maintained before any MEC activities occur due to the potential of encountering explosively configured/fuzed munitions. (ESS provided under a separate cover to field personnel, for this project, the EZ is listed in Table 6-2 of the ESS). If non-essential personnel enter the EZ, all MEC operations will cease until the EZ is re-established. EZs are intended to keep non-essential personnel from being exposed to hazardous blast overpressure and fragments resulting from an unintentional detonation. Authorized visitors are allowed to enter the EZ under the restrictions imposed by OP-5.

The EZ is required to be established and maintained for the Full RFI area. (ESS provided under a separate cover to field personnel, the EZ is listed in Table 6-2 of the ESS.) The active EZ must be established before any survey activities or intrusive activities occur because of the potential for encountering live explosively configured munitions. The EZ is based on the Intentional Minimum Separation Distance (MSD) (K328) is 63 feet for a M651 40mm CS grenade, the primary Munition with the Greatest Fragmentation Distance (MGFD). The information from the Fragmentation Data Review Forms dated 25 May 2011 (ESS provided under a separate cover to field personnel, see Appendix B of the ESS) was used to establish the EZ distance. Although not anticipated, if water activity is observed, procedures will be followed per the ESS.

The M651 is the primary MGFD and the M383 is the contingency MGFD for the site. If any member of the team finds an item with a greater K328 or HFD then the K328 of the primary MGFD, but not greater than the contingency MGFD, then that member will: (1) immediately direct all operations within the EZ to stop, (2) notify the SUXOS who will notify the Tetra Tech PM and adjust the EZ boundaries to the HFD for the contingency MGFD so that operations can continue, and (3) notify NOSSA (N53) of the change in MGFD. If any member of the UXO team or any other person on the project encounters an MEC item that has a greater HFD than the 219 feet associated with the M383 40mm grenade, the person discovering the item will: (1) immediately direct all operations within the HFD to stop and (2) notify the SUXOS who will then notify the Tetra Tech PM. In turn, the Tetra Tech PM will consult with the Navy regarding the selection of a new MGFD. Operations will resume only when the ESS and project documents are

updated to reflect the selected MGFD and when all safeguards associated with the new MFGD are in place.

Both routine and emergency response actions dictate the need for prevention of unauthorized site access and for the protection of vital records and equipment. All equipment will be brought to a designated secure location each day. All excavations will be backfilled prior to leaving the excavation, such that no open excavations will be present after duty hours. If it is not possible to backfill an excavation prior to the end of the day, caution tape and snow fencing may be used to surround the open trench overnight.

17.2.3 Site Security

Site security will be maintained to ensure that non-essential personnel do not access the EZ during UXO operations at the site. Barricades will be positioned with a red (BRAVO) flag on access routes a minimum of the HFD or K328 distances for the selected MGFDs from the edges of the respective sites. Notification procedures will be posted on the barricades to ensure that non-essential personnel notify the team working in the area prior to entering the area during active operations. Barricades and red (BRAVO) flags will be removed when operations stop for the day.

Refer to MRP SOPs 01 and 03 for more detail on setup and preliminary activities.

17.2.4 Out-of-Box Tests

The following out-of-box tests will be conducted before the detector-aided survey and geophysical survey begin and at the start of each day of surveying:

- Inventory and inspect all equipment to confirm that all components are present and in good condition.
- Assemble the equipment and power up.

Refer to MRP SOPs 01, 03, and 05 for more detail on equipment out-of-box and start-up procedures.

17.2.5 Governing Regulations/Guidance and ESS

An ESS for MEC Operations is concurrently being prepared by Tetra Tech for the Full RFI and submitted through NOSSA to DDESB for approval (the approved ESS provided under a separate cover to all field personnel). All MEC/MPPEH-related work at NAPR will be conducted in full compliance with the approved ESS, provided as a separate document. Additionally, MEC/MPPEH activities will be performed in accordance with all local, state, and federal regulations, including all applicable DoD requirements

including those in Engineer Manual-1110-1-4009 (USACE, 2007a) and Data Item Description (DID) MMRP-09-005 (USACE, 2009). Activities involving work in areas potentially containing MEC/MPPEH hazards will be conducted in full compliance with the Military Munitions Division (CEHNC-CX-MM) of the Environmental and Munitions Center of Expertise (EM CX), Department of the Navy, and DoD requirements regarding personnel, equipment, and procedures. Navy requirements include OP-5 and NOSSAINST8020.15C. All activities involving donor explosives will be performed in accordance with Puerto Rico Explosive Law. In order to comply with Puerto Rico Explosive Law, all receipt, transport, and storage of donor explosives will be performed by Alpha Aggregate Inc., who is licensed under Puerto Rico Explosives Law. Alpha Aggregate Inc. will also be onsite during operations involving donor explosives.

The Full RFI is being conducted as part of the Defense Environmental Restoration Program (DERP) MRP and will be performed in accordance with CERCLA Sections 104 and 121.

The site where surveys that will be conducted may contain live munitions, and caution should always be exercised while working in the area.

17.3 SITE SURVEYING

Information for the survey boundaries, survey areas, and Phase I RFI results will be preloaded into the GPS unit by the GIS staff at the Tetra Tech office in Pittsburgh, Pennsylvania (Tetra Tech, 2011, Phase I results are presented in Attachment 1-4 of Volume II). This information will be used to mark the areas using stakes and flagging tape in the field. Figures 17-1, 17-2, 17-3, and 17-4 depict the survey transects and areas to be investigated as described in this SAP.

Survey locations described in the UFP-SAP will need to be established in the field so that anomalies can be efficiently reacquired. Evaluation of GPS accuracy must be made to determine the level of its use. If GPS signal reception is inadequate, a compass, tape measure, or survey wheel will be used to locate transects from a known location. Easy-to-see temporary markings will be used to mark the location of transects for vegetation management, and fiducial surveying will be set using short wooden survey stakes so the geophysical survey equipment can pass overtop (6-inch clearance required for equipment to pass). If tree canopy permits accurate integrated GPS data collection for positioning the geophysical data, this technique will be preferentially used to reduce survey time. Otherwise, the use of distance (fiducial) marks will be used to position the data by imprinting the geophysical data (by the operator pressing an instrument button) at regular intervals between known locations.

Refer to MRP SOP 05 for more detail on GPS surveying procedure.

17.4 VEGETATION MANAGEMENT

Brush cutting/vegetation management will be kept to a minimum during the Full RFI due to the valuable ecological resources on site, which includes threatened and endangered species on NAPR. Ecological sensitivity must be taken into consideration during the planning and implementation of all vegetation management activities.

No trimming or cutting of trees greater than 2 inches in diameter is permitted between March 15 and August 30 except in an emergency. Prior to any vegetation management of trees, a permit must be acquired from the Department of Natural and Environmental Resources (DNER) Humacao Regional Office. A clear overview of the existing vegetation and scope of work to be performed (pertaining to trees) is required. A copy of the approved DNER permit will be on site and reviewed with Tetra Tech vegetation management personnel prior to the start of this activity.

Contact information from the DNER Humacao Regional Office is as follows:

(787)852-4467/(787)852-4440
PO Box 8448
Humacao, PR 00791

Brush and grass can present impediments to positioning the metal detectors in close proximity to the ground surface. The degree of brush/vegetation management necessary at each subarea will be determined by site conditions at the time of fieldwork and will be accomplished in accordance with Tetra Tech MRP SOP 06 (Vegetation Management at MEC Sites). The following are the types of equipment/techniques that may be used:

- Hand-held brush cutters (string or blade) will be used to cut light vegetation and small grassy areas.
- Chain saws will be used in heavier brush areas and to cut small trees up to 2 inches in diameter (as necessary and as per the DNER permit).
- Brush/vegetation debris will be left on site at the edge of the area cleared.

The UXO team will conduct brush cutting/vegetation management operations. However, if it is necessary to use subcontractors, a UXO escort will be provided during subcontractor brush/vegetation management operations.

17.5 INSTRUMENT VERIFICATION STRIP

To test the capabilities of the Schonstedt GA-52Cx, White's XLT, (or equivalent equipment), and subsurface geophysics equipment, the UXOQCS and Site Geophysicist will use a Geophysical System Verification (GSV) to provide rigorous QA/QC of MEC survey performance. The Environmental Security Technology Certification Program (ESTCP) developed the GSV specifically for UXO work. Each operator will perform the IVS described in the subsequent section and demonstrate the required proficiency of equipment operation. If new equipment or new operators are necessary, then both operator and equipment will need to be tested on the GSV. The GSV generally includes two main components, an IVS and a production area blind seeding program.

The specific objectives of the IVS are as follows:

- Demonstrate that the detector-aided survey equipment and geophysical equipment are operating properly.
- Provide a safe area with a known set of isolated objects for testing detection with the survey equipment.
- Assess operator performance.
- Evaluate detection of seed items. The UXOQCS or SUXOS and Project Geophysicist will determine whether the IVS performance is acceptable, and consequently when survey work may begin.

IVS Survey Procedure

An IVS representing the subareas will be developed and used as a QA tool. The IVS will be established in a clear (unvegetated) area chosen to avoid cultural areas potentially containing clutter that might interfere with the ability of the geophysical instrument(s) to definitively detect the seed items. The IVS will be located in an area suitable to remain seeded for the duration of the project in the event that different equipment or operators need to be tested. To streamline the process of locating a suitable test site, the IVS area used for the Phase I RFI will be reused for the Full RFI (Figure 17-5) (Tetra Tech, 2011, Phase I results are presented in Attachment 1-4 of Volume II). A utility clearance and/or dig permit will not be required prior to establishing the IVS because the area was previously cleared.

Before the start of the surveying activities, site operators and associated detector-aided or geophysical survey methodologies planned for site work must successfully perform the initial IVS and must be given approval to move on to site production work. Following the initial IVS, data will be collected over the IVS at the beginning of each fieldwork day, and assessment of the data will be made by the UXOQCS or SUXOS and Site Geophysicist before proceeding with survey work for the day. The IVS DGM surveying is planned with integrated GPS because it is expected that conditions will permit its use on all or most of the subareas, and this will also test the setup with the most equipment operated by the geophysical operator. If GPS cannot be used due to poor satellite reception, an alternate positioning technique such as compass and tape measure or fiducials will be employed.

IVS Seeding

Tetra Tech will seed the IVS using ISOs. Prior to seeding the area with ISO items, the UXO team will conduct a detector-aided surface survey of the selected IVS location to ensure that the area is free of anomalies and to evaluate instrument response to site background conditions. Tetra Tech will bury the seeds horizontally in a well-marked straight line at least 10 feet from one another to allow survey passage directly over top of the emplaced seeds. Each seed item will be labeled with a unique identifier, photographed (open hole), and located in relation to the IVS survey ends, which will also be located. Depths, orientations, and physical descriptions of the seeds will be accurately documented. Seed items burial depths are presented in the following table.

Seed Item	Burial Depth
Small ISO (1-inch-diameter 4-inch-long pipe)	3 inches
Small ISO (1-inch-diameter 4-inch-long pipe)	6 inches
Medium ISO (2-inch-diameter 8-inch-long pipe)	12 inches

IVS Disassembly

The IVS will be seeded for the duration of the project to allow for daily testing of the equipment prior to work on the investigation subareas. After project work is complete, the IVS items will be removed from the IVS plot, and the holes will be backfilled and restored.

17.6 GPS POSITIONAL DATA COLLECTION

The UXO team will collect GPS data in accordance with MRP SOP 05. A sub-meter-accuracy GPS unit (e.g., Trimble GeoXM or GeoXH) will be used to collect positional data during the Full RFI. SWMU 77 is located on a remote peninsula with no surveyed monuments located on the peninsula, local landmarks at

locations to be determined in the field will likely be used during the Full RFI. Possible landmarks include the concrete wall at the Rifle Range Subarea and the shed at the Pistol Range Subarea. Positional data from the select monuments or markers will be collected twice daily. The GPS data will be used to accurately record the positions of surface and subsurface suspect MEC, MPPEH, and munitions-related debris. Tetra Tech GIS personnel will load site boundaries, transect end point locations, known cultural/terrain features that may affect surveys, and background maps into the GPS prior to deployment. GPS data collected during the investigation will be stored in the GPS and downloaded to a personal computer daily or as soon as possible. Data will also be manually entered into a field log as it is collected. All data will be collected in North American Datum (NAD) of 1983 Puerto Rico and Virgin Islands Coordinate System 83 in U.S. survey feet. Once downloaded from the GPS unit, the data will then be uploaded for processing to the MRP Data Repository website located at http://www.ttnus.com/MrpRepository/Login.aspx by Tetra Tech GIS personnel.

If GPS accuracy is not sub-meter for detector-aided surveys, data will not be collected until more satellites are available and the accuracy criteria specified in Worksheet #12 are met, or an alternative positioning technique will be employed (e.g., compass and tape measure, fiducials).

17.7 DETECTOR-AIDED SURVEYING

The UXO team will survey the surface at the Rifle Range Subarea; surface surveys are not planned at the Potential OB/OD Subarea or the Potential Munitions Trench Subarea. Additionally, the geophysical crew will be accompanied by a UXO escort during all fieldwork and geophysical mapping at the Potential OB/OD Subarea and Potential Munitions Trench Subarea. The UXO escort will conduct a detector-aided survey to ensure that boundary stake and grid corner stake locations are free of subsurface anomalies prior to stakes being driven. No surface MEC/MPPEH are expected to be encountered at these two subareas; however, the UXO escort will conduct a visual survey of the ground surface ahead of the geophysical instrument survey as a precaution.

17.7.1 <u>Scope</u>

The Full RFI detector-aided surface survey using the Schonstedt and White's Spectrum XLT all-metals detectors and intrusive investigation (hand digs) will be conducted as shown on Figure 17-1 (transect locations and intrusive investigation locations). The Phase I RFI results will serve as a guide as to where anomalies are located; however, rather than reacquiring previous anomalies in all areas, anomaly identification will be "redone" real time in select areas to focus efforts on actual anomaly

locations rather than previous anomaly locations where GPS coordinates may be off by several feet (Tetra Tech, 2011, Phase I results are presented in Attachment 1-4 of Volume II).

Any surface MEC/MPPEH and non-munitions-related metallic debris encountered, if a manageable size/weight will be removed from the work area. All shallow subsurface anomalies identified during surveying will be marked and all anomalies will be intrusively investigated in real time using manual techniques (hand digs). Intrusive investigations are being conducted to determine the source of each anomaly, and in doing so determine if subsurface MEC/MPPEH is a concern. The areas planned for surveying would have received the majority of fire and any dud ammunition during training events. MEC/MPPEH items present at the site would be the result of munitions fired at the berm or targets or used at the surface. It is unlikely that these items would have penetrated into subsurface soil to any significant degree. MEC suspected at the ground surface or in the shallow subsurface soil only.

17.7.2 UXO Escort Operations

The geophysical crew will be accompanied by a UXO escort during all fieldwork and geophysical mapping during its work at the Potential OB/OD Subarea and Potential Munitions Trench Subarea. No surface MEC/MPPEH are expected to be encountered at these two subareas based on the Phase I RFI results; however, the UXO escort will conduct a visual survey of the ground surface ahead of the geophysical instrument survey as a precaution. The sampling crew will similarly be escorted during work at the two subareas plus at the two target berm areas at the rear of the Rifle Range Subarea (see MC SAP for sampling information).

1. If any MEC/MPPEH are encountered by non-UXO personnel, the item will be avoided. The UXO escort will not attempt to identify the type or condition of the ordnance. Its location will be reported to the UXO team leader, and the item will be flagged for avoidance and addressed after the conclusion of UXO escort operations in the area. Potential exposure to chemical warfare material (CWM) at the site is not anticipated. In the event that hazardous, toxic, and radiological waste (HTRW) is encountered on site, the work site will be evacuated upwind until the Project HSM and Navy RPM identify and implement appropriate protective measures. All documented disposal of HTRW will be in accordance with the Navy's Low-Level Radioactive Waste (LLRW) Disposal Progam. No personnel will remain downwind in the event of a chemical release even though donning escape masks.

2. The UXO escort will clearly mark any area with visible MEC/MPPEH, and the area will be avoided. The visible MEC/MPPEH will be noted on field log sheets or in the field logbook. The UXO escort will report the MEC to the UXO team leader.

3. No ordnance, munitions, explosives, or ordnance-related materials will be moved, removed, or disposed of during UXO escort duties.

4. The UXO escort will conduct UXO avoidance surveys for all proposed survey stake locations using a metal detector to check for possible MEC/MPPEH. If an anomaly is encountered or if the UXO escort suspects the presence of MEC, the proposed stake location will be relocated to an area free of concerns/anomalies.

17.7.3 Detector-Aided Survey Instrumentation, Methods, and Standards

The Schonstedt GA-52Cx or equivalent will be used as the primary survey instrument to conduct detector-aided surveys at the subareas. In addition to the Schonstedt, a White's Spectrum XLT all-metals detector, or equivalent, will be used during the IVS setup and in survey areas. The White's Spectrum XLT has reduced depth detection capabilities but has the added capability of detection of nonferrous metals. Given the nature of the subareas where mostly unknown ordnance (either ferrous or nonferrous) was employed, this is the best combination of technology based on industry standards.

The Schonstedt GA-52Cx and White's Spectrum XLT are expected to detect the anticipated munitions to a depth of approximately 11 times the diameter of the target item. The White's has the added capability of detection of nonferrous metals. To test the detector-aided survey instruments, the UXO team will verify instrument response using the newly installed IVS established by the UXOQCS. To test the detector-aided surface survey instrument, the UXOQCS will use blind seeding in the production area. The blind seed items will be placed on the ground surface in locations free from anomalies at a minimum frequency of one and a maximum frequency of six blind seeds per estimated daily lot of work. The daily lot of work will be determined by the SUXOS based on field conditions and estimated production rates at the time of the surveys. The blind seed items will be ISOs of similar size and material as the defined targets for the site IVS as described in Section 17.5.

The detection depth capabilities of the Schonstedt GA-52Cx and White's Spectrum XLT are limited by the size and orientation of the target and soil characteristics of the work area. These instruments provide an audio signal for response but do not store data (analog). The Schonstedt GA-52Cx magnetic locator (magnetic gradiometer) does not need to be calibrated. The White's Spectrum XLT all-metals detector requires setup to establish the sensitivity setting for UXO detection (see MRP SOP 1, Table 1, for settings). To ensure that each detector is operating properly, the operator turns on the instrument and slowly moves the locator towards metal. As the probe advances toward the target, the audio signal will

increase. Failure to detect the object is reason to reject the instrument. The detector will be checked at the start and end of each day during MEC activities and after any battery change. UXO Technicians will also conduct random checks during daily operations.

17.7.4 Discovery of Chemical Warfare Material

Potential exposure to CWM on this site is not anticipated. In the event that CWM is located or suspected, Tetra Tech personnel will evacuate the area immediately in an upwind direction from the CWM, secure the site, and request assistance from the Navy RPM.

Upon discovery of suspect CWM, the responsible UXO Technician III will:

- Ensure that all personnel are clear of the area
- Maintain security of the area until relieved

After the area is clear and secured, the responsible UXO Technician III will:

- Notify the Tetra Tech UXO/MEC Program Manager
- Notify the Tetra Tech PM
- Notify the Navy RPM
- Stop all field operations
- Assemble the crew at a designated assembly point
- Stand by to provide assistance as required

If directed, UXO personnel will take emergency non-invasive actions such as covering the item with plastic sheeting or placing sandbags around the item.

Refer to MRP SOP 01 for more detail on detector-aided survey procedures.

17.8 GEOPHYSICAL EQUIPMENT CALIBRATION, MAINTENANCE, TESTING, AND INSPECTION

Geophysical sensors and support equipment, navigation equipment, and operator performance will be tested at specific intervals and must meet the appropriate acceptance criteria. Worksheet #12 lists additional tests or checks, their required frequencies, and acceptance criteria. Additionally, calibrations

and other equipment setup information are detailed in Worksheet #22. Initially, out-of-box tests are planned and detailed below.

17.8.1 Geophysical System Verification

A GSV will be performed to provide rigorous QA of MEC geophysical survey performance. The GSV is intended only to test the geophysical instruments (Schonstedt, White's, and EM-61 MK2). The GSV is a tool developed by ESTCP specifically for UXO work because the inherent safety risks associated with the work. The GSV includes two main components, an IVS, and blind seeding in the production area. Each process is described in more detail below.

The GSV and geophysical investigations will be managed and performed by a qualified Project Geophysicist and Site Geophysicist who meet the requirements stated in United States Army Corps of Engineers (USACE) DID OE-025.02 (4), the UXOQCS, and the UXO team. At least one UXO Technician II or higher will be present throughout the IVS installation and geophysical investigations to provide UXO avoidance support. Worksheet #7 describes the personnel qualifications and experience for these positions. Each operator will perform the IVS described in the subsequent section and demonstrate the required equipment operation proficiency. If new equipment or new operators are necessary, both operator and equipment will need to be tested in the IVS.

17.8.2 Instrument Verification Strip

IVS objectives, procedures, seeding, and disassembly are described in Section 17.6.

17.8.3 Geophysical Blind Seeding Program

Blind seeds will be small and/or medium ISOs for the detector-aided survey instruments, and DGM survey seeding will use medium ISOs that will be buried, shallow depths to test their detection and response values with the geophysical instrument in the survey areas. Blind seeds for the manual intrusive investigation will be buried within 2 feet of the pen flag marking the location of the anomaly. Blind seeds for the test pits will be buried along the line marked for trenching. The ISOs will be buried at a frequency of one to six per daily lot of work and at depths not to exceed the depth of the IVS, which should generate a mid- or high-level response in the horizontal orientation.

17.9 DIGITAL GEOPHYSICAL MAPPING

Geophysical data collection is planned at the Potential OB/OD Subarea and Potential Munitions Trench Subarea.

17.9.1 Geophysical Surveys and Positioning

Subsurface MEC are possibly present at Potential OB/OD Subarea and Potential Munitions Trench Subarea. Geophysical data will be collected at each subarea where specified (i.e., subsurface MEC/MPPEH suspected in the accessible portions of the established survey areas to search for and locate anomalous areas identified during the Phase I RFI) (Tetra Tech, 2011, Phase I results are presented in Attachment 1-4 of Volume II). Although the planned geophysical methods can detect anomalies created by small to large metallic objects such as MEC items, the methods cannot identify what the detected anomalies represent. The planned geophysical methods alone cannot differentiate whether MEC or some other metallic object is present at the location of a detected anomaly within the investigation subareas. Based on previous survey results and results of the geophysical survey performed to reacquire and further define the previous identified anomalies, the Site Geophysicist (in consultation with the PM) will identify in the field which anomalies/areas are to be intrusively investigated to determine the sources of the anomalies.

Geophysical survey data collected along transects will be from a single operator using both the Geonics EM-61 MK2 with standard coil and EM-61 MK2 HH (hand held) to address excavation depth requirements in Worksheet #11 of 2 feet and 4 feet bgs. The EM-61 MK2 HH was selected due to its portability and ability to maneuver in vegetated areas. Although the depth of detection is suitable for typical range munitions, the areas being investigated have the potential for munitions to be buried at deeper depths; therefore, the EM-61 MK2 with standard coil will be used in areas believed to require addition depth penetration. This will require additional vegetation management in most of the targeted areas. The EM-61 MK2 with standard coil is believed to be most useful in evaluating the eastern suspect trenches in the Potential Munitions Trench Subarea. An approximate 2-foot survey width is expected for geophysical surveys; however, the lateral detection capability will be generally dependent on the size, orientation, and depth of the buried item near the survey line. Larger shallower items can be detected further to the side of a survey line than smaller deeper items. Data station intervals will be determined with the suspected MEC sizes in mind to provide adequate sampling for the smallest suspected MEC sizes. These intervals are normally controlled by survey speed and acquisition rate (readings per second) but may also be controlled by a survey wheel in some cases.

Data will be collected where the ground surface is accessible, and a UXO visual surface survey will precede geophysical surveying. Non-munitions-related debris may be removed from the work area by the UXO Technicians to aid in the geophysical surveying, as allowed by the ESS (provided to field personnel under a separate cover) (see Section 17.7 for procedures). This will avoid mapping of anomalies that are not of concern. Accessibility is defined as surface conditions that impact the ability to safely and effectively survey a given area. The location and size of any inaccessible areas will be recorded via GPS. These areas, if any, will be determined at the discretion of the field team and will be addresses with project management during daily conference calls.

Geophysical data anomalies and relative locations or absolute locations (only when using GPS) can be stored automatically. A sub-meter accuracy category GPS unit is planned for geophysical surveying; however, GPS signal reception will need to be monitored while data are being collected using the GPS accuracy criteria specified in Worksheet #12. Monitoring is required because site conditions (e.g., tree canopy) may prohibit accurate positioning with GPS, and it may be necessary to use an alternative positioning technique (e.g., tape-measured grid, or fiducial). The GPS survey will most likely use local landmarks rather than third order monumentation as surveyed monuments are not located on the SWMU 77 peninsula. The monuments or markers (e.g., local landmarks) will be visited twice each day, at the start of each day and toward the end of each day. Gaps in the geophysical data due to unusable data or data that could not be positioned will be evaluated to determine whether they are sufficiently large enough to warrant data recollection in those areas. If a data gap of more than 10 feet occurs, then the data in the area will be recollected. If caused by a gap in gps coverage, then fiducials will be used. The geophysical team will be responsible for positional data for non-munitions cultural features at a given subarea that might affect geophysical data interpretation (to include culverts, power lines, fencing, etc.).

All geophysical crews will be accompanied by a UXO Technician II or higher during all fieldwork and geophysical mapping. Before the crew sets monuments or drives stakes, the UXO Technician will conduct a detector-aided surface survey and visual survey for surface MEC/MPPEH (a magnetic locator or electromagnetic survey of the site to ensure that it is free of anomalies).

17.9.2 GEOPHYSICS SURVEY RATIONALE FOR POTENTIAL OB/OD AND POTENTIAL MUNITIONS TRENCH SUBAREA

Survey Rationale

The Full RFI geophysical survey will be conducted within same footprints as the Phase I RFI, focused on the areas of anomaly clusters and large amplitude anomalies identified at the Potential OB/OD Subarea

during the Phase I RFI and the areas of linear anomalies identified near the historic road at the Potential Munitions Trench Subarea during the Phase I RFI (Tetra Tech, 2011, Phase I results are presented in Attachment 1-4 of Volume II). Subsurface MEC may be present in each of these investigation subareas. The EM-61 MK2 HH will be used to reacquire the targeted anomalies identified on Figures 17-2, 17-3, and 17-4. The instrument was used during the previous survey because it is portable in a wooded setting (minimizing brush clearance) and can detect small to large MEC in the subsurface. It is being used as the primary instrument for reacquisition to best match the previous survey data. The EM-61 MK2 HH was selected over the EM-61 MK2 with standard coil because it is portable, which is important for the NAPR project because of sensitive ecological habitat. In particular, wooded areas need to be traversed to access the grassy trench areas. The EM-61 is capable of detecting ferrous and non-ferrous metals. The EM-61 MK2 with standard coil will be used in areas where the potential MEC may be at deeper depths; the EM-61 MK2 HH appeared ineffective at these depths based on the results of previous surveys. The survey detection depth capability depends on the size of the potential item and will increase for larger items (more metal mass and diameter). The EM-61 MK2 with standard coil is expected to have a maximum depth of penetration of over 10 feet for large objects or clusters of objects; whereas, the hand-held coil is not expected to be effective at depths over 5 feet. The standard coil is typically configured as a trailer and will require additional clearing activities in the areas where it is used.

Scope

The scope of geophysical survey activities at Potential OB/OD Subarea (see Figure 17-2) and Potential Munitions Trench Subarea (see Figures 17-3 and 17-4) is summarized as follows:

Potential OB/OD Subarea

- The focus of the Full RFI will be the level grassy area where berms, if any, were most likely constructed to support OB/OD operations. MEC/MPPEH burial may have occurred in this area, and subsurface MEC/MPPEH may be present. Where a detonation occurred, kick-out would have thrown dirt and pieces of the detonated items outward from the detonation location. Because munitions are not fired from a weapon during detonation, the maximum probable depth from kick-out was estimated to be approximately 1 foot bgs. MEC/MPPEH may also be present in the subsurface because munitions are commonly buried prior to detonation via OB/OD to suppress the explosion and minimize noise. Duds, misfires, or partial destructions could result in MEC/MPPEH hazards at 4 feet bgs or deeper in the subsurface soil of the detonation areas; however, because of shallow bedrock at the subarea, depths are expected to be less than 4 feet.

- Phase I RFI results will serve as a guide as to where anomalies are located; however, rather than reacquiring previous anomalies, anomaly identification will be "redone" in real time (Tetra Tech, 2011, Phase I results are presented in Attachment 1-4 of Volume II). Geophysical surveying will be conducted across the planned survey area (shown on Figure 17-2) using a meandering path where necessary in inaccessible areas, or, otherwise, 2-foot transect spacing. During the geophysical survey, in real-time, the Site Geophysicist will identify areas for manual intrusive anomaly investigation (hand digs), estimated to be approximately 16 suspect locations, and areas for mechanical intrusive anomaly investigation (test pits) estimated to be four locations. Intrusive investigations will be conducted at anomaly clusters and large amplitude anomalies to determine the sources of the select anomalies, and in doing so to determine if subsurface MEC are a concern.

- Locations for intrusive investigation are shown on the figures, and MC sampling is addressed in accordance with a separate MC UFP-SAP.

Potential Munitions Trench Subarea

- The Full RFI geophysical survey will be conducted in the eastern portion of the site in the same area as the Phase I RFI, focused in the area of the linear anomalies. During typical trench burial operations, munitions to be disposed of are laid in the trench, the trench is backfilled with soil, and operations then proceed to a new trench. The likelihood of MEC being encountered on the surface is minimal, nor was surface MEC/MPPEH previously encountered. Subsurface MEC/MPPEH are of primary concern at this subarea. The maximum depth of subsurface MEC is assumed to be 4 feet bgs based on site-specific conditions (shallow bedrock suspected) and Phase I RFI results. (Tetra Tech, 2011, Phase I results are presented in Attachment 1-4 of Volume II)

- Phase I RFI results will serve as a guide as to where anomalies are located in the eastern trench areas; however, rather than reacquiring previous anomalies, anomaly identification will be "redone" in real time (Tetra Tech, 2011, Phase I results are presented in Attachment 1-4 of Volume II). Geophysical surveying is planned across the survey area (shown on Figure 17-3 and Figure 17-4) using a meandering path where necessary in inaccessible areas, or, otherwise, 2-foot transect spacing.

- During the geophysical survey, in real-time, the Site Geophysicist will identify areas for mechanical excavation (test pits) estimated to be at two to three locations per trench disposal area. Intrusive investigations will be conducted along linear anomalies, which may represent trenches, to determine

the sources of the linear anomalies, and in doing so to determine if subsurface MEC/MPPEH are a concern.

- Geophysical surveys will also be conducted at potential former trench areas located in the western portion of the subarea to confirm anomalies are not present at the Potential Munitions Trench Subarea. An EM-61 MK2 HH will be used because it is portable and can be more easily used in a wooded setting, minimizing brush clearance.

- Locations for intrusive investigation are shown on the figures, and MC sampling is addressed in accordance with a separate MC UFP-SAP

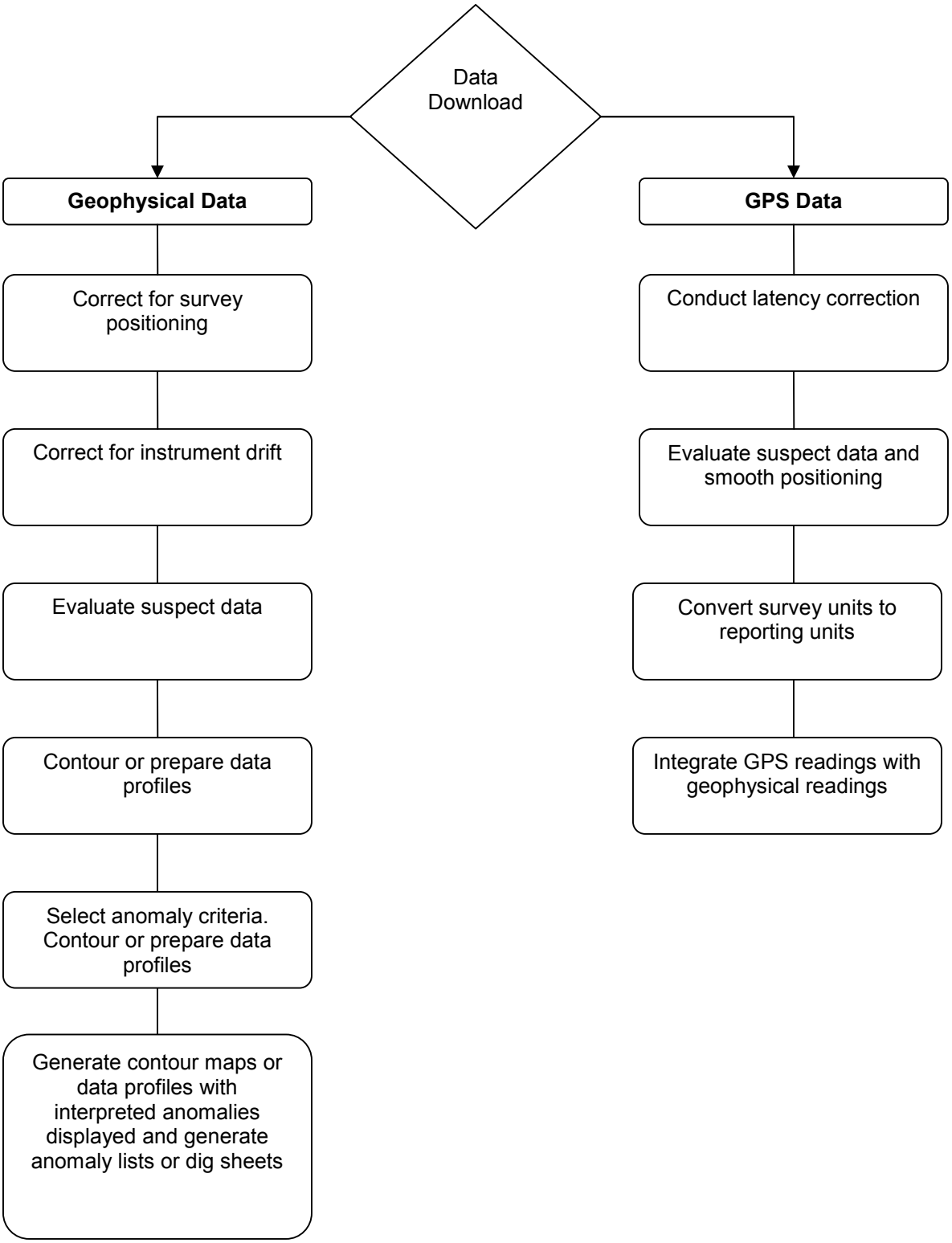
Geophysical Surveying

A Geonics EM-61 MK2 HH and EM-61 MK2 with standard coil are planned for use at these subareas because the suspected targets are potential MEC, and these instruments are industry standard instrument for these types of investigations. The geophysical team will conduct the geophysical survey along accessible portions of the planned transects along a meandering path where necessary in inaccessible areas, or, otherwise, at 2-foot spacing.

17.10 GEOPHYSICAL DATA PROCESSING AND INTERPRETATION

All geophysical data will be processed as soon as possible. After the geophysical data have been backed up, the data will be copied to the processing computer and imported into geophysical data processing and mapping software (Geosoft-Oasis montaj). This software will be used to process, analyze, and present the findings of the geophysical surveys. The processing and analysis will consist of applying standard corrections to the data, producing data profiles to interpret the data, and identifying responses that could be associated with individual anomalies that represent MEC (this process is depicted in the flowchart below). The geophysical team will prepare a detailed map and anomaly target list for each subarea that depicts the northing and easting locations of all anomalies that meet the identification criteria of potential ordnance items. Each anomaly will be assigned a unique reference number for tracking and reporting.

GEOPHYSICAL DATA PROCESSING FLOWCHART



17.11 ANOMALY INFORMAL REACQUISITION

GPS coordinates of targets identified for reacquisition will be used to relocate the general area of the anomaly. The EM-61 MK2 HH will be used to relocate each anomaly, comparing both the position and amplitude of the anomaly with the previous target signature. The location will be marked in the field with a surface marker such as paint or a cone. Once identified, the area will be further surveyed to identify any other anomalies at that location that may also be of interest. The reacquisition is focused further by investigating a single targeted item per location. However, if multiple objects are located in the vicinity; a field decision will be made as to whether multiple items will be excavated or only the anomaly that best matches the previous investigation. Because the EM-61 MK2 HH appeared to be ineffective in identifying several of the eastern trenches during the Phase I RFI (based on comparison with the EM31), the EM-61 MK2 with standard coil will be used to identify and locate metallic anomalies in the eastern trench areas at the Potential Munitions Trench Subarea.

17.12 MANUAL ANOMALY INTRUSIVE INVESTIGATION - HAND DIGS

The number of subsurface anomalies designated for intrusive investigation at the Rifle Range Subarea will be determined in the field based on the results of the detector-aided survey. All anomalies identified at the Rifle Range during the Phase I RFI will be reacquired and will be intrusively investigated (hand digs) (see Figure 17-1 for Phase I RFI anomaly locations) (Tetra Tech, 2011, Phase I results are presented in Attachment 1-4 of Volume II). Anomalies will be cleared to a depth of 2 feet bgs, excavations will be conducted until the sidewalls and bottom of each excavation are clear of anomalies or the 2-foot-bgs depth is reached, and to a horizontal distance of 2 feet from the pin flag, in all directions. During the geophysical survey at the Potential OB/OD Subarea, in real time, the Site Geophysicist will identify areas for intrusive anomaly investigation (hand digs), estimated to be 30 locations (see Figure 17-2 for approximate locations).

Each intrusive “dig team” will consist of two qualified UXO personnel including at least one UXO Technician II or higher. Dig teams will be supervised by a UXO team leader (UXO Technician III) who will be able to supervise up to three dig teams at one time as long as visual and verbal communications can be maintained between the UXO team leader and his assigned dig teams. Intrusive activities will not begin until the UXOSO has given a safety briefing, the SUXOS has given a site-specific operations briefing, communications are established, and all non-essential personnel are evacuated outside the EZ. Authorized visitors will be allowed to enter the EZ during intrusive operations in accordance with requirements in NOSSA guidance, OP-5, and the DDESB-approved ESS.

If a UXO team member discovers a suspect MEC/MPPEH item, he/she will: (1) call for a temporary work stoppage within the team's work area and (2) request that the SUXOS identify and/or verify the identity of the item and the hazards associated with it. The SUXOS will have ultimate responsibility for proper identification of the item and its condition, and only the SUXOS can declare that an item is safe to move. Suspect MEC/MPPEH items that are not safe to move will be secured in place, and the SUXOS will coordinate for treatment of the item with a donor charge using blow-in-place (BIP) procedures. If MEC/MPPEH are deemed safe to move, the UXO team may transport the item(s) to collection point established at the site by the SUXOS for recovered MEC/MPPEH that are determined safe to move and awaiting disposal. This collection point will be under the control of the SUXOS until the item has been thermally treated by detonation. The purpose of the collection point is to facilitate tracking of smaller items that are not easily seen if left in place. The ESQD arc created by the NEW for each collection point will not extend beyond that established for the site, which will allow site operations to continue.

Upon finding a MEC/MPPEH item, the UXO Team will assign a unique name to each MEC/MPPEH item found, take a digital photograph of the item, and record the items location with a GPS. The MEC/MPPEH Tracking Logs provided in Attachment 2 will be completed daily by the SUXOS. The UXO team leader will document all information in a logbook and report pertinent information to the SUXOS for inclusion in the daily report. Information documented by the UXO team leader will include, at a minimum, the length, width, and depth of each excavation, the location(s) excavated, and a description of each MEC/MPPEH removed along with general descriptions and weight. Non-munitions items removed will likewise be recorded.

The UXOQCS will conduct QC of excavation. Upon completion of each excavation, the cleared soil will be backfilled and compacted within the excavation. Excavations will be closed prior to the end of the day. If it is not possible to backfill an excavation prior to the end of the day, caution tape and snow fencing may be used to surround the open trench overnight.

17.12.1 Archeological Discovery

If archeological items are encountered during the field work (e.g., fragments of pottery), the location will be flagged and recorded via GPS. The item(s) will be left in place and the location(s) will be avoided until direction is received from the project archeologist at NAVFAC SE. The project archeologist can be contacted as follows:

Darrell Gundrum
NAVFAC SE Archeologist
Phone: (904)542-6844
e-mail: darrell.gundrum@navy.mil

17.13 MECHANIZED ANOMALY INTRUSIVE INVESTIGATION - TEST PITS

Test pitting activities will be conducted at the Potential OB/OD Subarea and Potential Munitions Trench Subarea. The locations of the test pits will be determined based on real-time results of the geophysical surveys to investigate and determine the sources of the anomaly clusters, large amplitude anomalies, and/or linear anomalies identified at these subareas during the Phase I RFI (Tetra Tech, 2011, Phase I results are presented in Attachment 1-4 of Volume II). If the presence of these anomalies is determined to be munitions-related and/or landfilling related, the test pitting will also acquire data on the type, depth, and volume of munitions related items, non-munitions related items, and soil characteristics in these areas. If the water table or bedrock is encountered at a given location, test pitting will be discontinued at that depth.

17.13.1 Scope

Test pitting activities will be conducted at the Potential OB/OD Subarea and Potential Munitions Trench Subarea. During the geophysical survey at these subareas, in real-time, the Site Geophysicist will identify areas for mechanical excavation (test pitting), estimated to be four locations at the Potential OB/OD Subarea, two to three locations per trench disposal area in the eastern portion of the Potential Munitions Trench Subarea, and if anomalies, which appear to be indicative of trenches, are identified at on the western side of the Potential Munitions Trench Subarea, intrusive investigation via hand digs or mechanical investigation will be conducted.

17.13.2 Methods and Procedures

Test pitting is considered an explosive operation and will follow all applicable explosive-related procedural and safety requirements. The test pitting team will initially consist of, at a minimum, a UXO team leader, heavy equipment operator (who will be an UXO technician), and two UXO Technicians to remove, investigate, and clear MEC/MPPEH from the excavated material.

Upon completion of detector-aided surface surveys, surface MEC removal, and subsurface geophysical surveys, test pitting activities (to a maximum depth of 4 feet bgs) at the Potential OB/OD Subarea and Potential Munitions Trench Subarea will begin with soil excavation with a hydraulic excavator, or

equivalent, by an equipment operator. The primary MGFD does not require shielding during excavation; however, if an item that requires shielding is found during excavation and is not larger than the contingent MGFD, work will be halted and the shielding required for the contingent MGFD will be installed. A hydraulic excavator or equivalent will be used for excavation operations. During excavation activities, a UXO Technician will be present to observe the excavation process and identify any visible MEC/MPPEH. Soil and debris contents of the excavator bucket will be spread on the ground near the excavation, investigated, and cleared of MEC/MPPEH and other non-munitions debris larger than 20 mm in size (size of smallest MEC item) by UXO Technicians. During investigation and removal operations, no more than 1 cubic yard (CY) of soil will be spread on the ground at a time, no more than 8 inches deep. The UXO Technicians will perform a 100-percent detector-aided surface survey of the spread soil. Each UXO Technician will work with a dig team partner. Each of the UXO Technicians will perform survey and investigation of any targets within the spread soil. After MEC/MPPEH/scrap metal and other non-munitions debris is removed, the remaining soil will then be placed in the cleared soil pile. A piece of polyethylene sheeting will be placed on the ground prior to the establishment of cleared soil pile(s) to minimize the introduction of small metallic items and small arms (less than 20 mm), and the unintentional surface spreading of potentially MC-contaminated subsurface soil into already cleared surface soil. Test pitting excavation operations will continue in batches as described above until the end of the work shift or until the trench has been characterized.

The test pitting operation at these subareas is not intended to remove all MEC/MPPEH and non-munitions debris items but to acquire data on the type, depth, and volume of MEC/MPPEH and non-munitions debris within the selected trench area. Test pit operations will be observed by two UXO Technicians from outside the swing arc of the mechanized equipment. If an item larger than the primary MGFD is found that requires shielding, the UXO team will observe the excavation from behind a blast shield. If MEC/MPPEH are observed in the excavated test pit, the operation will temporarily stop. For health and safety purposes, the UXO Technicians will investigate the MEC/MPPEH item and determine if it is safe to move, personnel will not enter a test pit greater than 4 feet deep. The depth of each test pit will be determined in the field with the purpose of determining the approximate depth of buried MEC/MPPEH. Unfuzed safe-to-move items may be moved to a central location determined by the SUXOS for later explosive treatment. Items determined to be unsafe to move will be treated with BIP procedures.

Upon completion of the excavation, the cleared soil will then be backfilled and compacted within the test pit area, and the area will be seeded with grass.

Depending on the amount of potential MEC/MPPEH-related debris, non-munitions debris, and/or metal fragments remaining, these items will be removed either by hand or by using a magnet and collected in plastic containers. Easily identifiable MPPEH will be segregated from other metal material during this collection process. Metal debris collected and MPPEH identified will be brought to a separation area for segregation. Two UXO Technicians will separate the MPPEH from the other metal debris through visual inspection.

MPPEH will be transported to a designated area for storage. In the event that MEC are discovered at this process area, the SUXOS and UXOQCS will be called immediately for identification and disposition. The UXO team leader will maintain a daily log recording, at a minimum, the length, width, and depth of the excavated test pit (and test pit corners if possible), the location(s) excavated, and a description of the MEC/MPPEH removed along with the estimated weight and estimated number of other metallic debris. Estimated weight and number of expended cartridges and bullets (small arms MDAS) removed will also be documented. If it is not feasible to determine precisely where each item came from, the UXO team leader will record a general observation and description.

The test pitting operation at NAPR will be self-performed by Tetra Tech with a team consisting of six personnel with responsibilities as follows:

- The SUXOS will be responsible for general oversight of the entire operation.
- The UXOSO/UXOQCS will be responsible for oversight of safety and QC.
- Two UXO Technicians (one Technician III and one Technician II or higher) will be responsible for conducting the detector-aided surface survey of the material and debris during excavation of each test pit for the presence of MEC/MPPEH.
- One UXO Technician (Technician II or higher) will be responsible for observing the excavations for the presence of MEC/MPPEH.
- One UXO Technician (Technician II or higher with operator's certification) will be responsible for conducting excavator operations.

Essential personnel must be provided protection equal to that provided for an unintentional detonation, from blast overpressure, fragments, and chemical exposure. The blast overpressure protection is provided by maintaining distances between the equipment operator and device contacting the MGFD

(e.g., the excavator bucket), and between the UXO Technician observing the operation and the device contacting the MGFD. This distance must not be less than K24 (i.e., distance between the operator and excavator bucket striking a potential munitions item) for the selected MGFD. The fragment protection is provided by placing equipment operators and UXO Technicians observing the operation behind shields constructed of material with thicknesses not less than those shown in the ESS (provided to field personnel under a separate cover) for the selected MGFD. Shielding requirements only apply for the MGFD at the Potential OB/OD Subarea and Potential Munitions Trench Subarea; mechanical operations are not planned for the Rifle Range Subarea. Chemical exposure protection is provided by on-site personnel carrying escape masks during operations while working inside the HFD. In the event of a chemical release all on-site personnel will immediately evacuate upwind of the affected area.

17.14 DONOR EXPLOSIVES HANDLING

17.14.1 General Requirements and Licensing for Explosive Acquisition

The explosives used for this project will be managed in accordance with Federal Acquisition Regulation 45.5, local and state laws and regulations, ATF Pamphlet 5400.7, DoD 6055.9-M, Department of Transportation regulations, OP 5, and applicable Puerto Rico guidance documents including the Puerto Rico Explosives Law. Tetra Tech shall have and, upon request, make available to any local, state, or federal authority a copy of the Alcohol, Tobacco, Firearms, and Explosives license or permit authorizing the purchase, storage, transport, and use of explosives.

17.14.2 Explosives Acquisition

Detonation explosives (donor charges) will be obtained from a local vendor such as Alpha Aggregate on an as-needed basis. No magazine is available at the station for storage of explosives. Transportation and delivery of explosives will be coordinated to ensure that explosive-laden routes are followed and that an escort meets and guides the delivery truck along the correct route.

Explosives will be purchased and shipped to Puerto Rico from a licensed vendor such as:

OMNI Explosives
(800)277-6664
P. O. Box 69
Marion, Arkansas 72364

Recovered MEC will be treated the same day discovered, if possible, or secured by Tetra Tech UXO specialists until treatment can be coordinated or until responsibility for its security is transferred per instructions from the NAPR POC (e.g., the SUXOS may be directed to transfer security to NAPR Security).

17.14.3 Initial Receipt of Explosives

The SUXOS and UXOSO/UXOQCS will be responsible for receipt of explosives from the commercial vendor. The SUXOS will coordinate all receipt and management of explosives.

Explosives delivered to the site will be inspected when received to confirm the content and quantity of the delivery by the Tetra Tech SUXOS and UXOQCS. Discrepancies will be reconciled at the time of receipt with the Tetra Tech SUXOS, vendor, Tetra Tech UXO/MEC Manager, and Tetra Tech PM. Documentation will address the discrepancy and the resolution.

17.14.4 Explosives Storage

No ATF-approved magazines will be available for this Full RFI. Explosives will be ordered as needed and consumed that same day. Once on site, explosives packages will be marked “LIGHT BOX” in accordance with OP 5 paragraph 11-2.6.4. Recovered MEC/MDEH will be managed as hazard C/D 1.1, Storage Compatibility Group (SCG) L, CD munitions will be manages as hazard C/D 6.1, SCG G, unless assigned differently by NOSSA (N82).

Discovered MEC/MPPEH items that are safe to move and cannot be treated the same day will be stored on site until they can be treated. The MEC/MPPEH will be left where found or moved to a collection point to keep better track of small items. Collection points will be flagged and their locations will be recorded with a GPS and in the SUXOS logbook. Security of MEC/MPPEH items will be the responsibility of the SUXOS until the items are treated or secured by Tetra Tech UXO specialists until treatment can be coordinated or until responsibility for its security is transferred per instructions from the NAPR POC (e.g., the SUXOS may be directed to transfer security to NAPR Security).

17.14.5 Explosives Transportation

Donor explosives to be used for thermal treatment of MEC/MPPEH items will be transported to the treatment area by the explosive vendor providing the explosives. Explosives will be inventoried prior to being issued by the SUXOS and transported from the issue point to disposal locations at the project site in accordance with ATF licensing requirements. During the transportation of explosives from the issue

point to the detonation area, blasting caps will be stored separately from main charges in an ATF-approved day box or by keeping a safe separation distance between the person carrying the explosives and the person carrying the blasting caps.

Only Tetra Tech UXO Technicians who are certified as being fully qualified to operate an explosive-laden vehicle and are medically certified to transport ammunition and explosives will transport donor explosives or MEC on site.

17.14.6 Explosives Receipt Procedures

Each item of explosives will be receipted from initial delivery to NAPR until the item is expended. Tetra Tech will maintain a list of individuals authorized to receive, issue, transport, and use explosives by position and title, and those individuals will assume accountability by signing the receipt documents. The end user of explosives will certify in writing that the explosives were used for their intended purpose. Receipt documents will be reconciled at the time of delivery, issue, and disposal inventory. The Tetra Tech SUXOS will document any discrepancies and report them to the Tetra Tech UXO/MEC Manager, Tetra Tech PM, Navy RPM, and others as required by law.

17.14.7 Explosives Inventory

The Tetra Tech SUXOS and Tetra Tech UXOSO/UXOQCS will physically inventory all explosives when received. The Tetra Tech SUXOS will document any discrepancies and report them to the Tetra Tech UXO/MEC Manager, Tetra Tech PM, Navy RPM, and others as required by law.

The following procedures will be followed upon discovery of lost, stolen, or unauthorized use of explosives:

- The Tetra Tech UXO/MEC Manager, Tetra Tech PM, and Navy RPM will be notified immediately by telephone and with a written report within 24 hours.
- Proper authorities (ATF and State Fire Marshall) will be notified in writing within 24 hours of the event.

All explosives will be expended during that day's treatment operation. No explosives will be stored on site. Documents will be completed showing final disposition of all explosives.

17.15 MEC MANAGEMENT – TREATMENT

If a UXO team member discovers a suspect MEC/MPPEH item, he/she will: (1) call for a temporary work stoppage of the team discovering the item and (2) request that the SUXOS identify and/or verify the identity of the item and the hazards associated with it. The SUXOS will have ultimate responsibility for proper identification of the item and its condition, and only the SUXOS can declare that an item is safe to move. MEC will not be moved until a positive identification is made by a UXO Technician III or higher, and the SUXOS concurs that the item(s) can be safely moved. Currently a moratorium is in place on the OB/OD of CS items. At no time will a CS item identified as MEC be moved. CS munitions that are identified as MEC will be flagged and recorded. Proper notification will be made and EOD support will be requested inall instances of chemical related MEC. Upon notification EOD will determine if the situation is either a level 1 or level 2 emergency response. This determination will be at the sole discretion of EOD:

Level 1: EOD responds and handles all treatment and final disposition of the item.

Level 2: EOD gives direction that the UXO qualified team will perform treatment and final disposition of the item. All treatment of CS MEC items will be performed using BIP operations.

Detonation operations will be performed on the day the non-CS MEC item is discovered or when donor explosives are received; treatment operations may be delayed due to availability of donor explosives from the vendor or requirements for advance notification of the Navy. If it is not possible to treat items the day of discovery, item will be secured by Tetra Tech UXO specialists until treatment can be coordinated or until responsibility for its security is transferred per instructions from the NAPR POC (e.g., the SUXOS may be directed to transfer security to NAPR Security). Treatment/disposal of MEC will be performed in accordance with MRP SOP 07. Suspect non-CS MEC items determined by the SUXOS to be safe to move can be moved in a sand-filled wood container to a collection point established to keep better track of small items, and the SUXOS will coordinate treatment of the item at that location or when donor explosives are received. The collection point will be under the control of the SUXOS until the item has been treated by donor charge. The ESQD arc created by the NEW for each collection point will not extend beyond that established for the site to allow site operations to continue. Suspect MEC items that are not safe to move will be secured in place, and the SUXOS will coordinate for treatment of the item with a donor charge using BIP procedures.

Any item that is not safe to move and/or cannot be treated the day that it is discovered will be flagged and its location marked for treatment by donor charge the following day. Security for treatment and BIP operations will be set outside the EZ, and the area will be checked for the presence of staff and intruders.

The EZ for intentional detonation of the primary MGFD is listed the ESS (ESS provided to field personnel under a separate cover, EZ in Table 6-2 of the ESS). Engineering controls may be employed to reduce the EZ associated with intentional detonation of the MGFD prior to treatment. Approved engineering controls are detailed in the ESS (ESS provided to field personnel under a separate cover, Fragmentation Data Sheet in Appendix B of the ESS), provided to field personnel under a separate cover. Engineering controls authorized by DDESB TP 16 may also be implemented. Deviations from approved engineering controls will require NOSSA approval prior to implementation.

The treatment area will be cleared of vegetation to minimize the chance of a fire during detonation with a donor charge. The treatment area will also be cleared of all metal debris to eliminate the chance of having fragments from an unknown source remaining after the treatment.

The SUXOS will maintain security of any MEC item and report its location and other information, in accordance with MRP SOP 03, to the Tetra Tech UXO/MEC Manager and Tetra Tech PM. Security of the item will be maintained until it is treated.

Figure 17-4 depicts the decision flow path described below for MEC. Each item will be marked with flagging tape and assigned a unique number starting with the abbreviated site ID followed by the transect/grid number and item number. All available information about the item will be recorded in the logbook, including location using GPS coordinates, tape measure, or other grid coordinate location system, identification, item number, and whether the item is suspect MEC or MPPEH. A digital photograph will be taken of each item.

Although unexpected, if the UXO team is unable to identify a MEC item, Tetra Tech personnel will notify the Navy RPM who will request assistance from the nearest military EOD Detachment from Mayport, Florida.

Once identified, all MEC items and their original locations will be recorded by GPS or other means. This information will be recorded on the MEC Tracking Log in accordance with MRP SOP 02, and all MEC items will be photographed. This information will be added to the data collected for the site. The MEC Tracking Log will be reviewed for accuracy by the SUXOS, UXOQCS, and UXO Manager on days when MEC is discovered or when disposition of MEC recorded on the tracking log has changed.

Blow-In-Place Operations

If BIP operations become necessary, the K328 or MFG (whichever is greater) will be used to establish an EZ for intentional detonations in accordance with the approved ESS (provided to field personnel under a separate cover). The intentional detonation EZ for the site is listed in the ESS (ESS provided to field personnel under a separate cover, from Table 6-2 of the ESS). The procedures to be followed should BIP become necessary are presented in MRP SOP-07, UXO Demolition/Disposal Operations, and MRP SOP-04, MEC Management and Accountability.

17.16 MPPEH MANAGEMENT – INSPECTION

If MPPEH are encountered during the operation, the SUXOS and UXOQCS will independently inspect and separate the MPPEH into MDEH or MDAS in accordance with MRP SOPs 02, 07, and 09. Items will then be segregated into items that require demilitarization and those ready for certification. If any items are suspected to or found to contain HTRW, the field team will proceed in accordance with the HASP/APP; if warranted by the HASP/APP requirements, the work site may need to be evacuated until the Project HSM, with concurrence of the Navy RPM, identifies and implements appropriate protective measures. Recovered CS MPPEH will be reported to EOD Mayport for guidance/disposal. If required, the items will be packaged and shipped to Pine Bluff Arsenal for final disposition. A formal request for Interim Hazard Classification (IHC) will be submitted. All items transported will adhere to the specification set forth in the IHC. Shipping will be coordinated through the Item Inventory Manager from the Single Manager for Conventional Ammunition (SMCA) Mr. Lorin Daniels 309.782.4387 DSN: 793-4387; or with AMMOLANT 1.800.600.2666. Items identified as CS MEC/MPPEH will be handled as described in Sections 17.15 and 17.18.

17.17 MPPEH MANAGEMENT – CERTIFICATION

The Tetra Tech PM must identify the personnel authorized and qualified to inspect MPPEH and then to document the MPPEH item's explosives safety status as either MDAS or MDEH, in writing by the NAVFAC LANT Commanding Officer.

Persons certifying MPPEH as MDAS or MDEH will be designated in writing to the Commanding Officer of the cognizant Facilities Engineering Command, who must endorse the designation letter. The designation letter will include sample signatures of the personnel qualified and authorized to inspect MPPEH and document its explosive safety status. A current list of personnel, along with their sample signatures, who are qualified and authorized to inspect MPPEH and document its explosives safety

status, will be provided to any Defense Reutilization Marketing Office (DRMO) or Qualified Recycling Program (QRP) receiving the MDAS.

In the event that HTRW is encountered on site, the work site will be evacuated until the Tetra Tech Project HSM, with the concurrence of the Navy RPM, identifies and implements appropriate protective measures.

A UXO Technician III (team leader) will then:

- Reinspect 100 percent of all recovered items to determine if each item is free of explosive hazards and other visible liquid HTRW materials.
- Record the information that each recovered item is free of explosive hazards and other visible HTRW materials.
- Certify the recovered items as MDAS. Following the inspection and reinspection by personnel approved by the Commanding Officer, MDAS will be certified and verified and transported off site by an approved subcontractor in accordance with Section 17.19.
- Coordinate transfer of MDEH to the treatment area for treatment/disposal.

The Tetra Tech UXOQCS will:

- Conduct daily audits of the procedures used by UXO teams and individuals for processing MPPEH.
- Perform and document random sampling of all MPPEH collected from the various teams to ensure that no items with explosive hazards and other visible liquid HTRW material are identified as MDAS.
- Ensure that specific procedures and responsibilities are followed while processing MPPEH for certification as MDAS.
- Conduct a final 100-percent inspection of all MDAS prior to certification and transport off site.

The UXOSO will ensure that all procedures for processing MPPEH are being performed safely and consistently.

The Tetra Tech SUXOS will:

- Ensure that all documentation is completed for all MDAS.
- Perform random checks to verify that the MDAS is free from explosive hazards.
- Conduct a final 100-percent inspection of all MDAS prior to certification and transport off site.
- Maintain custody of the seal/key for all certified MDAS. If custody of the sealed container is lost, the Tetra Tech SUXOS and UXOQCS will conduct another 100-percent inspection of all MDAS.
- Certify all MDAS as free of explosive hazards and other visible liquid HTRW materials.
- Ensure that all voids and cavities are exposed.
- If possible item is demilitarized by crushing with mechanized equipment.
- Be responsible for ensuring that MDAS is secured in a locked, labeled, and sealed container.
    - The container will be closed and clearly labeled on the outside with a unique identification.
    - The container will be closed in such a manner that a seal must be broken to open the container. The seal will have the same unique identification number as the container, or the container will be clearly marked with the seal's identification if different from the container.
    - A documented description of the container will be provided with the following information for each container: contents, approximate weight of container, location where contents were obtained, contractor name, names of certifying and verifying individuals, unique container identification, and seal identification.

The SUXOS will certify that the MDAS has been 100 percent properly inspected, and to the best of his/her knowledge and belief, is free of explosive hazards. The UXOQCS will verify that the MPPEH inspection process has been followed in accordance with this SAP and has been 100 percent properly inspected, and to the best of his/her knowledge and belief, is free of explosive hazards. All

certification/verification documentation will clearly show the printed names of the Tetra Tech SUXOS and UXOQCS, signatures, and phone numbers of the persons certifying and verifying the material as free of explosive hazards.

The following certification/verification will be entered on each form for turnover of MDAS to a disposal/recycling company and will be signed by the Tetra Tech SUXOS and UXOQCS:

> "This certifies that the material potentially presenting an explosive hazard listed has been 100 percent properly inspected and, to the best of our knowledge and belief, is inert and/or free of explosives or related materials."

17.18 MPPEH MANAGEMENT – DISPOSAL

Non-CS MDEH will be treated with donor charges then addressed as MPPEH. The locked and sealed containers containing items classified as MDAS will remain at the site until custody of the treated material is assumed by a subcontractor [in accordance with DoD 4160-21-M-1 (1995)]. This contractor will be responsible for transportation of the material to an off-site facility for disposal or demilitarization.

MDAS items that can be demilitarized by crushing with the excavator on-site will be released to the recycler as scrap in accordance with DOD 4160-21-M (series). The SUXOS and UXOQCS must ensure the item that has been demilitarized can no longer be used for its intended purpose and does not have any remaining features of munitions.

MDAS will be managed at all times in such a manner as to prevent it from being:

- Co-mingled with MPPEH or MDEH
- Misidentified as MPPEH or MDEH after it has been determined to be safe

MDAS will be secured in a locked/sealed container, with the key/seal number held only by the SUXOS. An MDAS Certification From will be attached to the outside of the container in a waterproof holder and updated every time an item is added to the container (e.g., drum). The locked sealed container will remain at the site until released. A chain-of-custody form will be maintained for MDAS, and the proper documentation will be completed and signed by the responsible personnel (SUXOS and UXOQCS) before custody of MDAS is assumed by a contractor (in accordance with DoD 4160-21-M-1) for disposal or disposition. Detailed guidance on the policy and responsibilities for the management and disposition of

MPPEH is provided in OP 5 Change 9 (Navy, 2010), EM 1110-1-4009, Chapter 14 (USACE, 2007a) and DoD Instruction 4140.62 (2008).

The certified and verified MDAS will be released to the subcontractor, who will:

- Upon receiving the unopened labeled containers, each with its unique identified and unbroken seal ensuring a continued chain of custody, and after reviewing and concurring with all the provided supporting documentation, sign for having received and agreeing with the provided documentation that the sealed containers contained no explosives when received.

- Perform a shredding/cutting process capable of demilitarizing MDAS resembling military munitions.

- Perform a 100-percent inspection of the shredded/cut scrap to ensure no resemblance to military munitions. After this has been determined, the scrap will be transported to a qualified recycler and recycled.

- Provide an "End Use" certification confirming that the material has been recycled. End Use certifications will be included in the After Action Report.

If any organization breaks the MPPEH chain of custody, the affected MPPEH must undergo a second 100-percent inspection, a second 100-percent reinspection, and be documented to verify its explosive safety status as described above.

17.19 DEMOBILIZATION

When fieldwork is complete, the site will be restored and temporary survey markers will be removed. All field forms and field logbooks will be completed, field documentation will be provided to recipients, and equipment will be returned to providers. Personnel will demobilize with approval of the Tetra Tech UXO/MEC Manager and PM.

17.20 SITE-SPECIFIC FINAL REPORT PREPARATION AND APPROVAL

The Full RFI investigation will be used in conjunction with Phase I RFI results to establish specific locations for MC sampling (documented under separate cover) and to develop a CMS (Tetra Tech, 2011, Phase I results are presented in Appendix B-3 of Volume I and Attachment 1-4 of Volume II). The Full

RFI SAP is being written to allow field flexibility in establishing hand digging locations and test pitting locations based on data from the previous detector-aided surface and subsurface geophysical surveys.

A Full RFI report will be prepared summarizing the investigation and containing summaries of site background information, personnel utilized, objectives and scope, equipment, descriptions of survey activities, results, discussion of project data, and recommendations. The report will contain noted munitions-related discoveries, site photographs, field notes, checklists, QC data, and any other relevant information to aid in refinement of the CSM.

SAP Worksheet #18 – Sampling Locations and Methods/SOP Requirements Table

(UFP-QAPP Manual Section 3.1.1)

Sampling Location / ID Number	Exclusion Areas	Matrix	Approximate Depth (bgs)	Survey Methodology	Degree of Investigation	SOP Name[1]
Rifle Range Subarea	Potentially, small areas inaccessible due to thick vegetation or steep grade	Surface and Qualitative Subsurface	0 to 2 feet	Schonstedt and White's Spectrum XLT all-metals detector	Detector-aided surface survey along transects located north-northeast of Phase I RFI survey area (see Figure 17-1). Real-time survey to confirm and reacquire all Phase I RFI anomalies (see Figure 17-1). (Tetra Tech, 2011, Phase I results are presented in Attachment 1-4 of Volume II)	MRP SOP 01 MRP SOP 02 MRP SOP 05
OB/OD Subarea	Potentiall, small areas inaccessible due to thick vegetation	Surface and Subsurface	0 to 4 feet depends on target MEC size	Geonics EM-61 MK2 HH and EM-61 MK2 with Standard Coil	Meandering path or 2-foot line spaced geophysical survey in accessible portions of the specified investigation area to reacquire target anomaly location (see Figure 17-2)	MRP SOP 01 MRP SOP 02 MRP SOP 03 MRP SOP 04 MRP SOP 05 MRP SOP 06
Potential Munitions Trench Subarea	Potentially, small areas inaccessible due to thick vegetation	Surface and Subsurface	0 to 4 feet, depends on target MEC size	Geonics EM-61 MK2 HH and EM-61 MK2 with Standard Coil	2-foot line spaced geophysical survey in accessible portions of the specified investigation area to reacquire target anomaly location, particularly the test pit locations, and to survey western portion of subarea (see Figure 17-3 and 17-4)	MRP SOP 01 MRP SOP 02 MRP SOP 03 MRP SOP 04 MRP SOP 05 MRP SOP 06

1 SOPs can be found in Attachment 2.

SAP Worksheet #19 – Analytical SOP Requirements Table

(UFP-QAPP Manual Section 3.1.1)

☑ **Worksheet Not Applicable**

No laboratory samples are proposed for collection/analysis during this MEC investigation.

SAP Worksheet #20 – Field Quality Control Sample Summary Table

(UFP-QAPP Manual Section 3.1.1)

Matrix	Analytical Group	QC Survey Requirements	Field Duplicates/Repeat Data Collection	Sample	Quality Control
Soil	Detector-aided surface survey	Blind seed items will be used during the detector-aided surface survey process as a QC check. Blind seed items will be placed at the surface into the surface vegetation or if surface vegetation is not present, covered with surface vegetation from another location, at locations along transects prior to the start of the detector-aided surface survey. At least one blind seed item and no more than six blind seeds will be placed for each daily lot of work.	NA	Detect, recover, and record all blind seed items; non-detection of a blind seed item would result in failure of QC.	If a blind seed item is missed, that lot of work will be rejected and reworked.
Subsurface	EM-61 MK2 HH EM-61 MK with standard coil	IVS survey at the beginning or end of each day and after extended breaks.	NA	Geophysical survey over seed items buried in the IVS plot	IVS survey will be conducted at the beginning or end of each day and after extended breaks to verify that the equipment is operating properly by comparison of the instrument's anomalous responses to standardized buried items that have related empirically established instrument response curves

Matrix	Analytical Group	QC Survey Requirements	Field Duplicates/Repeat Data Collection	Sample	Quality Control
Subsurface	EM-61 MK2 HH EM-61 MK2 with standard coil	Daily instrument checks and calibrations (see Worksheet #22)	NA	Geophysical test data	Criteria stated in Worksheet #22 to test normal equipment function within established data ranges.
Anomaly Locations/ Excavated Soil	Manual Anomaly intrusive investigations	The UXOQCS will place 1 to 6 seeds per daily lot of work within two feet of pen flags marking intrusive investigation anomalies. UXOQCS will examine the field forms to ensure that all information is being recorded for each hand excavation location. Ensure that non-munitions debris being removed is free of MEC/MPPEH.	NA	Detect, recover, and record all metallic material excavated; non-detection of an anomaly source would result in failure of QC.	Resurvey excavated hand-dig location and excavated material to ensure that the anomaly source was located and correctly classified as MEC, MPPEH, or non-munitions related debris.
Soil	Anomaly intrusive investigation	Identify anomaly item and log results.	NA	Identification of 100% of all anomaly items; misidentification of an MEC/MPPEH item or classification would result in failure of QC.	If no MEC/MPPEH are identified, log what is the source of anomaly or that the anomaly is deeper than depth expected at subarea. If MEC/MPPEH are identified, record information on the field form and determine if treatment is required.

Matrix	Analytical Group	QC Survey Requirements	Field Duplicates/Repeat Data Collection	Sample	Quality Control
Soil	Mechanized anomaly intrusive investigation	The UXOQCS will place 1 to 6 seeds per daily lot of work in areas marked for test pit trenching. Ensure that all anomaly source material is properly classified. UXOQCS will examine the field forms to ensure that all information is being recorded for each hand excavation location. Ensure that non-munitions debris being removed is free of MEC/MPPEH.	NA	Detect, recover, and record all MEC/MPPEH; non-detection of an anomaly source would result in failure of QC.	Resurvey excavated test pit location and excavated material to ensure that all MEC, MPPEH 20 mm and above, or same size non-munitions-related debris, has been removed.

SAP Worksheet #21 – Project SOP References Table

(UFP-QAPP Manual Section 3.1.2)

Reference Number[1]	Title	Originating Organization of SOP	Equipment Type	Modified for Project Work? (Y/N)	Comments
MRP SOP 01	UXO Detector-Aided Surveys	Tetra Tech	Magnetic detector All-metals detector	N	Describes detector-aided surface surveys
MRP SOP 02	MEC/MPPEH Management and Accountability	Tetra Tech	GPS Digital camera	N	Describes actions to be taken if suspect MEC are encountered
MRP SOP 03	Geophysical Survey	Tetra Tech	Magnetic detector All-metals detector	N	Describes IVS requirements
MRP SOP 05	Global Positioning System	Tetra Tech	GPS	N	Describes usage of hand-held GPS units
MRP SOP 06	Vegetation Management at MEC/MPPEH Sites	Tetra Tech	Hand-held brush cutters, mowers, chain saws, brush hog, wood chipper	N	Describes brush cutting and vegetation clearance activities at MEC sites
MRP SOP 07	UXO Demolition Disposal Operations	Tetra Tech	Detonation and disposal materials	N	Describes UXO detonation disposal operations
MRP SOP 08	UXO Documentation	Tetra Tech	None	N	Describes documentation of field activities at MEC sites
MRP SOP 09	MPPEH Management and Certification	Tetra Tech	Storage container	N	Describes MPPEH certification procedures
MRP SOP 10	UXO Intrusive Investigation	Tetra Tech	Magnetic detector All-metals detector Hand tools	N	Describes intrusive investigation procedures

Field forms and SOPs are contained in Attachment 2 of this Full RFI SAP.

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

(UFP-QAPP Manual Section 3.1.2.4)

Field Equipment	Activity[1]	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference	Comments
EM-61 MK2 HH EM-61 MK2 with standard coil	Warm-up	Power on	5 Minutes	NA	Site Geophysicist	MRP SOP 03	None
EM-61 MK2 HH EM-61 MK2 with standard coil	Null	EM-61 null: power on	Per manufacturer recommendations	NA	Site Geophysicist	MRP SOP 03	None
EM-61 MK2 HH EM-61 MK2 with standard coil	Record sensor positions	First day and configuration and equipment change	+/- 6 inches	NA	Site Geophysicist	MRP SOP 03	None
EM-61 MK2 HH EM-61 MK2 with standard coil	Personnel test	Beginning of day	EM-61: +/- 2 millivolts (mV)	Remove interference source from operator	Site Geophysicist	MRP SOP 03	None
EM-61 MK2 HH EM-61 MK2 with standard coil	Static background and static spike	Beginning of day and equipment change	Acceptance criteria determined from data review. Guidance Criteria: EM-61: +/- 3 mV, Spike: +/- 20% of standard item response	Fix or replace unit or filter noise – evaluate site noise for survey feasibility	Site Geophysicist	MRP SOP 03	None
EM-61 MK2 HH EM-61 MK2 with standard coil	Pull-away test	First day on site and when there is a configuration or equipment change	Minimal effect	Increase distance of GPS to EM-61	Site Geophysicist	MRP SOP 03	None
EM-61 MK2 HH EM-61 MK2 with standard coil	Calibrations/ equipment null	Beginning of project	Follow manufacturer's recommendation	NA	Site Geophysicist	MRP SOP 03	None

Field Equipment	Activity[1]	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference	Comments
EM-61 MK2 HH EM-61 MK2 with standard coil	IVS detections	Start and end of each field collection day (more frequently if a long break or equipment malfunction is suspected)	+/- 20% of standard item response	Replace unit or correct technique	Site Geophysicist	MRP SOP 03	None
GPS	Positioning	Twice daily and when there is an equipment change	Accuracy: sub-meter HDOP <3, number of satellites at least four	Wait for better signal, replace unit, or choose alternate location technique	Site Geophysicist/ UXO Technician	MRP SOP 05	None
Magnetic Locator (Schonstedt)	Operational	Beginning and end of day and after battery change	Operating properly-detect surrogate items at IVS	Replace battery, replace instrument	UXO Technician	MRP SOP 01	None
All-Metal Detector (White's)	Calibration	Beginning and end of day	Detect inert surface segregate	Recalibrate, replace instrument	UXO Technician	MRP SOP 01	None

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22.1 REGULAR TESTS FOR GEOPHYSICAL SURVEYING EQUIPMENT

Equipment/Electronics Warm-Up. This test minimizes sensor drift caused by thermal stabilization. Most instruments need a few minutes to warm up before data collection begins. All manufacturer instructions will be followed, or if none are given, data readings will be observed until they stabilize. Acceptance criterion: equipment specific (typically 5 minutes). This test will be conducted each time the unit is started.

Equipment Null. The EM-61 MK2 HH and EM-61 MK2 with standard coil will be nulled according to manufacturer's recommendations.

Record Sensor Positions. The purpose of recording sensor positions is to document relative navigation and sensor offsets, detector separation, and detector heights above the ground surface. This information will ensure that the detector offset corrections and gradient calculations can be done correctly and that the surveys are repeatable. Acceptance Criterion: ±6 inches. This test will be conducted at the beginning of the first day and after an equipment configuration change is made.

Personnel Test. This test ensures that survey personnel have removed all potential interference sources (metal) from their bodies. Common interference sources are ballpoint pens, steel-toed boots, or large metallic belt buckles, which can produce data anomalies similar to investigation targets. All personnel who will be coming near the sensor during survey operations should remove metallic items from themselves, and if this is not possible, readings should be monitored and recorded to judge the effect of the metallic items to meet the following acceptance criteria: EM-61 ±2 mV. This test will be conducted at the beginning of each day if the operator is wearing metallic items that could interfere with equipment operation.

Calibrations. The survey instrument should be calibrated according to the manufacturer's recommendations prior to beginning the surveys. Detector-Aided Surface Survey Equipment: The White's all-metals detector requires calibration but the Schonstedt does not. Geophysical Survey Equipment: The EM-61 MK2 HH requires field calibration. GPS Equipment: The GPS, Omnistar or equivalent, unit will be used during this project and does not require calibration.

Static Background and Static Spike (or Standard Response) Test. This test quantifies instrument background readings and electronic drift, locates potential interference spikes in the time domain, and determines impulse response and repeatability of the instrument to a standard test item (typically a 2-inch-diameter steel trailer hitch ball). Improper instrument function, the presence of local sources of ambient noise (such as electromagnetic transmissions from high-voltage electric lines), and faulty equipment are all potential causes of inconsistent non-repeatable readings. A minimum 3-minute static background test after instrument warm-up, followed by a 1-minute standard response test, followed by an additional 1-minute static background test will be performed. The Site Geophysicist must review the readings to confirm that the data are usable. Acceptance criteria will be determined from this data review. Guidance criteria: static background test EM-61 ± 3 mVt; Static Response Test ±20% of standard item response after background correction. Ideally, the test data will meet the guidance criteria; however, in the event they do not, data must be evaluated to see if an equipment change is needed and whether the data are acceptable to achieve project goals. This test will be conducted at the beginning of each day and after equipment changes.

Pull-Away Test. This test demonstrates the effects of the navigational equipment. All equipment will be powered up and operating as it would be during the survey. Acceptance criterion: document the effects of navigational equipment on geophysical readings. Effects should be small. The test will be performed before the geophysical survey begins and after an equipment configuration change is made.

IVS Evaluation. This check will be performed using the EM-61 MK2 HH and EM-61 MK2 with standard coil to confirm similar detections as the initial IVS. This test data will be recorded at the beginning and end of each day, along a survey line passing overtop of the ISO items. The results will be compared to empirical data or type curves.

GPS Positioning. The GPS will be tested at the start of the project and twice daily during data acquisition by surveying two survey control points and comparing the GPS coordinates to the documented coordinates for the control points. Acceptance criterion: sub-meter. GPS survey instruments should also be closely monitored during field acquisition by using HDOP criteria, or at a minimum, the number of satellite signals being received. HDOP should normally be less than three to obtain high-quality results, and at least four satellites should indicate high-quality results.

Latency is an issue when a separate GPS controller (from the geophysical controller) is used to acquire GPS data. If a separate controller is used, care will be taken to synchronize the clocks in both the GPS and geophysical units, and a test must be set up to measure the latency inherent in using two different accuracy clocks. The test will consist of positioning oneself over a linear metallic object (e.g., pipe) at several points, recording data with all of the survey equipment, and then repeating the same measurements using only the GPS equipment to compare the results and determine any necessary adjustment. This test is not likely to be needed because the standard equipment uses an integrated GPS.

22.2 DATA COLLECTION VARIABLES FOR GEOPHYSICAL SURVEYING EQUIPMENT

The same equipment and procedures will be used for the IVS (Worksheet #12) and the geophysical survey. In addition, only personnel who have been tested on the IVS plot will perform the geophysical surveys. Multiple surveys using the planned geophysical instruments will be performed. Some elements of data collection are subject to modification and evaluation. Data collection variables subject to modification and optimization may include, but are not necessarily limited to, instrument height, instrument orientation and direction of travel, instrument channel selections, measurement interval along survey lines, and survey line spacing.

22.3 GEOPHYSICAL AND POSITIONING INSTRUMENTS

A Geonics EM-61 MK2 HH and EM-61 MK2 with standard coil are time-domain electromagnetic systems. The EM-61 generates 150 electromagnetic pulses per second and measures during the off time between pulses. After each pulse, secondary electromagnetic fields are induced briefly in moderately conductive soil and for a longer time in metallic objects. The EM-61 pauses between each pulse until the response from the conductive earth dissipates and then measures the prolonged buried metal response. This response is recorded in mV. By sensing only the buried metal response, the EM-61 detects metallic targets that might otherwise be missed. The EM-61 is able to detect all types of metallic objects, not just ferrous material. This capability is important for detection of potential targets at the sites that are likely to contain more aluminum than iron or steel (such as pyrotechnics). The EM-61 can measure four time gates to provide a more complete measurement of the response decay rate. The EM-61 can record up to 12 records per second, four time gates per record, or three time gates of better channel data coupled with one reading for the top channel per second.

Tetra Tech will use a sub-meter accuracy GPS unit where possible during geophysical data collection to provide precise location coordinates for the data collected. The anticipated tree cover at some of the survey areas at the base may dictate that only certain grid nodes are surveyed with GPS in open locations (no or limited tree cover), and the remainder of the survey grid will be tied to these locations. If the GPS accuracy is not sub-meter, data will not be collected until more satellites are available and the accuracy criteria are met, or surveying with alternate positioning techniques will be employed.

22.4 QUALITY ASSURANCE/QUALITY CONTROL

Operational and test procedures will conform to the manufacturers' standard instructions. QC of the instruments' data will be achieved daily by field testing, consisting of checking the sensor and navigation system against a known target to ensure that they are operating properly. All geophysical instruments and equipment used to gather and generate field data will be calibrated with sufficient frequency and in such a manner that accuracy and reproducibility of the results are consistent with the manufacturers' specifications. Calibration, repair, or replacement records will be filed and maintained by the Site Geophysicist and may be subject to audit by the Tetra Tech QAM. Potential data problems include source data errors, data entry errors, data editing errors, and user errors. All data will be reviewed to identify and correct any of these errors if they occur.

SAP Worksheet #23 – Analytical SOP Reference Table

(UFP-QAPP Manual Section 3.2.1)

☑ **Worksheet Not Applicable**

No project sampling is proposed for this MEC investigation (see Worksheet #21 for project SOPs).

SAP Worksheet #24 – Analytical Instrument Calibration Table

(UFP-QAPP Manual Section 3.2.2)

☑ **Worksheet Not Applicable**

No analytical instrument calibration data will be required to support this MEC investigation (see Worksheet #22 for equipment calibration information).

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

(UFP-QAPP Manual Section 3.2.3)

☑ **Worksheet Not Applicable**

No analytical instrument equipment maintenance, testing, or inspections will be required to support this MEC investigation. Field instrumentation maintenance, testing, and inspection information is presented in Worksheet #22.

SAP Worksheet #26 – Sample Handling System

(UFP-QAPP Manual Appendix A)

☑ **Worksheet Not Applicable**

This worksheet is not applicable because this will be an MEC investigation, and no samples will be handled.

SAP Worksheet #27 – Sample Custody Requirements Table

(UFP-QAPP Manual Section 3.3.3)

☑ **Worksheet Not Applicable**

No samples are proposed for collection/analysis during this MEC investigation.

SAP Worksheet #28 – Laboratory QC Samples Table

(UFP-QAPP Manual Section 3.4)

☑ **Worksheet Not Applicable**

No analytical laboratory QC sampling will be required for this MEC investigation.

SAP Worksheet #29 – Project Documents and Records Table

(UFP-QAPP Manual Section 3.5.1)

Document, Report, or Form	Generator	Definable Feature of Work	Frequency of Completion	Location/Where Maintained(1)
Project Personnel Sign-Off Record	PM	Site Preparation (including mobilization)	One time	SAP/Full RFI Report, Project File
ESS	UXO Program Manager	Site Preparation (including mobilization)	One time	Project File
Field Checklist	Field UXO Personnel	Detector-Aided Surveys Manual Anomaly Intrusive Investigation Mechanized Anomaly Intrusive Investigation	Field collection days	SAP/Full RFI Report, Project File
MEC Accountability Log	SUXOS	Detector-Aided Surveys Manual Anomaly Intrusive Investigation Mechanized Anomaly Intrusive Investigation, MEC Management - Treatment	As needed	SAP, MRP SOP 01, MRP SOP 02, MRP SOP 07/ Full RFI Report, Project File
MDAS Addition Form	SUXOS	MPPEH Management - Inspection MPPEH Management - Certification	Every time MDAS is added to container	Outside of Container
Demolition Explosives Accountability Log	SUXOS/UXOQCS	Donor Explosives Handling	As needed/weekly	SAP, MRP SOP 07/Full RFI Report, Project File

Document, Report, or Form	Generator	Definable Feature of Work	Frequency of Completion	Location/Where Maintained(1)
Daily Report	SUXOS	All	Field collection days	SAP, MRP SOP 08/Full RFI Report, Project File
Medical and OSHA Clearance Letter	HSM and PM	All	As needed	HASP/Project File
Daily Safety Meeting Sign-In Sheet	SSO	All	Daily	HASP/Full RFI Report, Project File
Medical Data Sheet	SUXOS	All	As needed	HASP/Project File
Target Survey Grid Map	Tetra Tech GIS Personnel	Detector-Aided Surveys	Field collection days	SAP/Full RFI Report, Project File
Dig Sheet/Geophysical Maps	UXO Personnel Site Geophysicist	Detector-Aided Surveys Geophysical Data Processing and Interpretation	Field collection days	SAP/Full RFI Report, Project File
Intrusive Operation Survey Data	UXO Personnel	Manual Anomaly Intrusive Investigations (hand digs)	Field collection days	SUXOS Logbook/Project File, Full RFI Report, NIRIS
Intrusive Operation Survey Data	UXO Personnel	Mechanical Anomaly Intrusive Investigation (Test Pits)	Field collection days	SUXOS Logbook/Project File, Full RFI Report, NIRIS
Field Notes (detailing equipment and procedures)	Field UXO Personnel	All	Field collection days	SUXOS Logbook, QC Logbook, MRP SOP 08/Full RFI Report, Project File
Raw Geophysical Data	Site Geophysicist	Digital Geophysical Mapping	Provided at end of project	Project File
Assessment Findings and Corrective Actions	Various (see Worksheet #31)	All	As needed	SAP/Full RFI Report, Project File

Document, Report, or Form	Generator	Definable Feature of Work	Frequency of Completion	Location/Where Maintained(1)
QC Preparatory, Initial, and Follow-On Report	UXOQCS	All	UXOQC - Minimum of once for each definable feature of work	SAP, QC Logbook, MRP SOP 08/Full RFI Report, Project File
Non-Conformance Report	UXOQCS	All	After any failure of QC/QA	QC Logbook/Full RFI Report, Project File
Daily QC Report	UXOQCS	All	Daily	SAP, QC Logbook/Full RFI Report, Project File
Processed Final Format files (maps) compatible with ArcView Version 8 or specified GIS platform	Site Geophysicist or Project Geophysicist	Geophysical Data Processing and Interpretation	One time	MPR SOP 04/Full RFI Report, NIRIS, Project File
Photographs (may be included in report)	Field UXO Personnel	All	As needed	MRP SOP 01, MRP SOP 02, MRP SOP 08/Full RFI Report, Project File
Field Change Request (FCR) Forms	SUXOS	All	As needed	SAP/Full RFI Report, Project File
Field Audit Checklist (if an audit is conducted)	PM	All	As needed	Full RFI Report, Project File
Full RFI Report (2)	Tetra Tech Personnel	Site-Specific Final Report Preparation and Approval	One time	SAP/Project File, Long-Term Third-Party Professional Document Storage Firm (Business Records Management, located at 651 Mansfield Ave., Pittsburgh, PA 15220)”

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NIRIS – Naval Installation Restoration Information Solution.

1 – Field forms and SOPs are provided in Attachment 2.
2 – See Volume 1, MC UFP-SAP for information on Interim Report/Memorandum

Project documentation will be maintained in the Tetra Tech project file. Processed final format files (maps) compatible with ArcView Version 8 or another specified GIS platform will be maintained on the Tetra Tech GIS server and in NIRIS.

SAP Worksheet #30 – Analytical Services Table

(UFP-QAPP Manual Section 3.5.2.3)

☑ **Worksheet Not Applicable**

No analytical services will be required to support this MEC investigation.

SAP Worksheet #31 – Planned Project Assessments Table

(UFP-QAPP Manual Section 4.1.1)

Assessment Type	Frequency	Internal or External	Organization Performing Assessment	Person(s) Responsible for Performing Assessment[1] (title and organizational affiliation)	Person(s) Responsible for Responding to Assessment Findings[1] (title and organizational affiliation)	Person(s) Responsible for Identifying and Implementing Corrective Actions[1] (title and organizational affiliation)	Person(s) Responsible for Monitoring Effectiveness of Corrective Actions[1] (title and organizational affiliation)
Personnel Qualifications	One time for all field personnel	Internal	Tetra Tech	UXOQCS	SUXOS	UXO/MEC Manager	QAM PM
Site-Specific Training	Once at start of fieldwork and at start of each definable feature of work	Internal	Tetra Tech	SUXOS UXO/MEC Manager PM	As designated by PM	As designated by PM	PM
Accident/Incident Reporting	Per event	Internal	Tetra Tech	SSO/UXOSO	Project HSM	HSM PM	HSM
Preventive Maintenance	Daily	Internal	Tetra Tech	UXOQCS	SUXOS	UXO/MEC Manager	PM
Communications Equipment Inspection	Daily	Internal	Tetra Tech	UXO Team Leader	SUXOS	SUXOS	UXO/MEC Manager PM

Assessment Type	Frequency	Internal or External	Organization Performing Assessment	Person(s) Responsible for Performing Assessment(1) (title and organizational affiliation)	Person(s) Responsible for Responding to Assessment Findings(1) (title and organizational affiliation)	Person(s) Responsible for Identifying and Implementing Corrective Actions(1) (title and organizational affiliation)	Person(s) Responsible for Monitoring Effectiveness of Corrective Actions(1) (title and organizational affiliation)
Safety Inspections	Daily (inspection); Weekly (formal surveillance)	Internal	Tetra Tech	SSO/UXOSO	SUXOS	SUXOS	UXO/MEC Manager PM
Site Surveying	Initial, then weekly	Internal	Tetra Tech	UXOQCS	SUXOS	SUXOS	UXO/MEC Manager
Vegetation Management	As needed to support operations	Internal	Tetra Tech	SUXOS	UXO Team Leader	UXO Team Leader	PM
IVS – Assessment	Twice daily	Internal	Tetra Tech	SUXOS	UXO Team Leader	UXO Team Leader	PM
GPS Positional Data Collection	Twice daily	Internal	Tetra Tech	SUXOS	SUXOS	SUXOS	UXO/MEC Manager PM
Detector-Aided Surface Survey	Blind seeds	Internal	Tetra Tech	UXOQCS	SUXOS	SUXOS	UXO/MEC Manager PM
Daily Field Checklists (Geophysical)	Daily during survey performance	Internal	Tetra Tech	Project Geophysicist	Site Geophysicist	Project Geophysicist	Project Geophysicist

Assessment Type	Frequency	Internal or External	Organization Performing Assessment	Person(s) Responsible for Performing Assessment(1) (title and organizational affiliation)	Person(s) Responsible for Responding to Assessment Findings(1) (title and organizational affiliation)	Person(s) Responsible for Identifying and Implementing Corrective Actions(1) (title and organizational affiliation)	Person(s) Responsible for Monitoring Effectiveness of Corrective Actions(1) (title and organizational affiliation)
Digital Geophysical Mapping – Field Notes Audit	Once during start of fieldwork, and after survey completion	Internal	Tetra Tech	Project Geophysicist	Site Geophysicist	Project Geophysicist Site Geophysicist	PM
Digital Geophysical Mapping – SOP Conformance (MRP SOP 03, MRP SOP 04)	Monthly during survey performance	Internal	Tetra Tech	Project Geophysicist	Site Geophysicist	Project Geophysicist Site Geophysicist	PM
Geophysical Data – General Appearance Assessment	Daily/after data are processed	Internal	Tetra Tech	Project Geophysicist	Site Geophysicist	Project Geophysicist Site Geophysicist	PM
Anomaly Informal Reacquisition	Daily/after data are processed	Internal	Tetra Tech	Project Geophysicist	Site Geophysicist	Project Geophysicist Site Geophysicist	PM

Assessment Type	Frequency	Internal or External	Organization Performing Assessment	Person(s) Responsible for Performing Assessment[1] (title and organizational affiliation)	Person(s) Responsible for Responding to Assessment Findings[1] (title and organizational affiliation)	Person(s) Responsible for Identifying and Implementing Corrective Actions[1] (title and organizational affiliation)	Person(s) Responsible for Monitoring Effectiveness of Corrective Actions[1] (title and organizational affiliation)
Manual Anomaly Intrusive Investigation	Blind seeding at the rate of 1 to 6 seeds per daily lot of work; field forms	Internal	Tetra Tech	UXOQCS	SUXOS	SUXOS	UXO/MEC Manager PM
	QC of each intrusive investigation location	Internal	Tetra Tech	UXOQCS	SUXOS	SUXOS	UXO/MEC Manager PM
Mechanized Anomaly Intrusive Investigation	Blind seeding at the rate of 1 to 6 seeds per daily lot of work and excavated soil; field forms	Internal	Tetra Tech	UXOQCS	SUXOS	SUXOS	UXO/MEC Manager PM
	QC of each intrusive investigation location	Internal	Tetra Tech	UXOQCS	SUXOS	SUXOS	UXO/MEC Manager PM

Assessment Type	Frequency	Internal or External	Organization Performing Assessment	Person(s) Responsible for Performing Assessment(1) (title and organizational affiliation)	Person(s) Responsible for Responding to Assessment Findings(1) (title and organizational affiliation)	Person(s) Responsible for Identifying and Implementing Corrective Actions(1) (title and organizational affiliation)	Person(s) Responsible for Monitoring Effectiveness of Corrective Actions(1) (title and organizational affiliation)
Donor Explosives Handling	Daily, as needed when explosives are on site	Internal	Tetra Tech	UXOQCS	SUXOS	SUXOS	UXO/MEC Manager PM
MEC Management - Treatment	Preparatory during start of fieldwork; Initial at first MEC; Daily follow-up during MEC activities	Internal	Tetra Tech	UXOQCS	SUXOS	SUXOS	UXO/MEC Manager PM
MPPEH Management - Inspection	Preparatory during start of fieldwork; Initial at first MPPEH find; Daily follow-up during MPPEH finds as needed	Internal	Tetra Tech	SUXOS and UXOQCS	SUXOS and UXOQCS	SUXOS	UXO/MEC Manager PM

Assessment Type	Frequency	Internal or External	Organization Performing Assessment	Person(s) Responsible for Performing Assessment(1) (title and organizational affiliation)	Person(s) Responsible for Responding to Assessment Findings(1) (title and organizational affiliation)	Person(s) Responsible for Identifying and Implementing Corrective Actions(1) (title and organizational affiliation)	Person(s) Responsible for Monitoring Effectiveness of Corrective Actions(1) (title and organizational affiliation)
MPPEH Management - Certification	Preparatory during start of fieldwork; Initial at first MPPEH find; Daily follow-up during MPPEH finds	Internal	Tetra Tech	UXOQCS	SUXOS	SUXOS	UXO/MEC Manager PM
MPPEH Management - Disposal	Preparatory during start of fieldwork; Initial at first treatment Daily follow-up	Internal	Tetra Tech	UXOQCS	SUXOS	SUXOS	UXO/MEC Manager PM
Surveying and Mapping Operations	Initial, then weekly	Internal	Tetra Tech	UXOQCS	SUXOS	SUXOS	UXO/MEC Manager
UXO/MEC Accountability	Weekly	Internal	Tetra Tech	UXOQCS	SUXOS	SUXOS	UXO/MEC Manager PM

Assessment Type	Frequency	Internal or External	Organization Performing Assessment	Person(s) Responsible for Performing Assessment[1] (title and organizational affiliation)	Person(s) Responsible for Responding to Assessment Findings[1] (title and organizational affiliation)	Person(s) Responsible for Identifying and Implementing Corrective Actions[1] (title and organizational affiliation)	Person(s) Responsible for Monitoring Effectiveness of Corrective Actions[1] (title and organizational affiliation)
Visitor Briefing/ Operational Assessment	Initial, then as needed to support operations	Internal	Tetra Tech	UXOSO	SUXOS	SUXOS	HSM
Hazard Assessment – Risk Analysis	Once at start of each definable feature of work, then as needed to support operations	Internal	Tetra Tech	UXOSO	UXOSO SUXOS	UXOSO SUXOS	HSM
Field Work Systems Audit	Once per contract year	Internal	Tetra Tech	QAM	UXO/MEC Manager Project Geophysicist PM	QAM UXO/MEC Manager Project Geophysicist	QAM PM
NOSSA and/or Third Party Audit	Once	External	TBD by Navy	TBD by Navy	PM UXO/MEC Manager Project Geophysicist	PM UXO/MEC Manager Project Geophysicist	TBD by Navy

1 Tetra Tech personnel unless otherwise noted.

SAP Worksheet #32 – Assessment Findings and Corrective Action Responses

(UFP-QAPP Manual Section 4.1.2)

Assessment Type	**Nature of Deficiencies Documentation**	**Individual(s) Notified of Findings** (name, title, organization)	**Time Frame of Notification**	**Nature of Corrective Action Response Documentation**	**Individual(s) Receiving Corrective Action Response** (name, title, organization)	**Time Frame for Response**
Personnel Qualifications	E-mail	Ralph Brooks – UXO/MEC Manager, Tetra Tech	Immediately upon discovery	E-mail	Linda Klink – PM, Tetra Tech	Prior to initiation of task
Site-Specific Training	E-mail	Ralph Brooks – UXO/MEC Manager, Tetra Tech Linda Klink – PM, Tetra Tech	Upon completion of training	Updated e-mail	Ralph Brooks – UXO/MEC Manager, Tetra Tech Linda Klink – PM, Tetra Tech	Within 24 hours
Accident/Incident Reporting	Accident/Incident Report Form	Matt Soltis – HSM, Tetra Tech Linda Klink – PM, Tetra Tech	Immediately	Dependent on accident/incident	Linda Klink – PM, Tetra Tech Ralph Brooks – UXO/MEC Manager, Tetra Tech Matt Soltis – HSM, Tetra Tech	Within 24 hours
Preventive Maintenance	Field forms	Ralph Brooks – UXO/MEC Manager, Tetra Tech Linda Klink – PM, Tetra Tech	Within 24 hours	Field forms	Ralph Brooks – UXO/MEC Manager, Tetra Tech Linda Klink – PM, Tetra Tech	Within 24 hours

Assessment Type	**Nature of Deficiencies Documentation**	**Individual(s) Notified of Findings** (name, title, organization)	**Time Frame of Notification**	**Nature of Corrective Action Response Documentation**	**Individual(s) Receiving Corrective Action Response** (name, title, organization)	**Time Frame for Response**
Communications Equipment Inspection	Field forms	Ralph Brooks – UXO/MEC Manager, Tetra Tech Linda Klink – PM, Tetra Tech	Within 24 hours	Field forms	Ralph Brooks – UXO/MEC Manager, Tetra Tech Linda Klink - PM, Tetra Tech	Within 24 hours
Safety Inspections	Field forms	Ralph Brooks – UXO/MEC Manager, Tetra Tech Linda Klink – PM, Tetra Tech	Within 24 hours	Field forms	Ralph Brooks – UXO/MEC Manager, Tetra Tech Linda Klink – PM, Tetra Tech	Within 24 hours
Daily Field Checklists, geophysical	Oral and e-mail or fax	Jim Coffman – Site Geophysicist Linda Klink - PM	Within 24 hours after assessment	Updated Geophysical Field Checklist and Forms	Bill Randall – Project Geophysicist, Tetra Tech Linda Klink – PM, Tetra Tech	Within 48 hours
Digital Geophysical Mapping – Field Notes Audit	Letter/e-mail	Jim Coffman – Site Geophysicist Linda Klink - PM	Within 5 business days of receipt	Complete Field Notes	Bill Randall – Project Geophysicist, Tetra Tech Linda Klink – PM, Tetra Tech	Within 5 business days of receipt

Assessment Type	**Nature of Deficiencies Documentation**	**Individual(s) Notified of Findings** (name, title, organization)	**Time Frame of Notification**	**Nature of Corrective Action Response Documentation**	**Individual(s) Receiving Corrective Action Response** (name, title, organization)	**Time Frame for Response**
Digital Geophysical Mapping – Conformance to SOPs (MRP SOP 03, MRP SOP 04)	Letter/e-mail	Jim Coffman – Site Geophysicist Linda Klink - PM	Within 5 business days of receipt	Justification or clarification of procedure to be provided in letter correspondence	Bill Randall – Project Geophysicist, Tetra Tech Linda Klink – PM, Tetra Tech	Within 5 business days of receipt
Geophysical Data – General Appearance Assessment	e-mail	Jim Coffman – Site Geophysicist Linda Klink - PM	Within 24 hours	E-mail	Bill Randall – Project Geophysicist, Tetra Tech Linda Klink – PM, Tetra Tech	Within 5 business days of receipt
Site Surveying	E-mail	Ralph Brooks – UXO/MEC Manager, Tetra Tech Linda Klink – PM, Tetra Tech	Within 24 hours	Updated e-mail	Ralph Brooks – UXO/MEC Manager, Tetra Tech Linda Klink – PM, Tetra Tech	Within 24 hours
Vegetation Management	Field forms	Ralph Brooks – UXO/MEC Manager, Tetra Tech Linda Klink – PM, Tetra Tech	Within 24 hours	E-mail	Ralph Brooks – UXO/MEC Manager, Tetra Tech Linda Klink – PM, Tetra Tech	Within 24 hours

Assessment Type	**Nature of Deficiencies Documentation**	**Individual(s) Notified of Findings** (name, title, organization)	**Time Frame of Notification**	**Nature of Corrective Action Response Documentation**	**Individual(s) Receiving Corrective Action Response** (name, title, organization)	**Time Frame for Response**
IVS - Assessment	Oral	SUXOS – TBD Ralph Brooks – UXO/MEC Manager, Tetra Tech Linda Klink – PM, Tetra Tech	Within 24 hours	E-mail	Ralph Brooks – UXO/MEC Manager, Tetra Tech Linda Klink – PM, Tetra Tech	Within 24 hours
GPS Positional Data Collection	Field forms	Ralph Brooks – UXO/MEC Manager, Tetra Tech Linda Klink – PM, Tetra Tech	Within 24 hours	E-mail	Ralph Brooks – UXO/MEC Manager, Tetra Tech Linda Klink – PM, Tetra Tech	Within 24 hours
Detector-Aided Surface Survey	QC Checklist	Ralph Brooks – UXO/MEC Manager, Tetra Tech Linda Klink – PM, Tetra Tech	Within 1 business day of assessment	Updated QC checklist	Ralph Brooks – UXO/MEC Manager, Tetra Tech Linda Klink – PM, Tetra Tech	Within 24 hours
Manual Anomaly Intrusive Investigation	Field forms	Ralph Brooks – UXO/MEC Manager, Tetra Tech Linda Klink – PM, Tetra Tech	Within 24 hours	Updated e-mail	Ralph Brooks – UXO/MEC Manager, Tetra Tech Linda Klink – PM, Tetra Tech	Within 24 hours

Assessment Type	**Nature of Deficiencies Documentation**	**Individual(s) Notified of Findings** (name, title, organization)	**Time Frame of Notification**	**Nature of Corrective Action Response Documentation**	**Individual(s) Receiving Corrective Action Response** (name, title, organization)	**Time Frame for Response**
Mechanized Anomaly Intrusive Investigation	Field forms	Ralph Brooks – UXO/MEC Manager, Tetra Tech Linda Klink – PM, Tetra Tech	Within 24 hours	Updated e-mail	Ralph Brooks – UXO/MEC Manager, Tetra Tech Linda Klink – PM, Tetra Tech	Within 24 hours
Donor Explosives Handling	Field forms	Ralph Brooks – UXO/MEC Manager, Tetra Tech Linda Klink – PM, Tetra Tech	Within 24 hours	Updated field forms	Ralph Brooks – UXO/MEC Manager, Tetra Tech Linda Klink – PM, Tetra Tech	Within 24 hours
MEC Management - Treatment	Field forms	Ralph Brooks – UXO/MEC Manager, Tetra Tech Linda Klink – PM, Tetra Tech	Within 24 hours	Updated field forms	Ralph Brooks – UXO/MEC Manager, Tetra Tech Linda Klink – PM, Tetra Tech	Within 24 hours
MPPEH Management - Inspection	Field forms	Ralph Brooks – UXO/MEC Manager, Tetra Tech Linda Klink – PM, Tetra Tech	Within 24 hours	Updated field forms	Ralph Brooks – UXO/MEC Manager, Tetra Tech Linda Klink – PM, Tetra Tech	Within 24 hours

Assessment Type	**Nature of Deficiencies Documentation**	**Individual(s) Notified of Findings** (name, title, organization)	**Time Frame of Notification**	**Nature of Corrective Action Response Documentation**	**Individual(s) Receiving Corrective Action Response** (name, title, organization)	**Time Frame for Response**
MPPEH Management - Certification	Field forms	Ralph Brooks – UXO/MEC Manager, Tetra Tech Linda Klink – PM, Tetra Tech	Within 24 hours	Updated field forms	Ralph Brooks – UXO/MEC Manager, Tetra Tech Linda Klink – PM, Tetra Tech	Within 24 hours
MPPEH Management - Disposal	Field forms	Ralph Brooks – UXO/MEC Manager, Tetra Tech Linda Klink – PM, Tetra Tech	Within 24 hours	Updated field forms	Ralph Brooks – UXO/MEC Manager, Tetra Tech Linda Klink – PM, Tetra Tech	Within 24 hours
Surveying and Mapping Operations	e-mail	Ralph Brooks – UXO/MEC Manager, Tetra Tech Linda Klink – PM, Tetra Tech	Within 24 hours	Updated e-mail	Ralph Brooks – UXO/MEC Manager, Tetra Tech Linda Klink – PM, Tetra Tech	Within 24 hours
UXO/MEC Accountability	Field forms	Ralph Brooks – UXO/MEC Manager, Tetra Tech Linda Klink – PM, Tetra Tech	Within 24 hours	Updated field forms	Ralph Brooks – UXO/MEC Manager, Tetra Tech Linda Klink – PM, Tetra Tech	Within 24 hours
Visitor Briefing/ Operational Risk Assessment	E-mail	SUXOS – TBD Linda Klink – PM, Tetra Tech	Within 24 hours	Updated e-mail	SUXOS – TBD Linda Klink – PM, Tetra Tech	Within 24 hours

Assessment Type	**Nature of Deficiencies Documentation**	**Individual(s) Notified of Findings** (name, title, organization)	**Time Frame of Notification**	**Nature of Corrective Action Response Documentation**	**Individual(s) Receiving Corrective Action Response** (name, title, organization)	**Time Frame for Response**
Hazard Assessment – Risk Analysis	E-mail	Linda Klink – PM, Tetra Tech Matt Soltis – HSM, Tetra Tech	Within 24 hours	Updated e-mail	Linda Klink – PM, Tetra Tech Matt Soltis – HSM, Tetra Tech	Within 24 hours
Field Work Systems Audit	Letter Report	Linda Klink – PM, Tetra Tech Tom Johnston – QAM, Tetra Tech	Within 5 business days of assessment	Letter report	Linda Klink – PM, Tetra Tech Tom Johnston – QAM, Tetra Tech	Within 10 business days of receipt
NOSSA an/dor Third Party Audit	Comment Memorandum	Linda Klink - PM, Tetra Tech	TBD by Navy	Comment Response Letter	TBD by Navy	TBD by Navy

SAP Worksheet #33 – QA Management Reports Table

(UFP QAPP Manual Section 4.2)

Type of Report	Frequency (daily, weekly monthly, quarterly, annually, etc.)	Projected Delivery Date(s)[1]	Person(s) Responsible for Report Preparation (title and organizational affiliation)	Report Recipient(s) (title and organizational affiliation)
Project Monthly Progress Report	Monthly (written) for duration of the project	Monthly	PM Tetra Tech	Navy RPM
MEC Accountability Log	Daily (e-mail)	TBD	SUXOS	PM Tetra Tech UXO/MEC Manager Tetra Tech Project Geophysicist Tetra Tech
Field Status Report	Daily (oral or e-mail) during the course of fieldwork	TBD	SUXOS Tetra Tech Site Geophysicist Tetra Tech	PM Tetra Tech UXO/MEC Manager Tetra Tech Project Geophysicist Tetra Tech
Daily QC Report (Detector-Aided Survey)	Daily (e-mail)	TBD	UXOQCS Tetra Tech	PM Tetra Tech UXO/MEC Manager Tetra Tech
Daily QC Report (Geophysics)	Daily (e-mail)	TBD	Site Geophysicist Tetra Tech	PM Tetra Tech Project Geophysicist Tetra Tech

Type of Report	Frequency (daily, weekly monthly, quarterly, annually, etc.)	Projected Delivery Date(s)[1]	Person(s) Responsible for Report Preparation (title and organizational affiliation)	Report Recipient(s) (title and organizational affiliation)
QC Meeting Minutes	Twice per month during project performance	TBD	UXO/MEC Manager Tetra Tech	PM Tetra Tech
Rework Items List	Twice per month during project performance Daily for UXO work	TBD	UXOQCS Tetra Tech Site Geophysicist Tetra Tech	PM Tetra Tech
Project QC Report	Internal draft, draft, and final (appendix to report)	TBD	PM Tetra Tech Project Geophysicist Tetra Tech	Navy RPM
Full RFI Report	Internal draft, draft, and final	TBD	Tetra Tech Project Personnel	Project Team

1 This worksheet will be modified to include the project delivery dates after fieldwork is scheduled.

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

(UFP-QAPP Manual Section 5.2.1)

A preparatory-phase inspection will be performed prior to beginning each definable feature of work to review applicable specifications and to verify that the necessary resources, conditions, and controls are in place and compliant with the SAP before the start of work activities. An initial-phase inspection will be performed at the beginning of each definable feature of work to observe/review the application of procedures to ensure their adequacy, to ensure that adequate resources are applied to the activity, and to ensure that a clear understanding exists as to the QC requirements of the definable feature of work. The responsible person will inspect the relevant items from the checklist in the appropriate SOP. All preparatory-phase and initial-phase inspection reports will be submitted the day the inspections occur to the SUXOS and UXO/MEC Manager for review.

Definable Feature of Work	**Description**	**Responsible for Verification** (name, organization)
Site Preparation (including mobilization)	Project readiness review to be performed by Tetra Tech PM and Navy RPM, including SAP review.	Linda Klink – PM, Tetra Tech Stacin Martin – Navy RPM
	Prior to the field crew mobilizing to the field for on-site data collection, the Tetra Tech UXO/MEC Manager will review resumes and training records, including those for UXO field personnel, to ensure that all required training and experience requirements identified in Worksheet #7 have been completed for each crew member. Certifications will also be obtained prior to conducting the tasks requiring certification.	Ralph Brooks – UXO/MEC Manager, Tetra Tech
	Review of mobilization and site preparation activities such as equipment setup and checkout, installation of IVS, and investigation area survey and layout.	Linda Klink – PM, Tetra Tech Ralph Brooks – UXO/MEC Manager, Tetra Tech Bill Randall – Project Geophysicist, Tetra Tech

Definable Feature of Work	Description	Responsible for Verification (name, organization)
Site Preparation (including mobilization) (continued)	Review of MRP SOP 01 (UXO Detector-Aided Surface Surveys) and MRP SOP 02 (MEC Management and Accountability), which document methodology to be used during surveys and QC procedures. Review of MRP SOP 08 (UXO Documentation), which describes documentation methodology to be used during performance of site work.	Ralph Brooks, – UXO/MEC Manager, Tetra Tech TBD – SUXOS, Tetra Tech TBD – UXOQCS, Tetra Tech Bill Randall – Project Geophysicist, Tetra Tech
	Review of MRP SOP 03 (Geophysical Survey), which documents methodology to be used during geophysical surveying and includes checklists and field forms.	Bill Randall – Project Geophysicist, Tetra Tech Jim Coffman – Site Geophysicist, Tetra Tech
	While the geophysical crew is initiating on-site geophysical investigations, the Project Geophysicist will review the fieldwork procedures to verify that performance criteria have been satisfactorily attained per Worksheet #22. The PM will review the recommendations of the Project Geophysicist and provide final approval.	Bill Randall – Project Geophysicist, Tetra Tech Linda Klink – PM, Tetra Tech
	Prior to surface survey crews initiating on-site investigations, the UXO Program Manager and Project Geophysicist will review the results of the IVS to verify that performance criteria have been satisfactorily attained per Worksheet #12. The Tetra Tech PM will review the recommendations of the UXO Program Manager and Project Geophysicist and provide final approval.	Linda Klink – PM, Tetra Tech Ralph Brooks – UXO/MEC Manager, Tetra Tech
Site Surveying	Prior to the start of field work, the site boundaries (in work areas, equipment laydown areas, and access ways) will be established. Prior to the start of the geophysical or detector-aided surveys, the transects will be established.	TBD – SUXOS, Tetra Tech TBD – SUXOS, Tetra Tech Jim Coffman - Site Geophysicist

Definable Feature of Work	**Description**	**Responsible for Verification** (name, organization)
Vegetation Management	Brush clearing and vegetation management (regarding work areas, equipment laydown areas, and access ways) will be conducted in accordance with MRP SOP 06.	Preparatory Inspections: Ralph Brooks – UXO/MEC Manager, Tetra Tech Initial Inspection: TBD – UXOQCS, Tetra Tech
IVS	Prior to collection of data at IVS, review MRP SOP 3.	Ralph Brooks – UXO/MEC Manager, Tetra Tech
GPS Positional Data Collection	Review or MRP SOP 05 (Global Positioning System), which documents procedures to be used in the collection of GPS positional data. Ensure that real-time accuracy is being achieved by confirming that data are only collected when HDOP is <3 and when at least four satellites are available. Ensure that sub-meter post-processing accuracy estimate is being achieved by checking that GPS positioning is compared to two known locations at least twice daily.	TBD – SUXOS, Tetra Tech
Detector-Aided Survey	Review of MRP SOP 01 (UXO Detector-Aided Surface Surveys) and MRP SOP 02 (MEC Management and Accountability), which include procedures for data collection and transcription. The SUXOS will verify that the data collected during the first lot of field work contain all elements required by the scope of work and do not contain questionable data or error points.	Ralph Brooks – UXO/MEC Manager, Tetra Tech TBD – SUXOS, Tetra Tech
	Review of MRP SOP 05 (Global Positioning System), which documents procedures to be used in the collection of GPS positional data. The SUXOS will verify that the detector-aided data collected during the first lot of field work contain all elements required by the scope of work and do not contain questionable data or error points.	Ralph Brooks – UXO/MEC Manager, Tetra Tech
Geophysical Equipment Calibration, Maintenance, Testing and Inspection	Prior to collection of field data, review UFP-SAP Worksheet #22 and MRP SOP 03	Bill Randall - Project Geophysicist, Tetra Tech

Definable Feature of Work	Description	Responsible for Verification (name, organization)
Digital Geophysical Mapping	The Project Geophysicist will oversee initial geophysical survey work.	Bill Randall – Project Geophysicist, Tetra Tech
Geophysical Data Processing and Interpretation	Review MRP SOP 04. The Project Geophysicist will verify that the data collected during the first lot of field work contain all elements required by the scope of work and do not contain questionable data or error points	Bill Randall – Project Geophysicist, Tetra Tech Jim Coffman – Site Geophysicist, Tetra Tech
Anomaly Informal Reacquisition	Review MRP SOP 05 (GPS), which documents procedures to be used during GPS data collection and use and includes checklists and field forms.	TBD – SUXOS/UXOQCS, Tetra Tech
Manual Anomaly Intrusive Investigation (Hand Digs)	Review MRP SOP 01 (UXO Detector-Aided Surface Surveys) and MRP SOP 02 (MEC Management and Accountability), which document methodology to be used during detector-aided survey and QC procedures. The SUXOS will verify that the data collected during the first lot of field work contain all elements required by the scope of work and do not contain questionable data or error points.	Ralph Brooks – UXO/MEC Manager, Tetra Tech TBD – SUXOS, Tetra Tech
Mechanized Anomaly Intrusive Investigation (Test Pits)	Review MRP SOP 01 (UXO Detector-Aided Surface Surveys) and MRP SOP 02 (MEC Management and Accountability), which document methodology to be used during detector-aided survey and QC procedures. The SUXOS will verify that the data collected during the first lot of field work contain all elements required by the scope of work and do not contain questionable data or error points.	Ralph Brooks – UXO/MEC Manager, Tetra Tech TBD – SUXOS, Tetra Tech
Donor Explosives Handling	Review MRP SOP 07 (UXO Demolition/Disposal Operations), which documents procedures to be used during UXO detonation operation and includes checklists and field forms.	Ralph Brooks – UXO/MEC Manager, Tetra Tech TBD – SUXOS, Tetra Tech

Definable Feature of Work	Description	Responsible for Verification (name, organization)
MEC Management - Treatment	Review MRP SOP 02 (MEC Management and Accounting), which documents procedures to be used during MPPEH management operations and includes checklists and field forms. Review MRP SOP 07 (UXO Demolition/Disposal Operations), which documents procedures to be used during UXO detonation operations and includes checklists and field forms.	Ralph Brooks – UXO/MEC Manager, Tetra Tech TBD – SUXOS, Tetra Tech
MPPEH Management - Inspection	Review MRP SOP 02 (MEC Management and Accounting), which documents procedures to be used during MPPEH management operations and includes checklists and field forms. Review MRP SOP 09, which documents procedures to be used during MPPEH inspection operations and includes checklists and field forms.	Ralph Brooks – UXO/MEC Manager, Tetra Tech TBD – SUXOS
MPPEH Management - Certification	Review MRP SOP 02 (MEC Management and Accounting), which documents procedures to be used during MPPEH management operations and includes checklists and field forms. Review MRP SOP 09, which documents procedures to be used during MPPEH certification operations and includes checklists and field forms.	Ralph Brooks – UXO/MEC Manager, Tetra Tech TBD – SUXOS
MPPEH Management - Disposal	Review MRP SOP 02 (MEC Management and Accounting), which documents procedures to be used during MPPEH management operations and includes checklists and field forms. Review MRP SOP 09, which documents procedures to be used during MPPEH disposal operations and includes checklists and field forms.	Ralph Brooks – UXO/MEC Manager, Tetra Tech TBD – SUXOS
Demobilization	Review of demobilization activities such as completion of field forms, return or equipment, and forwarding of all field documentation to PM.	Linda Klink – PM, Tetra Tech Ralph Brooks – UXO/MEC Manager, Tetra Tech Bill Randall – Project Geophysicist, Tetra Tech
Site-Specific Final Report Preparation and Approval (1)	Verify that all data and documentation have been acquired for report preparation	Tetra Tech

1 – see Volume 1, MC UFP-SAP, for information on Interim Report/Memorandum.

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

(UFP-QAPP Manual Section 5.2.2) (Figure 37 UFP-QAPP Manual) (Table 9 UFP-QAPP Manual)

Follow-up QC inspections will be conducted to ensure that procedures are being correctly performed, that no changed conditions exist that may affect the quality of work, and that lessons learned are being applied as identified. The responsible individual will inspect the relevant follow-up items from the checklist in the appropriate SOP at least as often as specified in this worksheet. Worksheet #32 describes actions to be taken in the event that non-conforming conditions are observed during the QC inspections. A daily QC inspection can take the place of a follow-up inspection.

Definable Feature of Work	Frequency of Inspection	Supporting QC Document(s)	Responsible for Validation (name, organization)
Site Preparation (including mobilization)	Once	No follow-up required for project readiness. Verify that the SAP can be implemented and carried out as written and that any deviations are documented.	Linda Klink – PM, Tetra Tech Stacin Martin – Navy RPM
Site Surveying	Daily	Checklist and field logbooks, which document equipment utilization and progress.	TBD – SUXOS, Tetra Tech
Vegetation Management	Daily	Checklists and field logbooks, which document equipment utilization and progress.	TBD – SUXOS, Tetra Tech Ralph Brooks – UXO/MEC Manager, Tetra Tech
IVS	Once by each team	Review results of IVS.	Ralph Brooks – UXO/MEC Manager, Tetra Tech TBD – SUXOS, Tetra Tech TBD – UXOQCS, Tetra Tech Jim Coffman – Site Geophysicist, Tetra Tech

Definable Feature of Work	Frequency of Inspection	Supporting QC Document(s)	Responsible for Validation (name, organization)
GPS Positional Data Collection	Daily	See MRP SOP 05 (GPS) and QC Follow-Up Report.	Ralph Brooks – UXO/MEC Manager, Tetra Tech TBD – SUXOS, Tetra Tech
Detector-Aided Survey	Once per week activity is conducted	Checklists and field logbooks, which document equipment utilization and progress.	Linda Klink – PM, Tetra Tech
	Minimum of once per day surveys are conducted or more frequently as necessary	Checklists and field forms, which document equipment utilization, grids/transects surveyed, and grids/transects checked for QC purposes.	Ralph Brooks – UXO/MEC Manager, Tetra Tech TBD – SUXOS, Tetra Tech TBD – UXOQCS, Tetra Tech
Geophysical Equipment Calibration, Maintenance, Testing and Inspection	Checklists: once per day after data is collected. Data from tests: project completion	Daily function tests which may be documented on checklist, field forms, or via e-mail.	Bill Randall - Project Geophysicist, Tetra Tech
Digital Geophysical Mapping	Once per day survey is conducted	Daily reports, general data appearance that document equipment utilization, areas surveyed.	Bill Randall – Project Geophysicist, Tetra Tech Jim Coffman – Site Geophysicist, Tetra Tech

Definable Feature of Work	Frequency of Inspection	Supporting QC Document(s)	Responsible for Validation (name, organization)
Geophysical Data Processing and Interpretation	After fieldwork is completed Once per day data are collected	Prior to entering data (field forms and electronic data) from the geophysics investigation into the permanent project database, the Project Geophysicist, or designated representative, will review the forms and data to ensure that all required information is provided as required by MRP SOP 03 and MRP SOP 04. Verify that all data have been transferred correctly and completely during collection. Ensure that data are downloaded and backed up at least once per day to prevent accidental loss of data/field efforts.	Bill Randall – Project Geophysicist, Tetra Tech Jim Coffman – Site Geophysicist, Tetra Tech
	As needed prior to data entry	Prior to entering data (field forms and electronic data) from the detector-aided surface surveys into the permanent project database, the UXO/MEC Manager, or designated representative, will review the field forms to ensure that all required information is provided as required by MRP SOP 01 (Detector-Aided Surface Survey) and MRP SOP 02 (MEC Management and Accountability). Verify that all data have been transferred correctly and completely during collection. Ensure that data are downloaded and backed up at least once per day to prevent accidental loss of data/field efforts.	Ralph Brooks – UXO/MEC Manager, Tetra Tech TBD – SUXOS, Tetra Tech
Anomaly Informal Reacquisition	Daily	See MRP SOP 05 and QC Follow-Up Report.	Ralph Brooks – UXO/MEC Manager, Tetra Tech TBD – SUXOS, Tetra Tech TBD – UXOQCS, Tetra Tech
Manual Anomaly Intrusive Investigations (Hand Digs)	Daily	See MRP SOP 01 (UXO Detector-Aided Surface Surveys), MRP SOP 02 (MEC Management and Accountability), MRP SOP 10 (UXO Intrusive Investigation), and QC Follow-Up Report.	Ralph Brooks – UXO/MEC Manager, Tetra Tech TBD – SUXOS, Tetra Tech TBD – UXOQCS, Tetra Tech

Definable Feature of Work	Frequency of Inspection	Supporting QC Document(s)	Responsible for Validation (name, organization)
Mechanized Anomaly Intrusive Investigation (Test Pits)	Daily	See MRP SOP 01 (UXO Detector-Aided Surface Surveys), MRP SOP 02 (MEC Management and Accountability), MRP SOP 10 (UXO Intrusive Investigation) and QC Follow-Up Report.	Ralph Brooks – UXO/MEC Manager, Tetra Tech TBD – SUXOS, Tetra Tech TBD – UXOQCS, Tetra Tech
Donor Explosives Handling	Before first event and any time a new procedure is introduced	See MRP SOP 07 (UXO Demolition/Disposal Operations) and QC Follow-Up Report.	Ralph Brooks – UXO/MEC Manager, Tetra Tech TBD – SUXOS, Tetra Tech TBD – UXOQCS, Tetra Tech
MEC Management - Treatment	Once per day activity is conducted	See MRP SOP 07 (UXO Demolition/Disposal Operations) and QC Follow-Up Report. See MRP SOP 02 (MEC Management and Accounting) and QC Follow-Up report.	Ralph Brooks – UXO/MEC Manager, Tetra Tech TBD – SUXOS, Tetra Tech TBD – UXOQCS, Tetra Tech
MPPEH Management - Inspection	Once per day activity is conducted	See MRP SOP 07 (UXO Demolition/Disposal Operations) and QC Follow-Up Report. See MRP SOP 02 (MEC Management and Accounting) and QC Follow-Up report.	Ralph Brooks – UXO/MEC Manager, Tetra Tech TBD – SUXOS, Tetra Tech TBD – UXOQCS, Tetra Tech
MPPEH Management - Certification	Once per day activity is conducted	See MRP SOP 02 (MEC Management and Accounting), MRP SOP 09, and QC Follow-Up Report.	Ralph Brooks – UXO/MEC Manager, Tetra Tech TBD – SUXOS, Tetra Tech TBD – UXOQCS, Tetra Tech

Definable Feature of Work	Frequency of Inspection	Supporting QC Document(s)	Responsible for Validation (name, organization)
MPPEH Management - Disposal	Once at end of project	See MRP SOP 02 (MEC Management and Accounting), MRP SOP 09, and QC Follow-Up Report.	Ralph Brooks – UXO/MEC Manager, Tetra Tech TBD – SUXOS, Tetra Tech TBD – UXOQCS, Tetra Tech
Demobilization	Once upon completion of the project	Verify that all demobilization activities have been completed.	Linda Klink – PM, Tetra Tech Ralph Brooks – UXO/MEC Manager, Tetra Tech
Site-Specific Final Report Preparation and Approval (1)	Once upon completion of the project	Verify that all activities have been documented, and reported, and have been included in the report.	Linda Klink – PM, Tetra Tech Stacin Martin – Navy RPM

1 – See Volume 1, MC UFP-SAP, for information on Interim Report/Memorandum.

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

(UFP-QAPP Manual Section 5.2.2.1)

Step IIa/IIb[1]	Matrix	Analytical Group	Validation Criteria	Data Validator (Title and organization)
IIa	Surface Soil	Detector-Aided Surface Survey Donor Explosive Handling MEC/MPPEH Management	Detection and location of blind seed items for step-out transects. Explosives handling performed in compliance with OP 5 and ATF regulations. Treatment conducted per MRP SOP 2, SOP 07.	TBD - SUXOS Tetra Tech TBD - UXOQCS Tetra Tech
IIa	Subsurface Soil	Geophysics investigation Detector-aided subsurface surface survey with manual MEC/MPPEH and non-munitions-related debris removal Intrusive investigation to depth as specified in Worksheet #17 and within 2 feet of target anomaly's reacquired location Test pits	a) Achievement of goals established for the IVS. b) Detection and location of blind seed items c) All anomalies detected and investigated to depth specified in Worksheet #17 and within radius of 2 feet of reacquired target anomaly location. No MEC 20mm or larger remains in the excavation.	Bill Randall - Project Geophysicist TBD - SUXOS Tetra Tech TBD - UXOQCS Tetra Tech

Step IIa/IIb[1]	Matrix	Analytical Group	Validation Criteria	Data Validator (Title and organization)
IIb	Surface Soil	Site Surveying Vegetation Management IVS GPS Positional Data Collection Detector-Aided Surface Survey	GPS positional error at known location less than 1 meter. Vegetation cut to between 6 to 12 inches above the ground surface. 100% vertical detection of ISOs at specified depth. HDOP less than three, number of satellites at least four. Sub-Meter. Discover and record all blind seeds placed in transect.	TBD - SUXOS Tetra Tech TBD - UXOQCS Tetra Tech
IIb	Subsurface Soil	Geophysics investigation Intrusive investigation to depth as specified in Worksheet #17 and within 2 feet of target anomaly's reacquired location	Minimize data dropouts and unusable data. 90% minimum of usable data per survey line. Type, condition, and fuzing state (of munitions-related items correctly identified). Type of non-munitions-related items. Detect all Seed Items, MEC/MPPEH 20 millimeter (mm) or larger.	Bill Randall - Project Geophysicist TBD - SUXOS Tetra Tech TBD - UXOQCS Tetra Tech

1 IIa = compliance with methods, procedures, and contracts (see Table 10, page 117, UFP-QAPP manual, V.1 March 2005).
IIb = comparison with measurement performance criteria (see Table 10, page 117, UFP-QAPP manual, V.1 March 2005).

SAP Worksheet #37 – Usability Assessment

(UFP-QAPP Manual Section 5.2.3)

Data Usability Assessment

The usability of the data directly affects whether project objectives can be achieved. The following characteristics will be evaluated at a minimum. The results of these evaluations will be included in the project report. To the extent required by the type of data being reviewed, the assessors will consult with other technically competent individuals to render sound technical assessments of these data characteristics.

Certification of Proper Operation of Detection and Positioning Systems

The Tetra Tech Project Geophysicist and UXO/MEC Manager, or designee, acting on behalf of the project team, will prepare a table listing planned calibration and QC checks, their occurrence, and the results (acceptable or not acceptable) for each type of metal detector, geophysical instrument, and positioning system equipment to be used on the project. Data collected by any improperly operating equipment will be identified. A determination will be made as to whether the affected data adversely impacted the ability to meet project objectives. If the project objectives have been adversely impacted, the Tetra Tech PM will consult with the Navy RPM and other project team members, as necessary (determined by the Navy RPM), to develop appropriate corrective actions.

Qualification/Certification of Survey Team

The Tetra Tech Project Geophysicist and UXO/MEC Manager, or designee, acting on behalf of the project team, will prepare a table listing each member of the MEC investigation team and required certifications, training, and demonstrations of competency. Any deviations from this SAP will be identified. Data collected by team members not meeting the required training and demonstrations of competency will be identified. A determination will be made as to whether affected data impacted the ability to meet project objectives. If the project objectives have been adversely impacted, the Tetra Tech PM will consult with the Navy RPM and other project team members, as necessary (determined by the Navy RPM), to develop appropriate corrective actions.

Coverage of Investigation Areas

The Tetra Tech Project Geophysicist and UXO/MEC Manager, or designee, acting on behalf of the Tetra Tech PM and project team, will determine whether data were collected in all areas planned to be investigated. Data gaps will be identified. The Tetra Tech PM will consult with the project team to determine the extent to which it is necessary to fill these data gaps prior to completion of the Full RFI Report.

Interpretation of Geophysical Data

The Project Geophysicist, acting on behalf of the project team, will analyze the geophysical interpretation and maps to check for completeness of anomaly interpretation (target picking), and whether acceptable anomaly selection criteria were applied in the interpretation of the data. Any deficiencies in anomaly interpretation will be identified, and their impact on the Project Quality Objectives (PQOs) will be summarized.

Identify the personnel responsible for performing the usability assessment:

The Tetra Tech PM will be responsible for conducting the listed data usability assessments. The data usability assessments will be reviewed with the Navy RPM, PREQB, and USEPA. The review will take place either in a face-to-face meeting or teleconference depending on the extent of identified deficiencies. If no significant deficiencies are identified, the data usability assessment will simply be documented in the project report and reviewed during the normal document review cycle.

Describe the documentation that will be generated during usability assessment and how usability assessment results will be presented:

Written documentation will support non-compliant data results in accordance with this SAP. The project report will identify and describe the data usability limitations and suggest corrective actions, if necessary.

Usability Checklist Table			
Phase of Work	**Item to be checked/verified**	**Verified (Yes or No)**	**Comments or Deviations**
Pre-Survey	Qualifications of survey team evaluated.		
	Personnel reviewed and signed off on relevant SAP section(s).		
MDAS Inventory	MDAS recorded on MDAS Addition Form. MDAS reported in daily report.		
GPS Data	Prepare a table listing planned calibration and QC checks, their occurrence, and the results (acceptable or not acceptable) for position system equipment to be used on the project. Verify uploads of GPS data to Tetra Tech's munitions response website.		
MEC Tracking Log	Conformance with SAP requirements and procedures for recording MEC items discovered. Report MEC/MPPEH and related items on Daily Reports.		
Detector-Aided and Geophysical Surveys	QC evaluation of survey equipment (tests and checklists satisfactorily completed).		
	Conformance to SAP requirements and procedures for all survey work and rework (including documentation requirements), and all deficiencies documented.		
	Coverage of areas to be investigated fulfilled and located within accuracy levels required for the Full RFI.		
	Interpretation and summary of geophysical data satisfies SAP requirements and conformance with Worksheet #17.		

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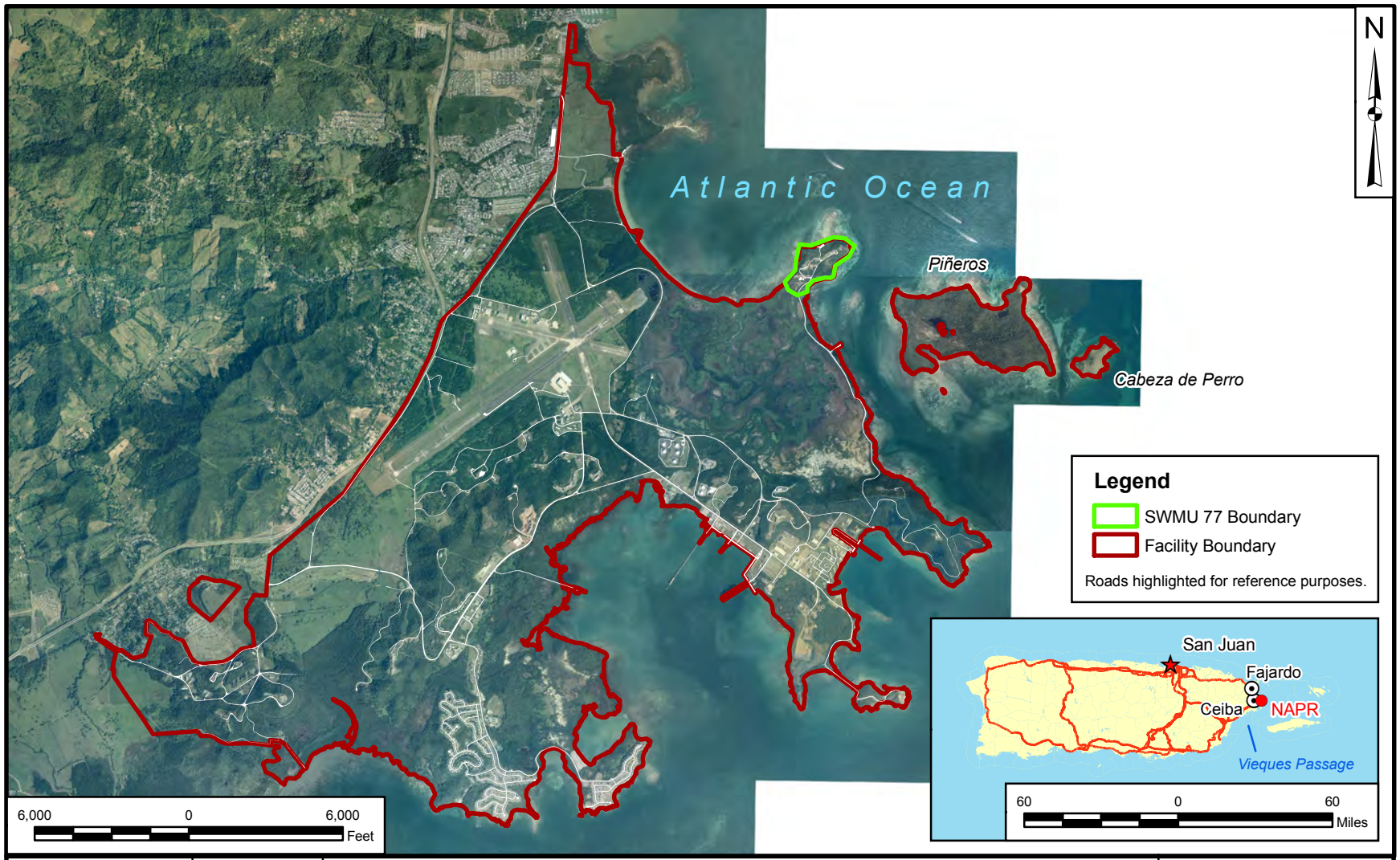

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FACILITY MAP

NAVAL ACTIVITY PUERTO RICO (NAPR)

CEIBA, PERTO RICO

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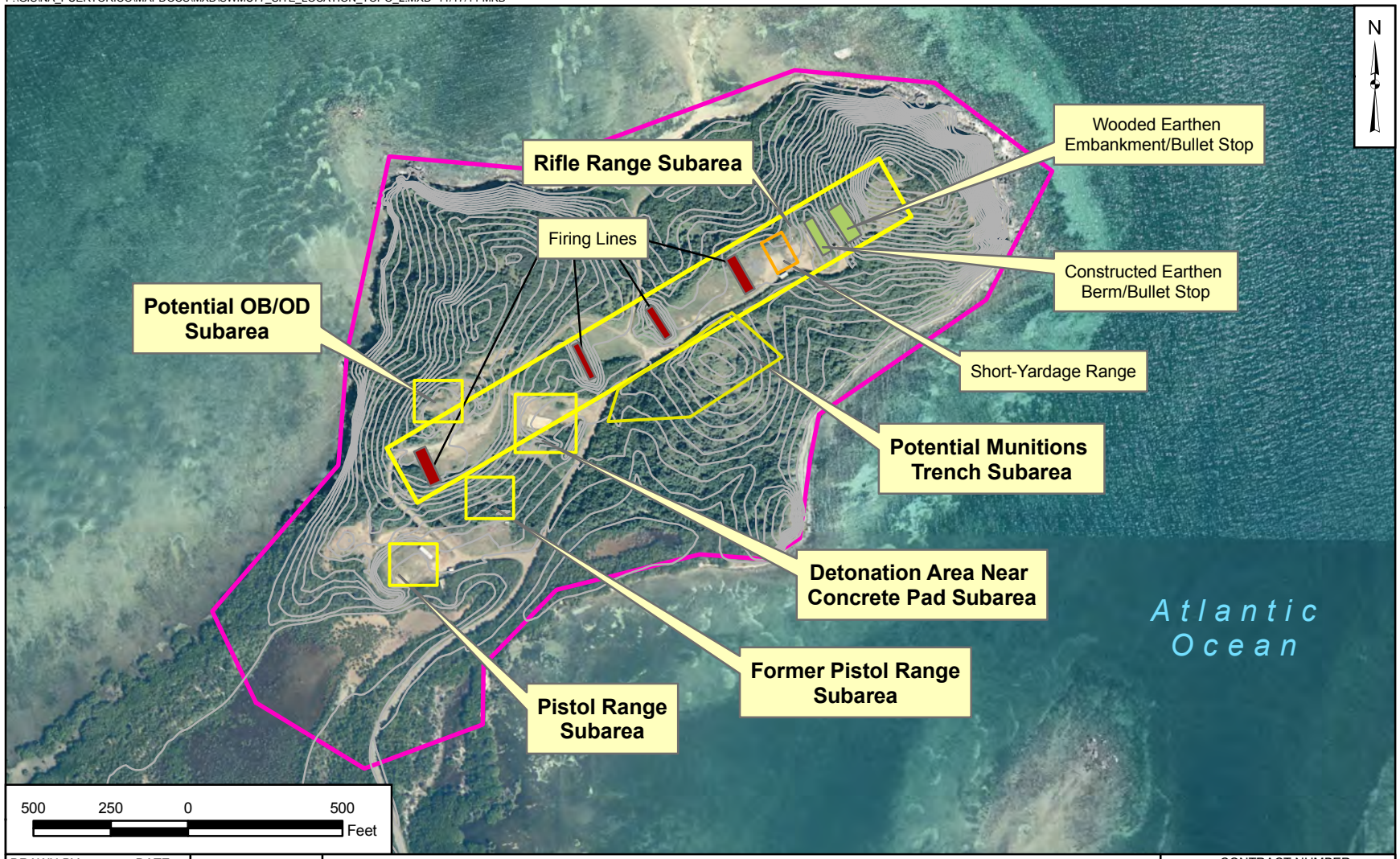

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SUBAREA LOCATION AND TOPOGRAPHY
SWMU 77
NAVAL ACTIVITY PUERTO RICO
CEIBA, PUERTO RICO

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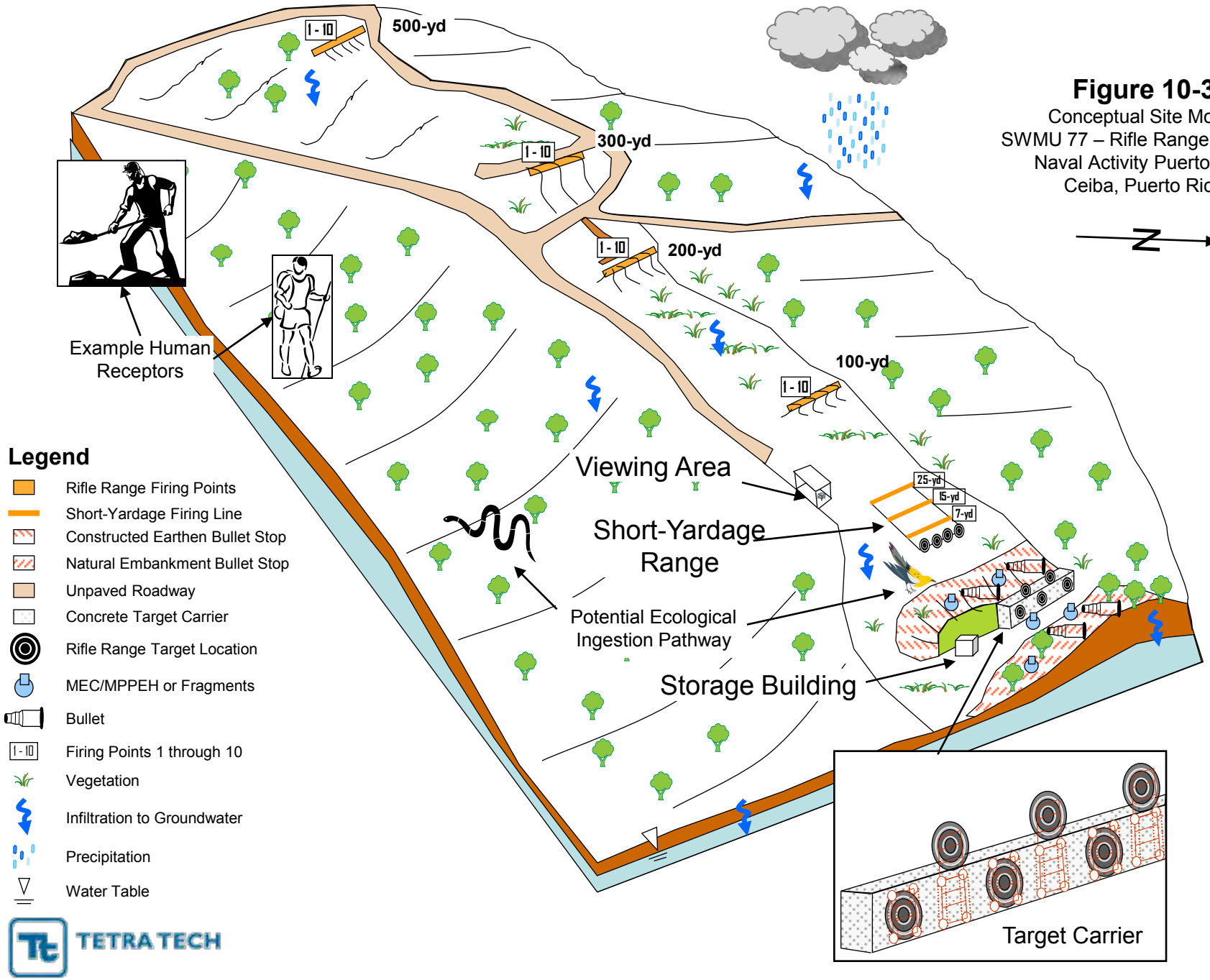
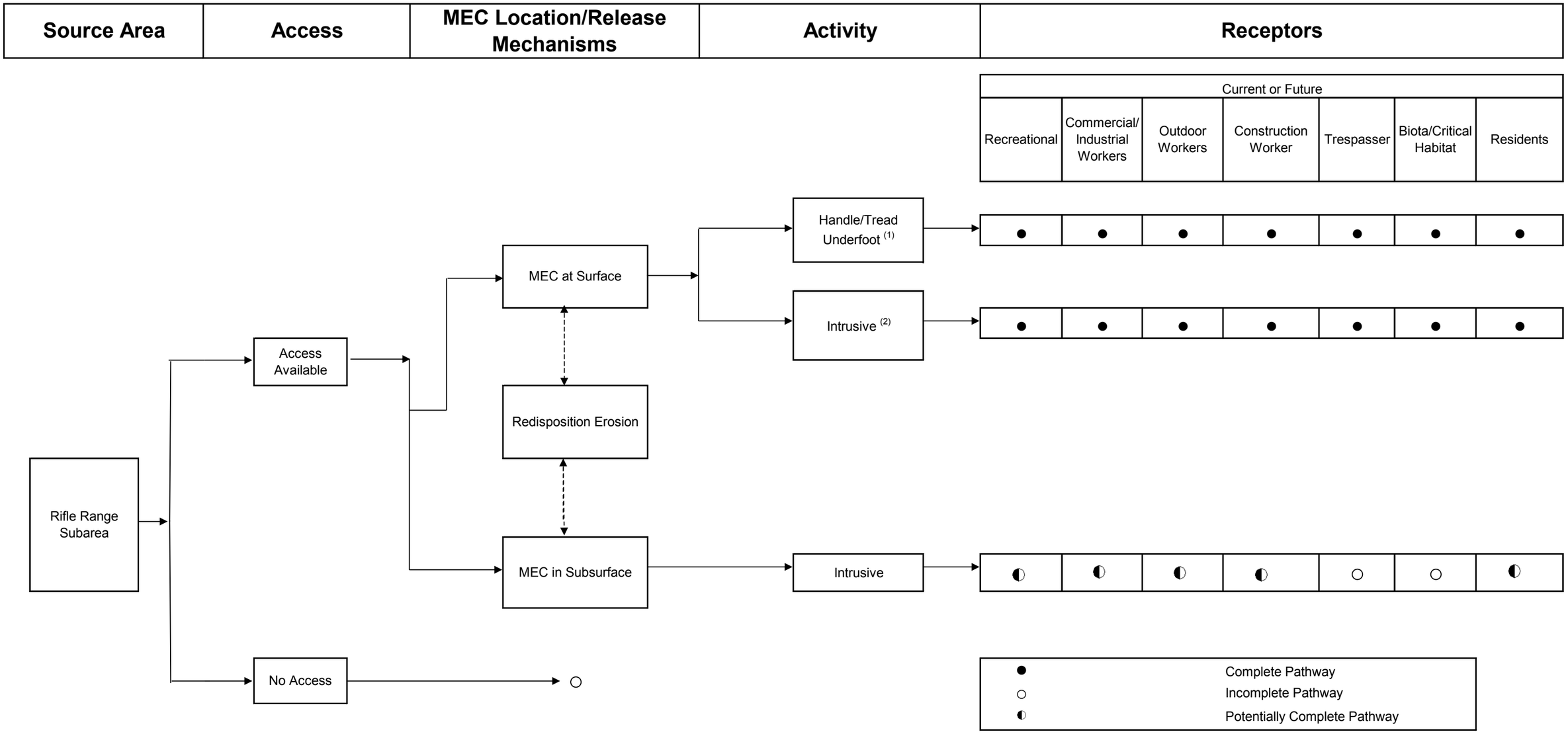


Figure 10-3
Conceptual Site Model
SWMU 77 – Rifle Range Subarea
Naval Activity Puerto Rico
Ceiba, Puerto Rico

FIGURE 10-4

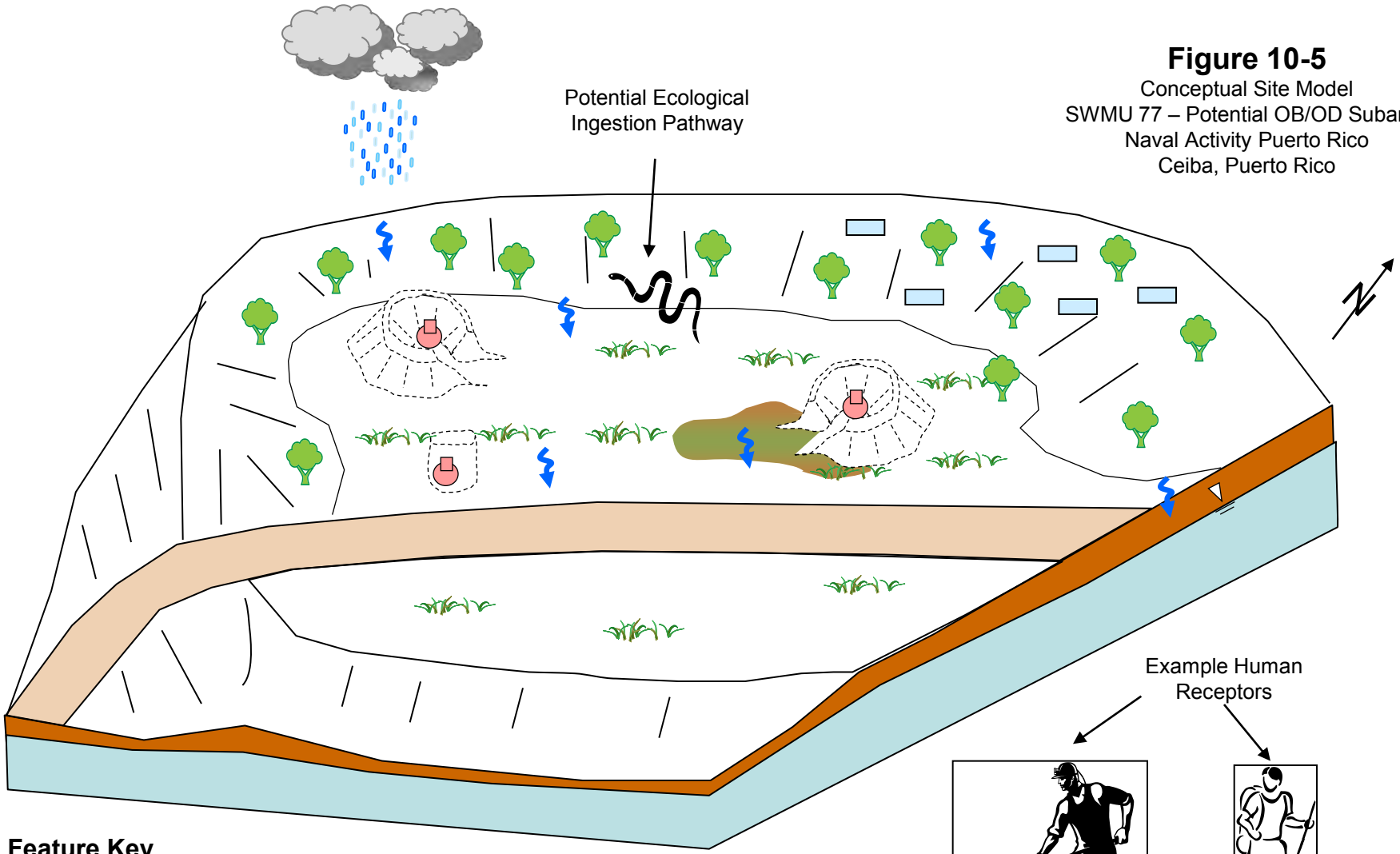
MEC EXPOSURE PATHWAY ANALYSIS
SWMU 77 - RIFLE RANGE SUBAREA
NAVAL ACTIVITY PUERTO RICO
CEIBA, PUERTO RICO



Note: MEC/MPPEH encountered at ground surface during Phase I RFI.
1. Handle/tread underfoot occurs at the ground surface.
2. Intrusive surface activities occur from the ground surface to a depth of 6-inches below the ground surface.

Figure 10-5

Conceptual Site Model
SWMU 77 – Potential OB/OD Subarea
Naval Activity Puerto Rico
Ceiba, Puerto Rico



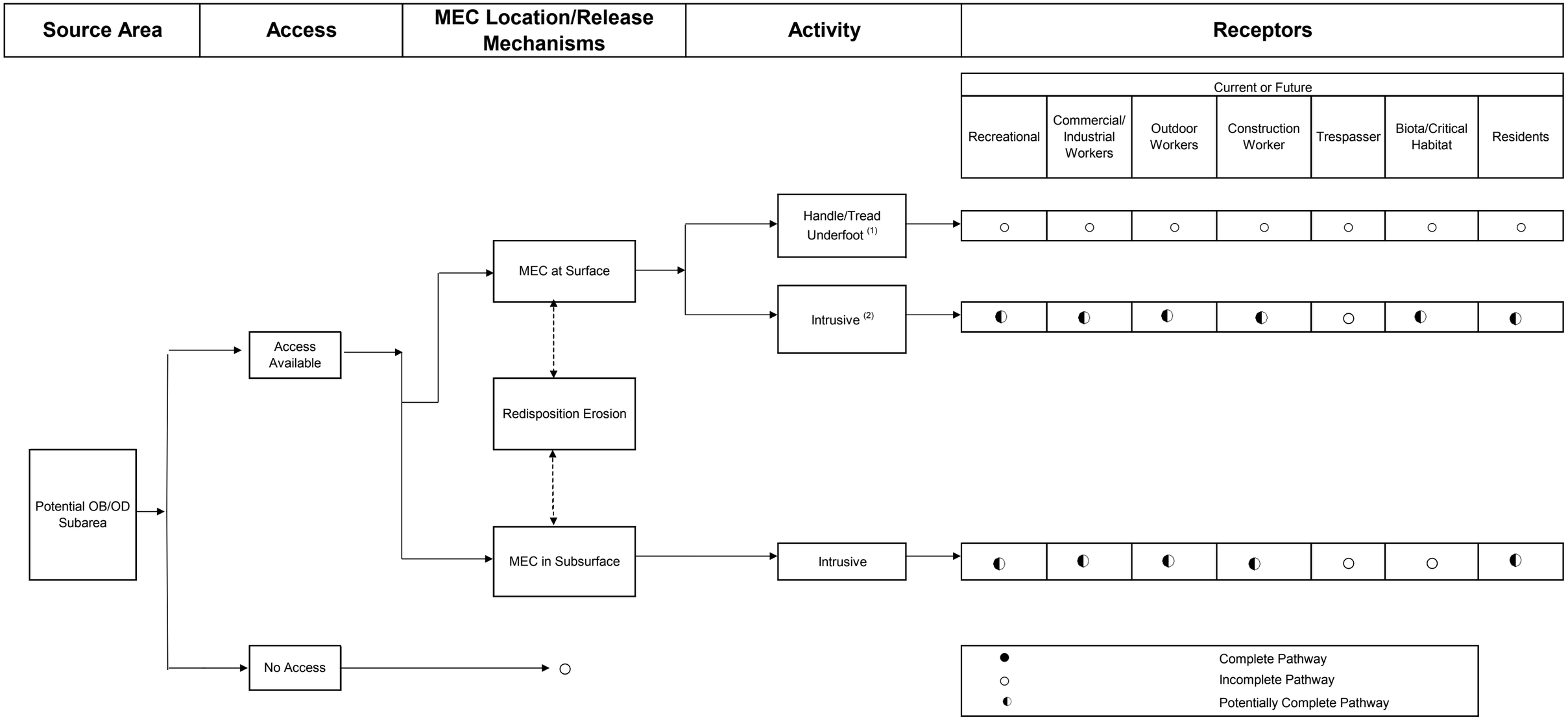
Feature Key

- Unpaved Roadway
- Vegetation
- Infiltration to Groundwater
- Precipitation
- Water Table
- Small Surface Depression
- .50 Caliber Blank Cartridge Casing
- Unknown Subsurface Potential MEC or MEC Fragment
- Potential Berm (Typ.)/Burn Pit

TETRA TECH

FIGURE 10-6

MEC EXPOSURE PATHWAY ANALYSIS
SWMU 77 - POTENTIAL OB/OD SUBAREA
NAVAL ACTIVITY PUERTO RICO
CEIBA, PUERTO RICO



Note: MEC/MPPEH not encountered at ground surface during Phase I RFI. Subsurface MEC/MPPEH unknown.
1. Handle/tread underfoot occurs at the ground surface.
2. Intrusive surface activities occur from the ground surface to a depth of 6-inches below the ground surface.

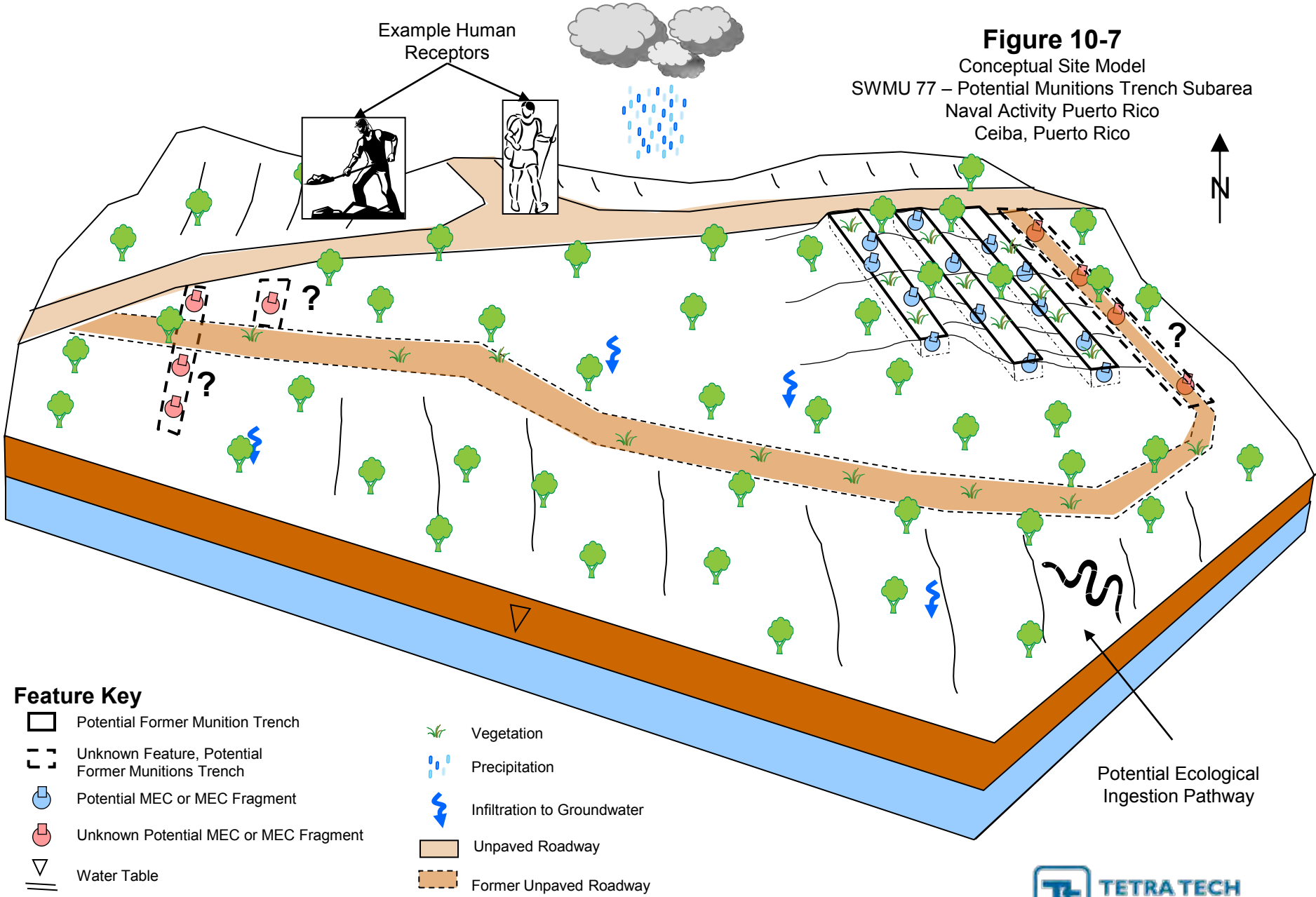
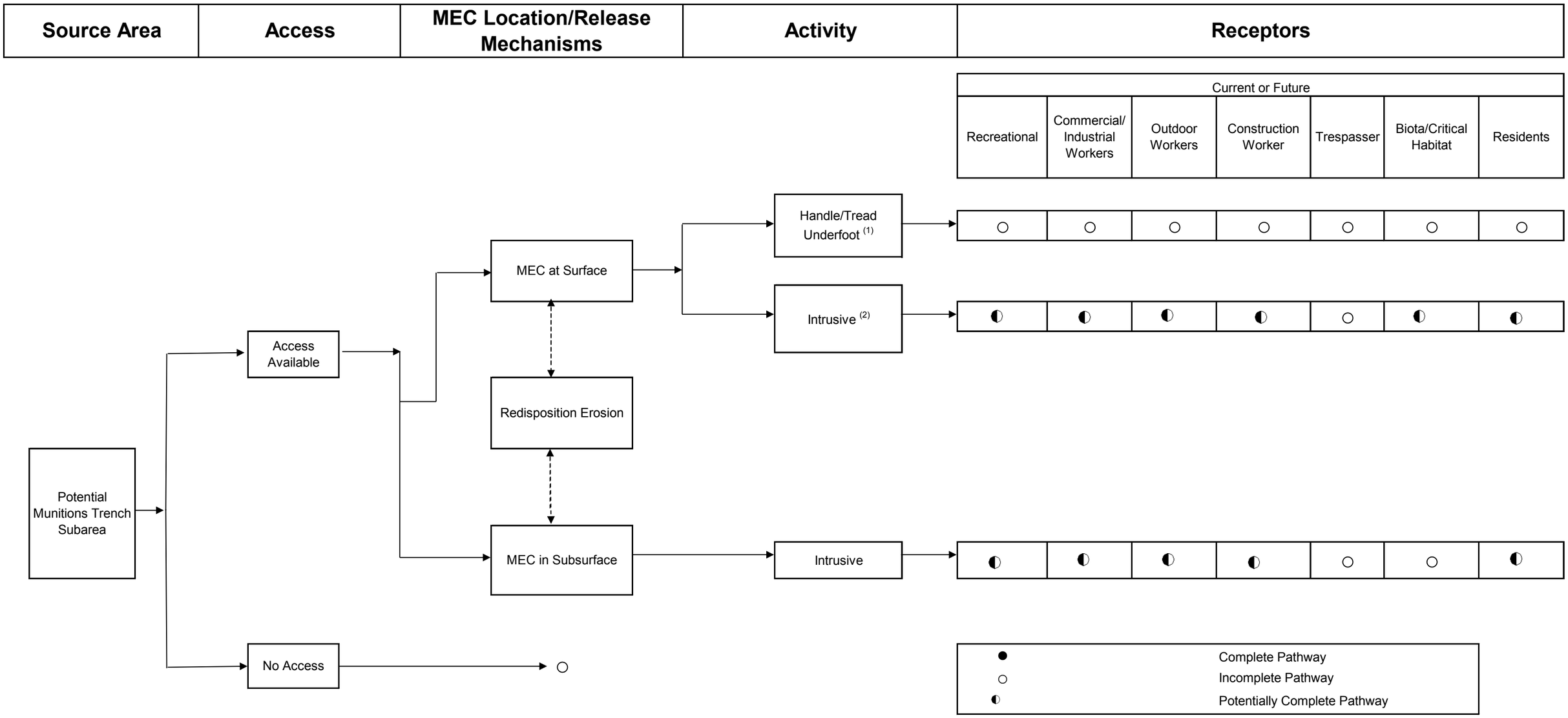


Figure 10-7
Conceptual Site Model
SWMU 77 – Potential Munitions Trench Subarea
Naval Activity Puerto Rico
Ceiba, Puerto Rico

TETRA TECH

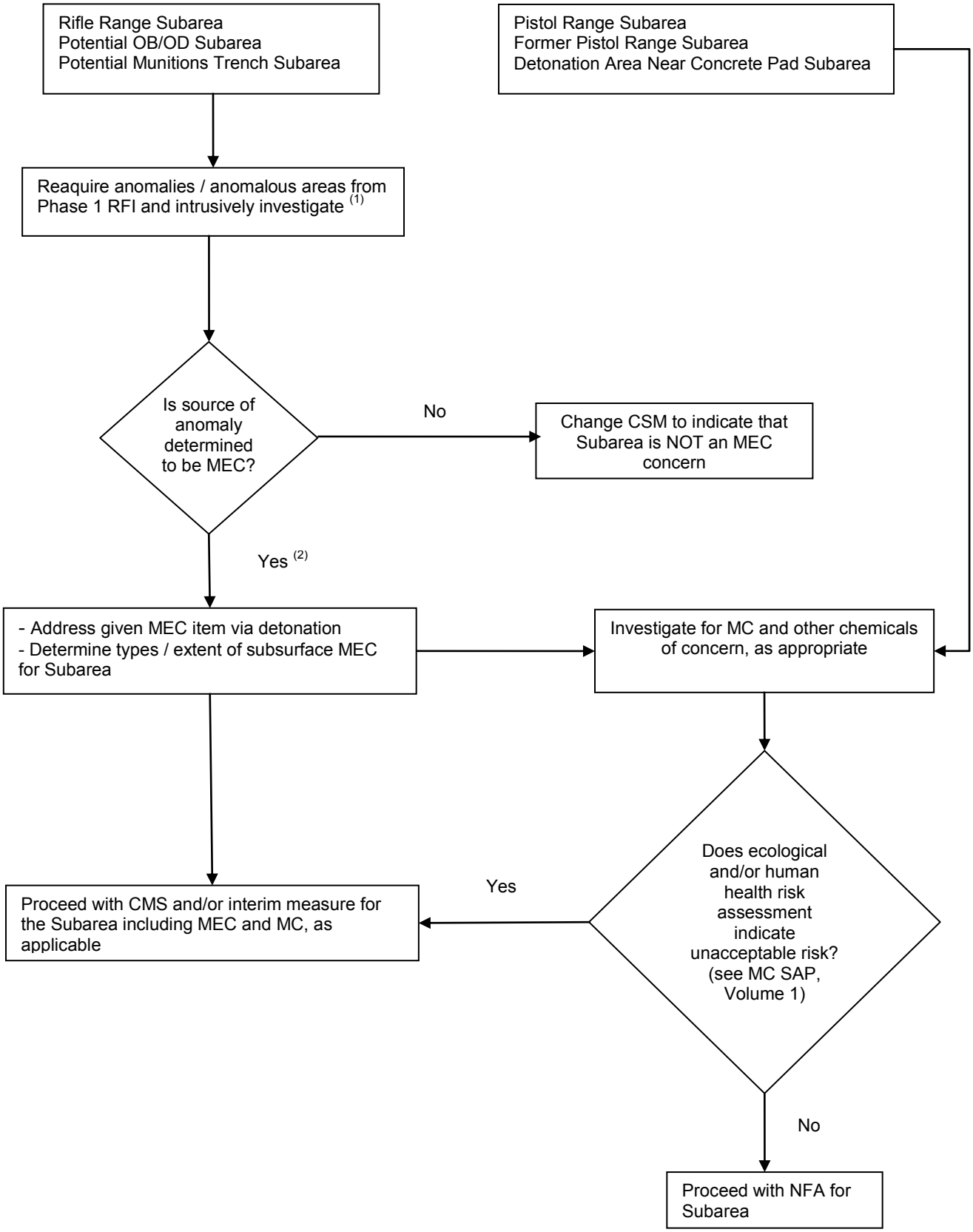
FIGURE 10-8

MEC EXPOSURE PATHWAY ANALYSIS
SWMU 77 - POTENTIAL MUNITIONS TRENCH SUBAREA
NAVAL ACTIVITY PUERTO RICO
CEIBA, PUERTO RICO



Note: MEC/MPPEH not encountered at ground surface during Phase I RFI. Subsurface MEC/MPPEH unknown.
1. Handle/tread underfoot occurs at the ground surface.
2. Intrusive surface activities occur from the ground surface to a depth of 6-inches below the ground surface.

FIGURE 11-1
STUDY GOAL AND DECISION RULE FLOW CHART
SWMU 77 – SMALL ARMS RANGE, ALL SUBAREAS
NAVAL ACTIVITY PUERTO RICO
CEIBA, PUERTO RICO



(1) Rifle Range Subarea: Intrusively investigate all detector-aided survey determined subsurface anomalies identified during the Phase 1 RFI, and any additional anomalies identified during the Full RFI surveys.

Potential OB/OD Subarea: Intrusively investigate selected geophysics survey determined anomaly cluster areas and large amplitude anomalies identified during the Phase 1 RFI, and any additional anomalies identified during Full RFI surveys.

Potential Munitions Trench Subarea: Intrusively investigate selected geophysics survey determined six linear anomalies identified during the Phase 1 RFI, and any additional anomalies identified during the Full RFI surveys.

(2) Rifle Range Subarea: While the Full RFI may remove the earthen embankment from further MEC concern, the wooded embankment will remain as a concern regardless, considering the area is heavily vegetated and MEC/MPPEH was encountered during the Phase I RFI; proceed to CMS.

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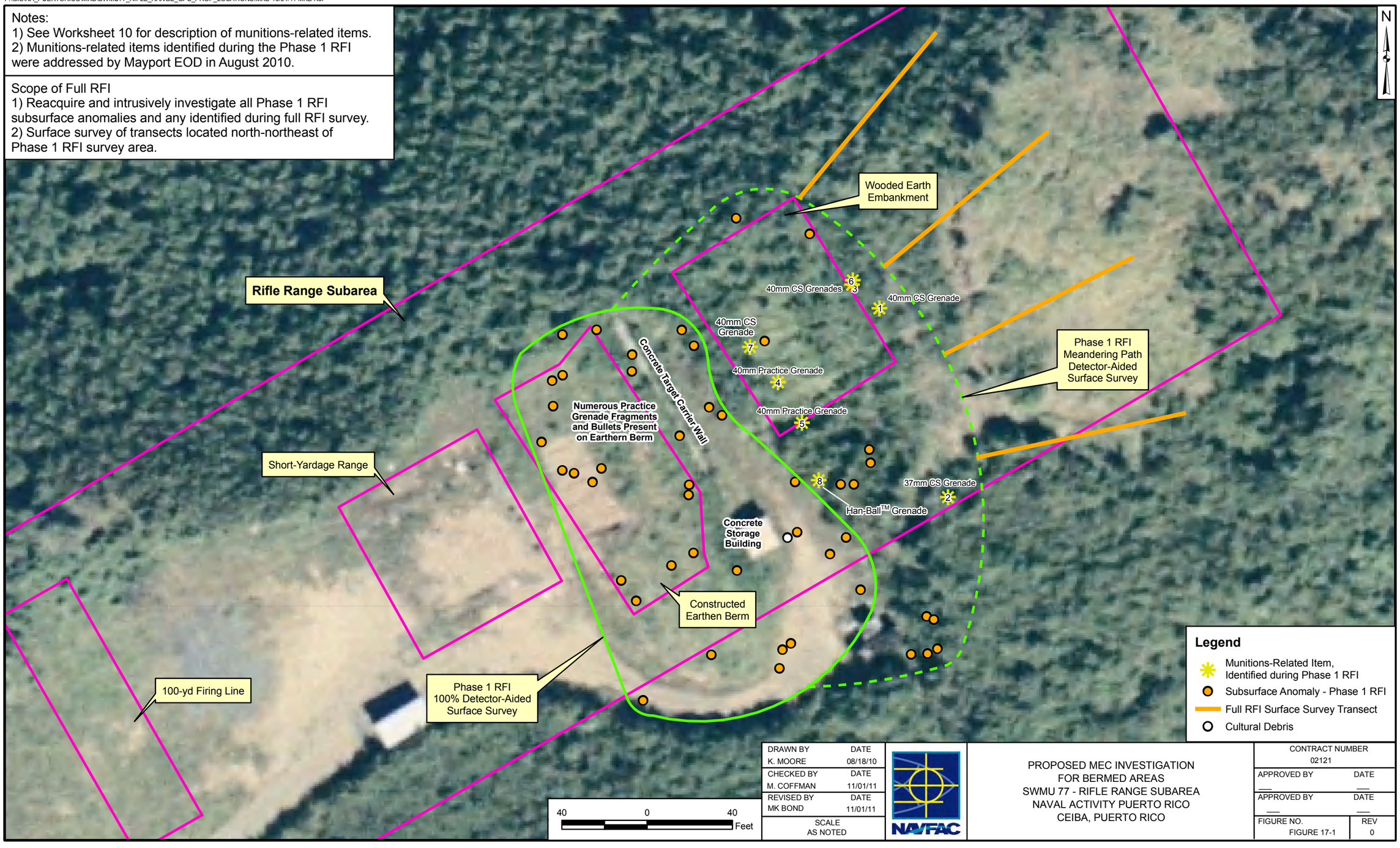
Notes:
1) See Worksheet 10 for description of munitions-related items.
2) Munitions-related items identified during the Phase 1 RFI were addressed by Mayport EOD in August 2010.

Scope of Full RFI
1) Reacquire and intrusively investigate all Phase 1 RFI subsurface anomalies and any identified during full RFI survey.
2) Surface survey of transects located north-northeast of Phase 1 RFI survey area.



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PROPOSED MEC INVESTIGATION
FOR BERMED AREAS
SWMU 77 - RIFLE RANGE SUBAREA
NAVAL ACTIVITY PUERTO RICO
CEIBA, PUERTO RICO

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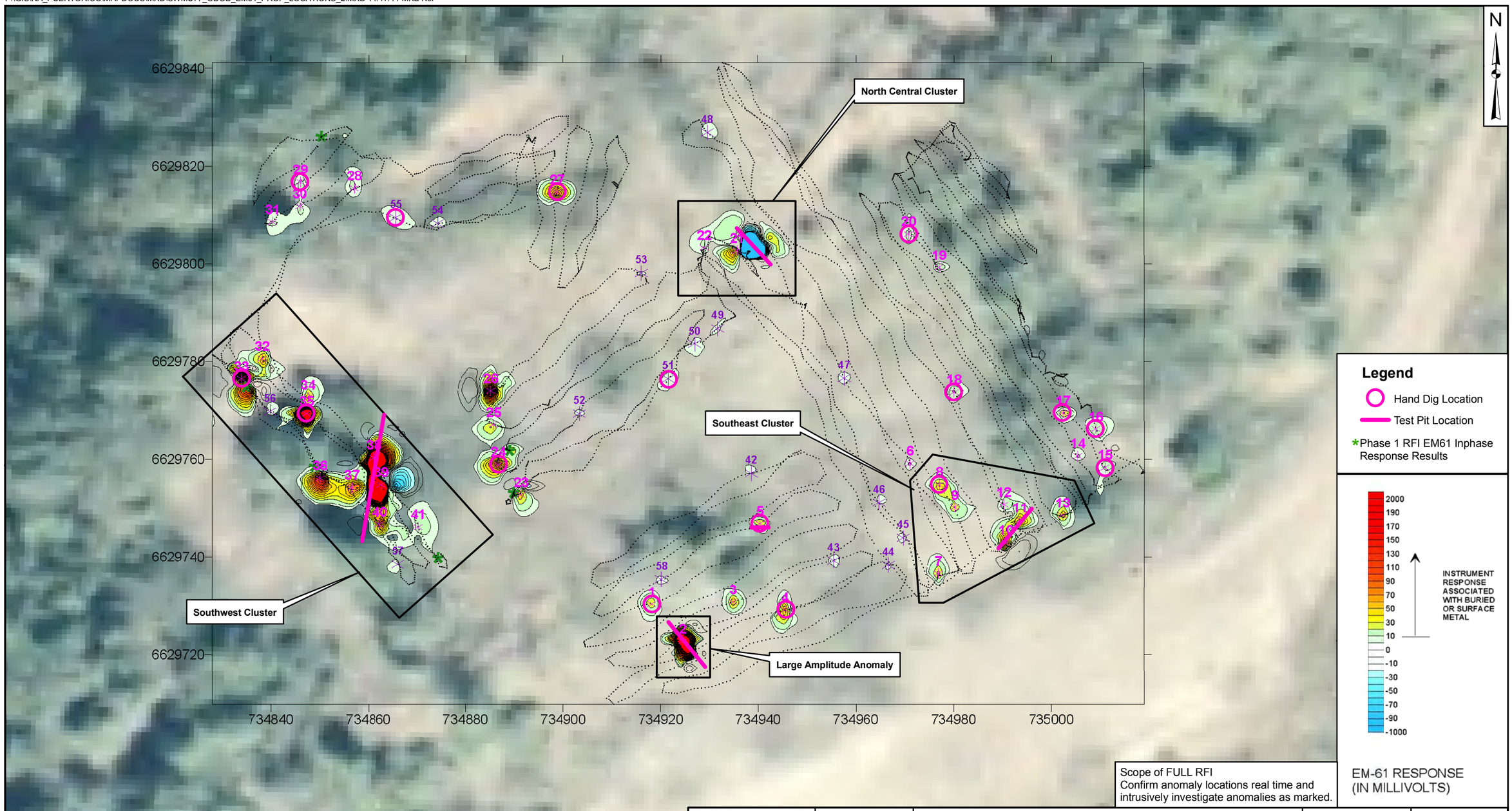

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PROPOSED MEC INVESTIGATION
SWMU 77 - POTENTIAL OD/OB SUBAREA
NAVAL ACTIVITY PUERTO RICO
CEIBA, PUERTO RICO

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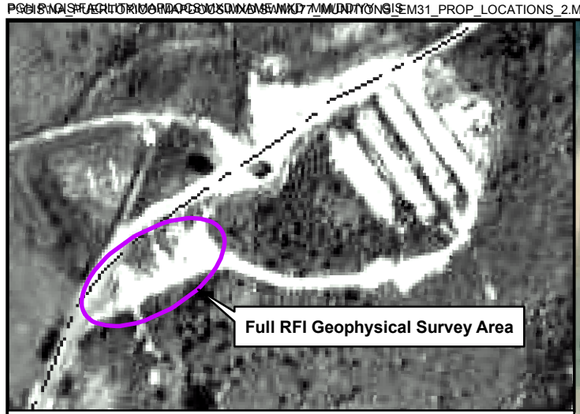
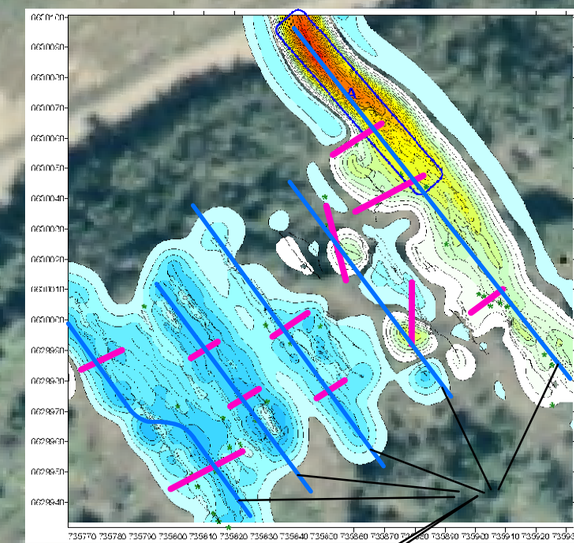


1958 Aerial Photograph (1" = 200')



Potential Trenches

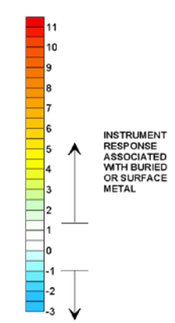
Full RFI Geophysical Survey Area
(See Inset)

N

Legend

Test Pit Location

* Phase 1 RFI EM31 Inphase Response Results



EM-31 RESPONSE
(IN PARTS PER THOUSAND)

Scope of FULL RFI
Eastern Area: Confirm anomaly locations real time and intrusively investigate anomalies as marked.
Western Area: Confirm absence of anomalies, if present, intrusively investigate via test test pits or hand digs.

50 0 50 Feet

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PROPOSED MEC INVESTIGATION (EM31 OVERLAY)
SWMU 77 - POTENTIAL MUNITIONS TRENCH SUBAREA
NAVAL ACTIVITY PUERTO RICO
CEIBA, PUERTO RICO

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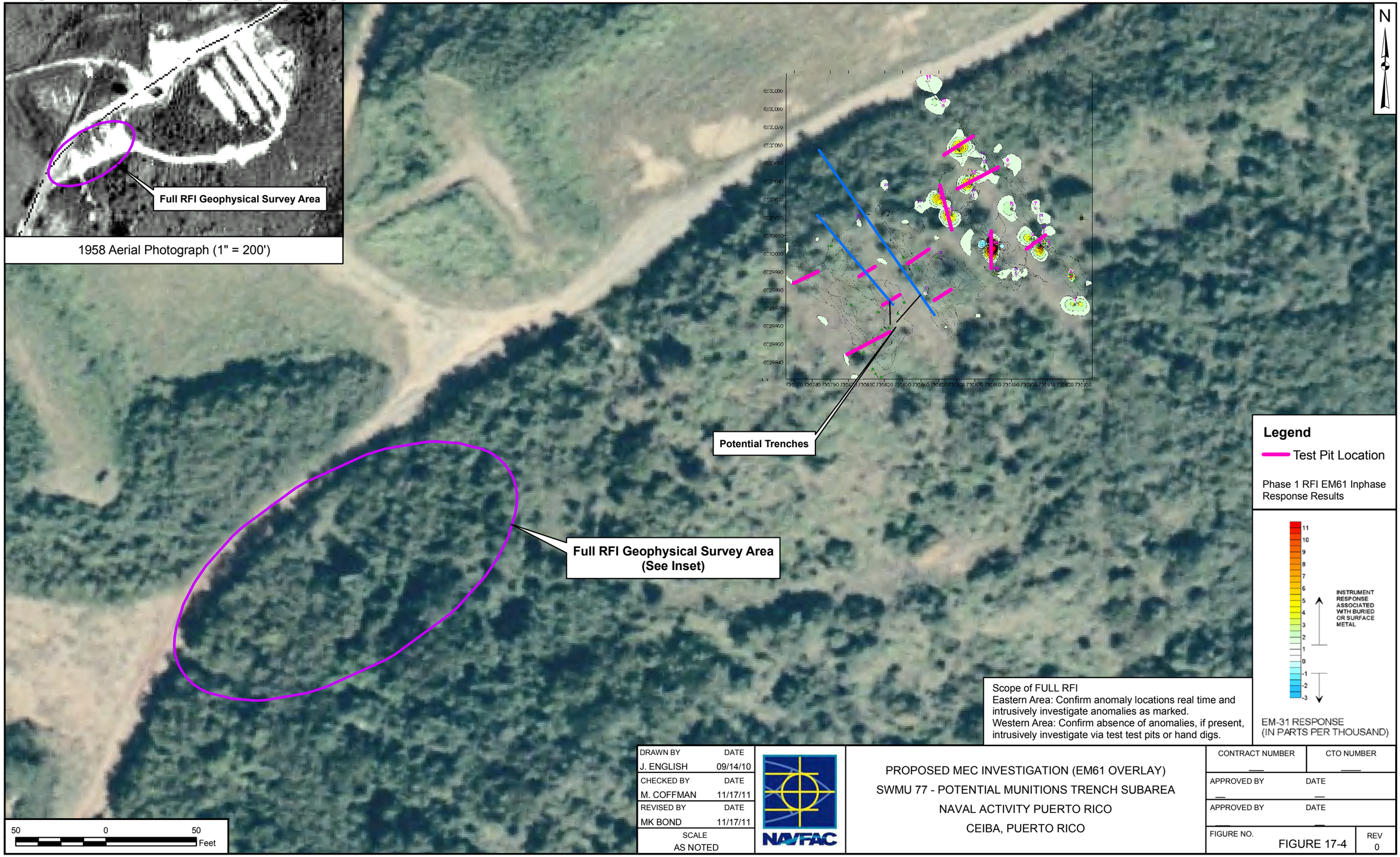

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PROPOSED MEC INVESTIGATION (EM61 OVERLAY)
SWMU 77 - POTENTIAL MUNITIONS TRENCH SUBAREA
NAVAL ACTIVITY PUERTO RICO
CEIBA, PUERTO RICO

CONTRACT NUMBER	CTO NUMBER
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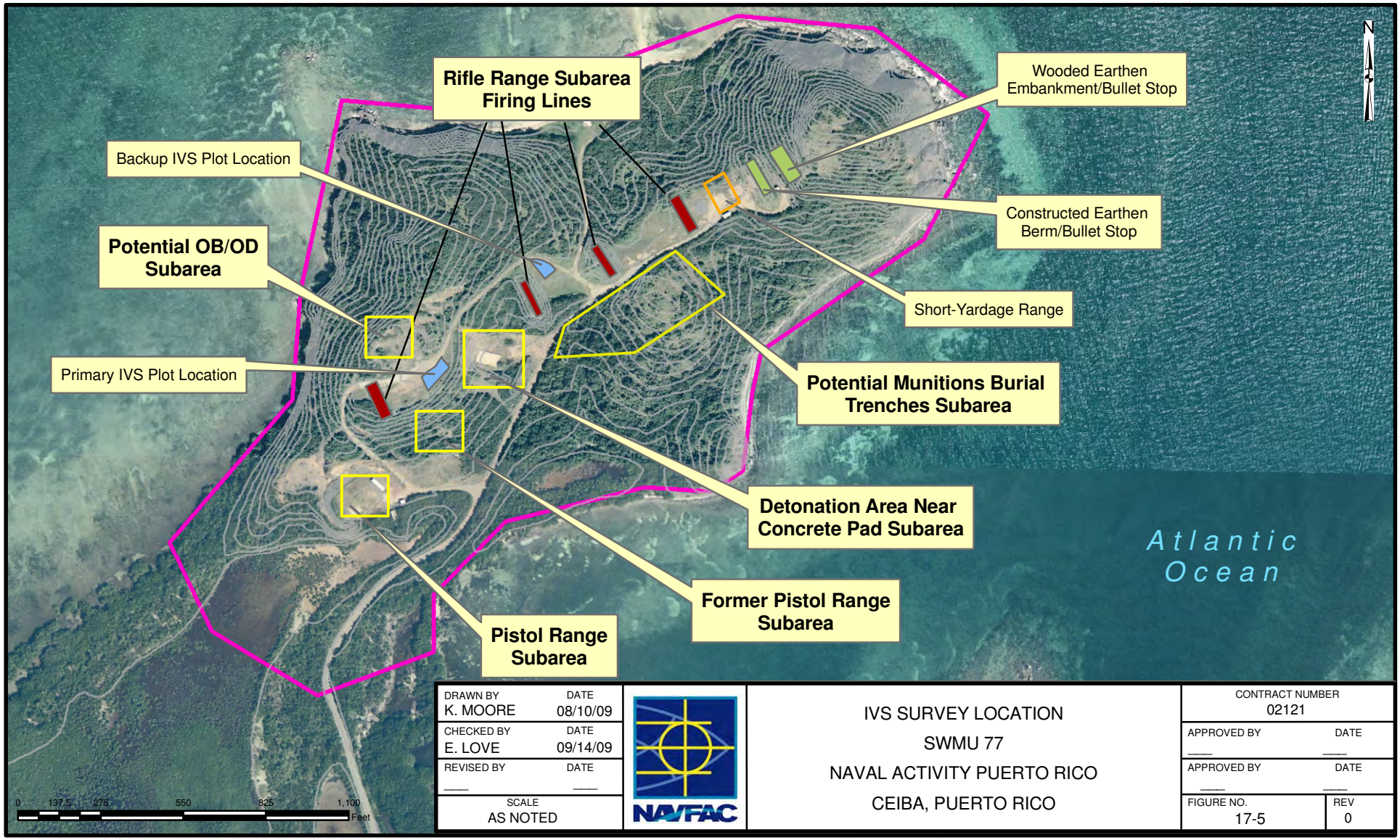

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ATTACHMENT 1

PROJECT SUPPORT INFORMATION

1-1 SUPPLEMENTAL HISTORICAL INFORMATION

1-2 HISTORICAL AERIAL PHOTOGRAPHS

1-3 SITE WALK AND PHASE I RFI PHOTOGRAPH LOGS

1-4 Phase I RFI Detector-Aided and Geophysical Survey Results

1-1 SUPPLEMENTAL HISTORICAL INFORMATION

1-1.1 SITE ENVIRONMENTAL SETTING

FINAL

Phase I/II Environmental Condition of Property Report

Former U.S. Naval Station Roosevelt Roads
Ceiba, Puerto Rico

Prepared For:

Commander, Navy Region Southeast (CNRSE)
U.S. Navy

Prepared By:

Naval Facilities Engineering Command Atlantic
6506 Hampton Blvd.
Norfolk, VA 23508-1278

15 July 2005

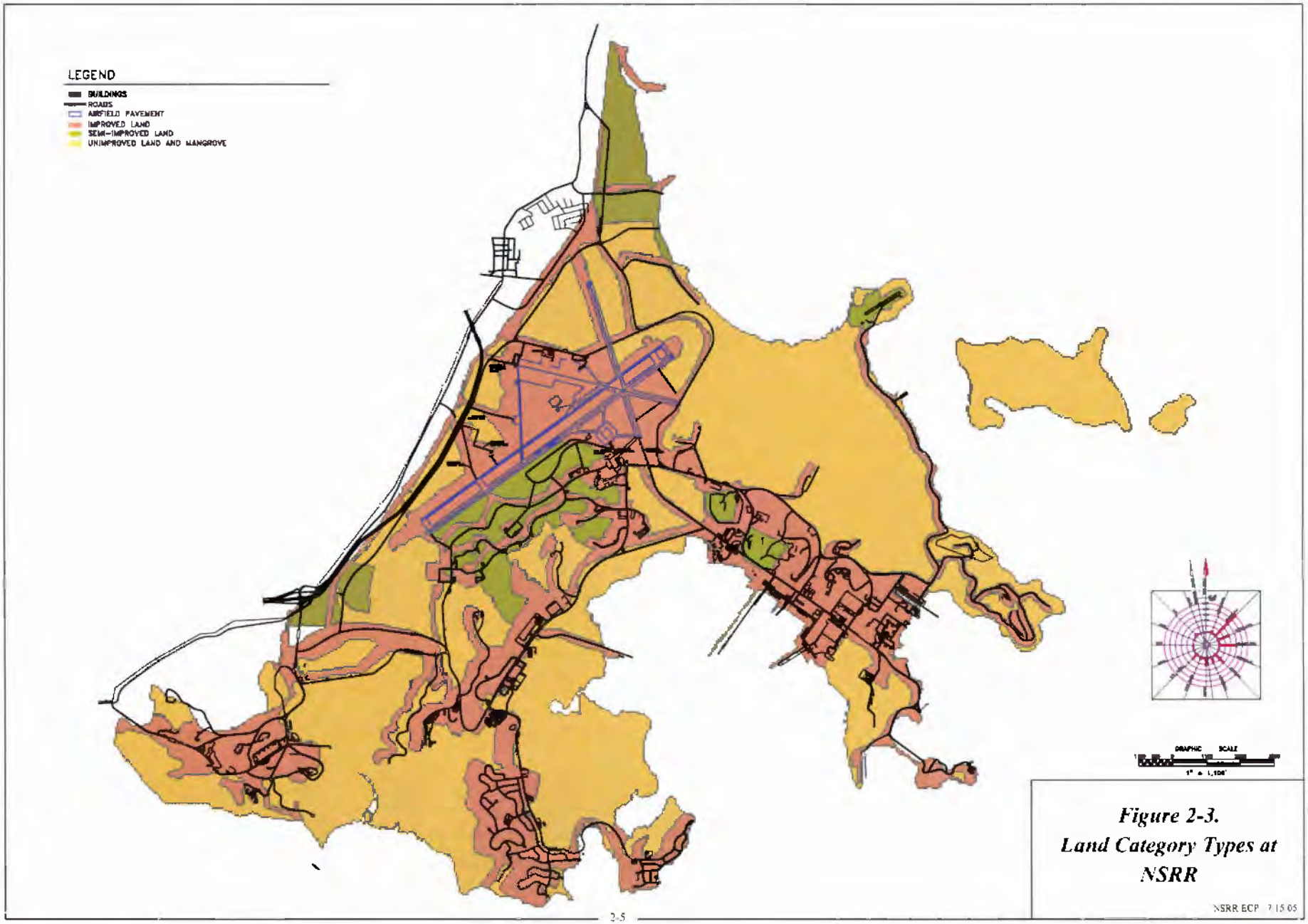


Figure 2-3. Land Category Types at NSRR

NSRR ECP 7/15/05

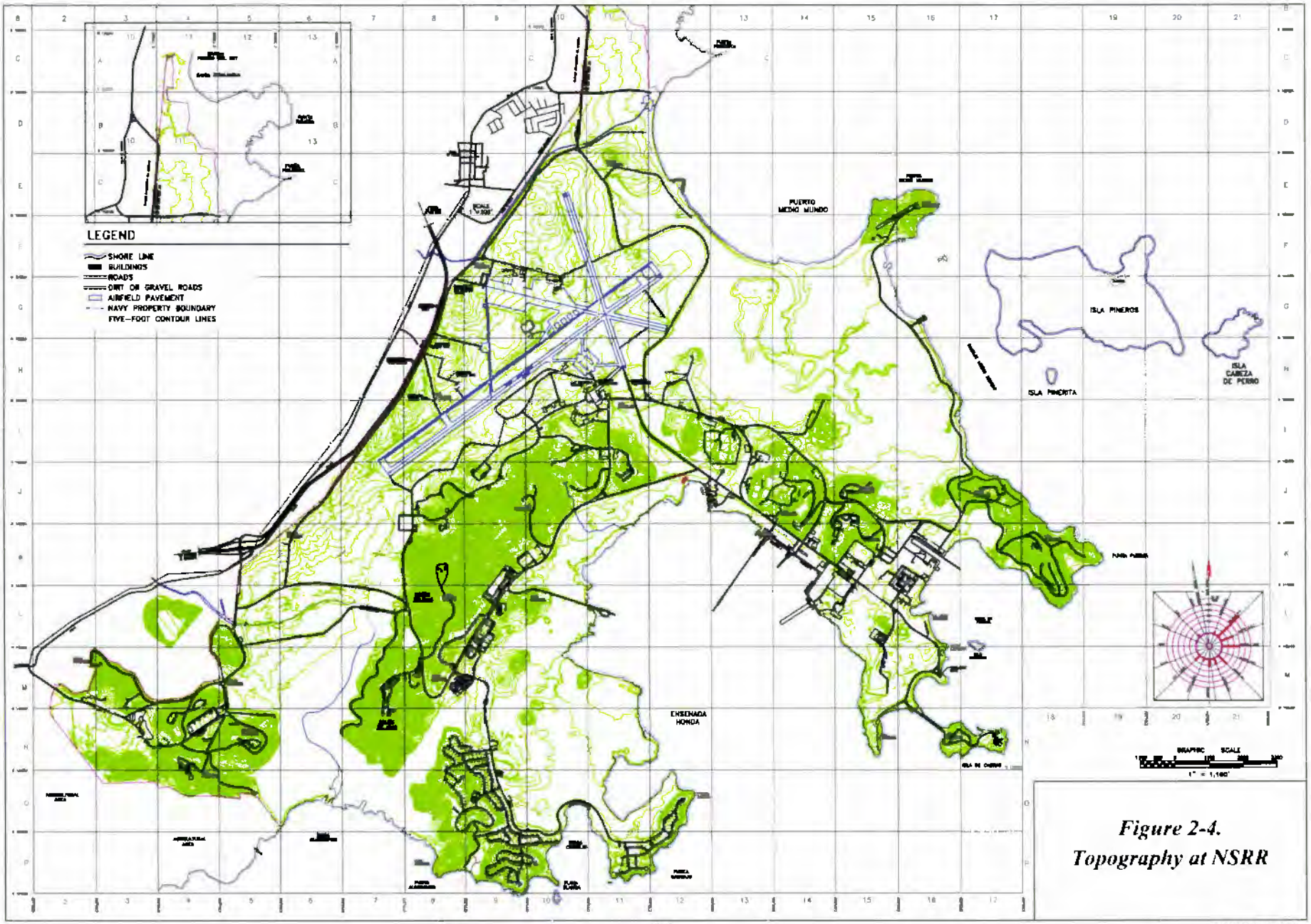


Figure 2-4.
Topography at NSRR

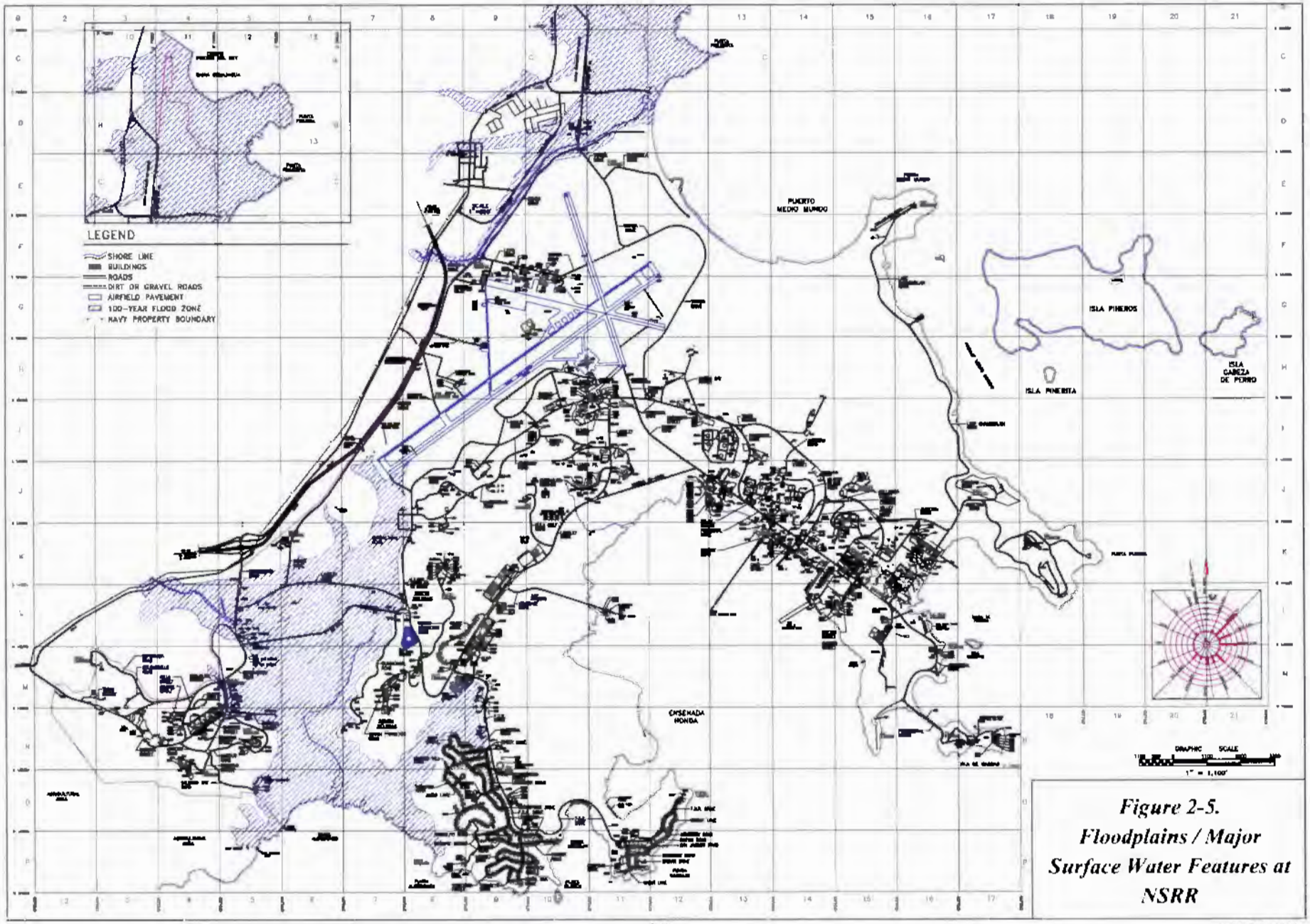


Figure 2-5. Floodplains / Major Surface Water Features at NSRR

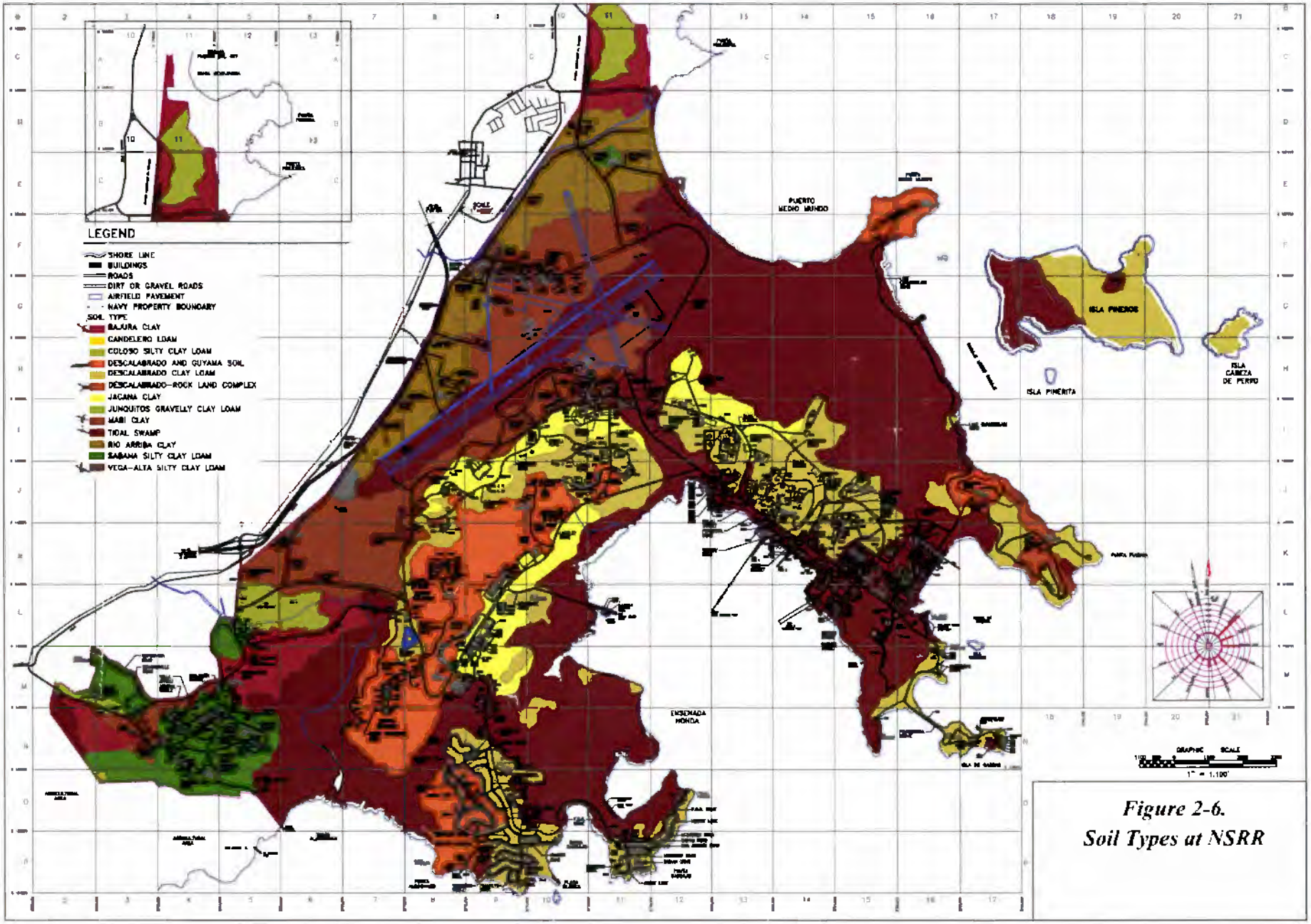


Figure 2-6.
Soil Types at NSRR

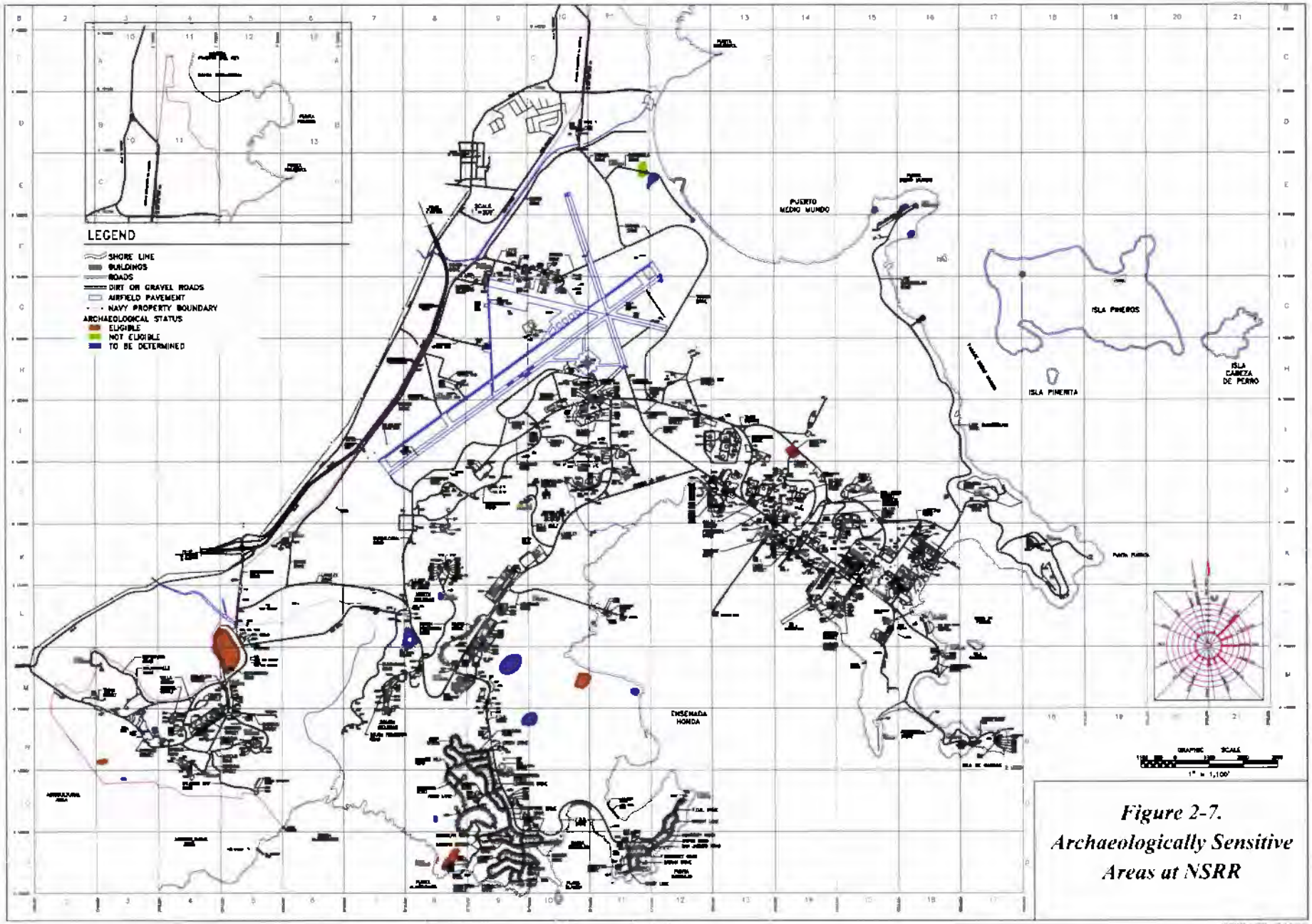


Figure 2-7.
Archaeologically Sensitive Areas at NSRR

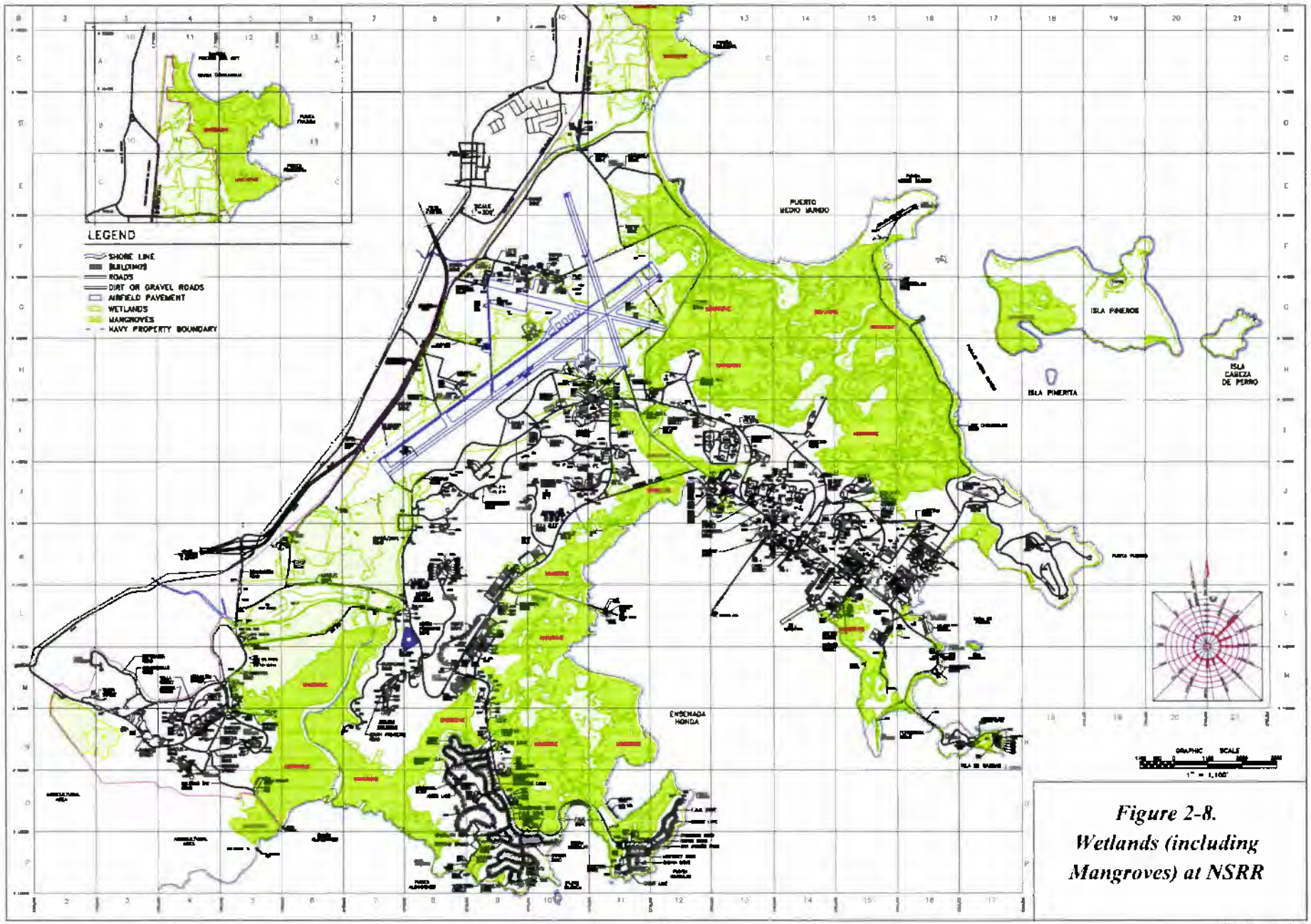


Figure 2-8. Wetlands (including Mangroves) at NSRR

1-1.2 RANGE RECORDS

Klink, Linda

From: Kalal, Daniel (NAPR) CDR OIC [KalalD@napr.navy.mil]
Sent: Monday, August 17, 2009 11:25 AM
To: 'Davidson, Mark E CIV OASN I&E, BRAC PMO SE'; Kalal, Daniel (NAPR) CDR OIC
Cc: Ruiz, Pedro CIV NAVFAC Atlantic; Sanford, Art F CTR OASN (I&E) BRAC PMO SE; Klink, Linda
Subject: RE: Range Records
Attachments: overall expended ammo.xls

Mark,

The attached listing is what we were able to find.

CDR Kalal

-----Original Message-----
From: Davidson, Mark E CIV OASN I&E, BRAC PMO SE [mailto:mark.e.davidson@navy.mil]
Sent: Thursday, July 30, 2009 3:59 PM
To: Kalal, Dan CDR NAPR OIC
Cc: Ruiz, Pedro CIV NAVFAC Atlantic; Sanford, Art F CTR OASN (I&E) BRAC PMO SE; Linda.Klink@tetratech.com
Subject: Range Records

Cdr:

On 19 August we will be on base for the RAB meeting. That morning and afternoon, we will be meeting with the regulators on the upcoming work at the small arms range.
To that end, can you help me with the following:

1) We will do a site visit to the small arms range around 1030. Can you check and ensure the range is not in use that morning.

2) Is there a conference room somewhere on base we can meet in? Your building or other will do. I estimate we will have 12 people.

3) The contractor (Tetra Tech) has requested we try to obtain the "range records". My understanding is these records would be a listing of known items used out at the range from the various entities (Navy, FBI, DHS, etc) that have used it over time. The purpose of having these records is so we know what type of UXO may be still present out there, and what chemical constituents we may need to sample for in the soils. This information will also be beneficial for the development of Health and Safety Plans and the Explosive Safety Submission. The intent IS NOT to lay blame on anyone. The navy will be remediating the range no matter who used what out there. We just want to know what we might encounter and what we should look for. Can you see if such records exist? If yes, can I get a copy of them sometime before we hold our meeting?

Thanks, and give me a call if you would like to discuss.
Mark

Mark E. Davidson
BRAC Environmental Coordinator
BRAC PMO SE
4130 Faber Place Drive

Suite 202
N. Charleston, SC 29405
(843) 743-2124
mark.e.davidson@navy.mil

NAVAL STATION ROOSEVELT ROADS PUERTO RICO N00389 FY 2003

NALC	DODIC NOMENCLATURE	UIC	EXPENDED
A011	Cartridge, 12 Gauge Shotgun, 00 Buck	N00389	**29078**
A071	Cartridge, 5.56 MM Ball, M193	N00389	**30000**
A131	Cartridge, 7.62 MM Linked, 4	N00389	**9600**
A363	Cartridge, 9 MM Nato Ball, M882	N00389	**174176**
A403	Cartridge, Caliber .38 Special Blank	N00389	**559**
G811	Body, Practice Hand Grenade F/M69 PR	N00389	**0**
G911	Grenade, Hand Offensive, MK3A2 W/Fuze	N00389	**0**
G945	Grenade, Hand Smoke M18 Yellow W/Fuze	N00389	**6**
G963	Grenade, Hand CS M7A2, Riot Control	N00389	**0**

NAVAL ACTIVITY PUERTO RICO N40003 AMMO EXPENDED FY 2004

NALC	DODIC NOMENCLATURE	UIC	EXPENDED
A011	Cartridge, 12 Gauge Shotgun, 00 Buck	40003	3234
A059	Cartridge, 5.56 MM Ball, M855	40003	840
A071	Cartridge, 5.56 MM Ball, M193	40003	8258
A080	Cartridge, 5.56 MM Blanks	40003	0
A363	Cartridge, 9 MM Nato Ball, M882	40003	23707

NAVAL ACTIVITY PUERTO RICO N40003 AMMO EXPENDED FY 2005

NALC	DODIC NOMENCLATURE	UIC	EXPENDED
A011	Cartridge, 12 Gauge Shotgun, 00 Buck	40003	1626
A059	Cartridge, 5.56 MM Ball, M855	40003	0
A071	Cartridge, 5.56 MM Ball, M193	40003	3280
A080	Cartridge, 5.56 MM Blanks	40003	0
A363	Cartridge, 9 MM Nato Ball, M882	40003	5634

NAVAL ACTIVITY PUERTO RICO N40003 AMMO EXPENDED FY 2006

NALC	DODIC NOMENCLATURE	UIC	EXPENDED
A011	Cartridge, 12 Gauge Shotgun, 00 Buck	40003	435
A059	Cartridge, 5.56 MM Ball, M855	40003	0
A071	Cartridge, 5.56 MM Ball, M193	40003	782
A080	Cartridge, 5.56 MM Blanks	40003	0
A363	Cartridge, 9 MM Nato Ball, M882	40003	1100

NAVAL ACTIVITY PUERTO RICO N40003 AMMO EXPENDED FY 2007

NALC	DODIC NOMENCLATURE	UIC/TENANTS COMMANDS	EXPENDED
A011	Cartridge, 12 Gauge Shotgun, 00 Buck	40003	792
A059	Cartridge, 5.56 MM Ball, M855	40003	0
A071	Cartridge, 5.56 MM Ball, M193	40003	2140
A080	Cartridge, 5.56 MM Blanks	40003	0
A363	Cartridge, 9 MM Nato Ball, M882	40003	505
	10MM used for the MP5	FBI	5013
	GLOCK .40 CAL	FBI	1000
	M-4 CARBINE RIFLE .223 CAL	FBI	620
	SPRINGFIELD .45	FBI	313
	REMINGTON 308	FBI	250
A363	Cartridge, 9 MM Nato Ball, M882	MARINES	3200
A011	Cartridge, 12 Gauge Shotgun, 00 Buck	USNR	2000
A071	Cartridge, 5.56 MM Ball, M193	USNR	2000
A363	Cartridge, 9 MM Nato Ball, M882	USNR	5000

NAVAL ACTIVITY PUERTO RICO N40003 AMMO EXPENDED FY 2008

NALC	DODIC NOMENCLATURE	UIC/TENANTS COMMANDS	EXPENDED
A011	Cartridge, 12 Gauge Shotgun, 00 Buck	40003	830
A059	Cartridge, 5.56 MM Ball, M855	40003	0
A071	Cartridge, 5.56 MM Ball, M193	40003	5147
A080	Cartridge, 5.56 MM Blanks	40003	0
A363	Cartridge, 9 MM Nato Ball, M882	40003	4900
	9MM	FBI	1425
	10MM used for the MP5	FBI	2400
	GLOCK .40 CAL	FBI	1225
	M-4 CARBINE RIFLE .223 CAL	FBI	400
	SPRINGFIELD .45	FBI	125
	SHOT GUN	FBI	125
	REMINGTON 308	FBI	200
	40 MM SMOKE GRENADE - TRAINING	FBI	30
A363	Cartridge, 9 MM Nato Ball, M882	MARINES	2280
A059	Cartridge, 5.56 MM Ball, M855	MARINES	9680
A011	Cartridge, 12 Gauge Shotgun, 00 Buck	USNR	8000
A071	Cartridge, 5.56 MM Ball, M193	USNR	8600
A363	Cartridge, 9 MM Nato Ball, M882	USNR	9000
A059	Cartridge, 5.56 MM Ball, M855	USNR SEABEES	3360
A363	Cartridge, 9 MM Nato Ball, M882	USNR SEABEES	2000
	9MM PISTOL	DHS CBP	26,600
	12 GA SHOTGUN	DHS CBP	9000
	M-16 RIFLE .223 CAL	DHS CBP	1000
	BOLT ACTION RIFLE .308	DHS CBP	900
	BARRET 50 BMG	DHS CBP	100
	M-4 CARBINE RIFLE .223	DHS CBP	12900

NAVAL ACTIVITY PUERTO RICO N40003 AMMO EXPENDED FY 2009

NALC	DODIC NOMENCLATURE	UIC/TENANTS COMMANDS	EXPENDED
A011	Cartridge, 12 Gauge Shotgun, 00 Buck	40003	972
A059	Cartridge, 5.56 MM Ball, M855	40003	0
A071	Cartridge, 5.56 MM Ball, M193	40003	669
A080	Cartridge, 5.56 MM Blanks	40003	0
A363	Cartridge, 9 MM Nato Ball, M882	40003	3199
	9MM	FBI	500
	10MM used for the MP5	FBI	200
	GLOCK .40 CAL	FBI	1400
	M-4 CARBINE RIFLE .223 CAL	FBI	700
	SPRINGFIELD .45	FBI	300
	SHOT GUN	FBI	0
	REMINGTON 308	FBI	50
	40 MM SMOKE GRENADE - TRAINING	FBI	25
A011	Cartridge, 12 Gauge Shotgun, 00 Buck	USNR	3200
A071	Cartridge, 5.56 MM Ball, M193	USNR	4600
A363	Cartridge, 9 MM Nato Ball, M882	USNR	6000
	9MM PISTOL	DHS CBP	0
	12 GA SHOTGUN	DHS CBP	0
	REMINGTON 700 7.62MM	DHS CBP	500
	M-16 RIFLE 5.56MM	DHS CBP	200
	M240B 7.62MM	DHS CBP	1000
	BOLT ACTION RIFLE .308	DHS CBP	620
	BARRET 50 BMG	DHS CBP	100
	M-4 CARBINE RIFLE .223	DHS CBP	0

Love, Erica

From: Irland, Craig
Sent: Thursday, September 03, 2009 1:14 PM
To: Love, Erica; Coffman, Jim
Cc: Brooks, Ralph; Klink, Linda; Blanken, Michelle; Basinski, Ralph; Fournier, Jeffrey
Subject: FW: EOD Incident Reports

Follow Up Flag: Follow up
Flag Status: Flagged

Categories: Puerto Rico

Jim/Erica,

FYSA
Received EOD reports for the past several years from the unit that supports NAPR. Looks like they have nothing to report for the area we will be conducting surveys... see string below.

-----Original Message-----
From: Cornely, Charles C LT EODMU6, DET MYPT [mailto:charles.cornely@navy.mil]
Sent: Thursday, September 03, 2009 11:08 AM
To: Irland, Craig
Subject: RE: Incident Reports

Craig,
I am passing on all info that I have found so far in relation to Puerto Rico with the 8027's from 2000-2006. I will see what I can dig up on the 2007-2008 files and I will also see if I can do any digging on what EOD Det Roosevelt Roads may have dealt with when they were stationed there.

The only Roosevelt Roads specific item that is listed below is the 12 May 04 item.

Since I have been here we responded to Culebra for Illum Rounds in the water and conducted Post Blast training with the FBI

29 Mar 04 Vieques
40mm Green Para Flare M661

12 May 2004 BOSC Scrapyard, Roosevelt Roads
2x large cylindrical items with tail fins-possibly practice torpedo, mine shape or drop tank (non-explosive)-turned over to site POC for disposition (Madeline Rivera)

31 August 2004 Mosquito Pier Area, Vieques
1x Mk 12 Training shape, 4x Mk 80 series practice bombs, empty 2.75in rocket pods

March 2005 Culebra
Search of potential mooring bouy sites. 21 sites searched. 7x illumination projectiles all empty.

March 2005 Camp Santiago
2x 81mm mortars, 2x 4.2in illum round, 1x practice bomb

16 Jun 2005 Camp Sanitago
1x hand grenade, 1x rifle grenade, 1x bazooka and 2x 40mm discovered during survey

1-1.3 TERMINATION OF USE LETTER

DEPARTMENT OF THE NAVY
BASE REALIGNMENT AND CLOSURE
PROGRAM MANAGEMENT OFFICE SOUTHEAST
4130 FABER PLACE DRIVE
SUITE 202
NORTH CHARLESTON, SC 29405

BPMOSE med/0026
09 Nov 09

From: Director, Base Realignment & Closure Program Management Office Southeast
To: Commander Navy Region Southeast, Code N44

Subj: NAVAL ACTIVITY PUERTO RICO (NAPR) SMALL ARMS RANGE CLOSURE

1. The Small Arms Range (SAR) at NAPR is currently an active range and located in Sale Parcel Three. In order to transfer the SAR, various environmental investigations are required to be completed and are scheduled to commence in January 2010. In support of these environmental initiatives, it is requested that Navy Region SE notify NAPR to terminate use of the SAR, including the pistol range, beginning 1 January 2010.

2. Should you have any questions, please contact Mark Davidson at (843) 743-2124 or by email at mark.e.davidson@navy.mil.

James E Anderson
JAMES E. ANDERSON

Copy to:
NAPR (CDR Kalal)

Copy to: (via email)
NAVFAC Atlantic (Pedro Ruiz)
NAVFAC SE (Darrell Gundrum)
Tetra Tech NUS (Linda Klink)

1-1.4 PHASE I RFI EOD RESPONSE

Klink, Linda

From: Davidson, Mark E CIV OASN (EI&E), BRAC PMO SE [mark.e.davidson@navy.mil]
Sent: Friday, August 27, 2010 11:52 AM
To: Gordon.Timothy@epamail.epa.gov; wilmarierivera@jca.gobierno.pr; Toro Agrait, Gloria
Cc: Martin, Stacin CIV NAVFAC Atlantic; Klink, Linda
Subject: FW: EOD Response to Roosevelt Roads 19 AUG 10
Attachments: Demo.jpg; Expended CS.JPG; Full CS.JPG; Broken CS.JPG; FW: Naval Activity Puerto Rico, SWMU 77, M651 CS grenade discovered (1.69 MB)

Tim, Wilmarie, Gloria

On 19 May I emailed you (attached) regarding some MEC discovered on the earthen backstop at SWMU 77, the Small Arms Range, during our Ph I RFI fieldwork. EOD responded on 19 August 2010 and disposed of these items. Below is their notification to me.

Thanks,
Mark

-----Original Message-----
From: Cornely, Charles C LT EODMU6, DET MYPT
Sent: Sunday, August 22, 2010 18:00
To: Davidson, Mark E CIV OASN (EI&E), BRAC PMO SE
Cc: Murray, Douglas CIV NOSSA; Martin, Stacin CIV NAVFAC Atlantic; Kalal, Dan CDR NAPR OIC; Sanford, Art F CTR OASN (EI&E), BRAC PMO SE; mark.ladd@sbcglobal.net; Toy, Jonah T DET MAYPORT EOD LCPO; Simmons, Michael J LT EODMU ONE
Subject: EOD Response to Roosevelt Roads 19 AUG 10

Good Evening Mark,
Here are the details and pictures from our 19 August 2010 response to the 40mm, CS, M651 grenades located at Roosevelt Roads.

We found 1x intact, full up 40mm located at 20Q KF 24393 20950, this was also the consolidation point for our disposal operation.

1x broken 40mm was located at 20Q KF 24389 20947.

1x expended 40mm was located at 20Q KF 24390 20951.

All items were disposed of onsite.

Please let me know if you have any additional questions and thank you for your time.

V/R,
LT Chuck Cornely
OIC, EODMU 6 PLATOON MAYPORT
NS MAYPORT FL, Bldg 190
Mayport, FL 32228-0023
Cell: (904) 219-7242
Office: (904) 270-5412/5416/5439
DSN: 312-960-...
charles.cornely@navy.mil

1-2 HISTORICAL AERIAL PHOTOGRAPHS

1-2.1 SWMU 77 – HISTORICAL AERIAL PHOTOGRAPHS 1936 - 1995

Appendix B-2.1
AERIAL PHOTOGRAPHY ANALYSIS

1.0 INTRODUCTION

Environmental Research, Inc. undertook an analysis of aerial photography to support an ongoing Environmental Baseline Survey (EBS) being conducted at the Naval Station, Roosevelt Roads, Puerto Rico. The analysis documents activity at 25 sites of potential environmental contamination, including SWMU 77 that was identified at the time as ECP Site 1. Aerial photography used in the analysis spanned the period 1936 to 1999. Section 3.0 provides a description of activity and features observed at each site on each date of photography analyzed. The accompanying aerial map and compact disc display the findings from the analysis.

2.0 METHODOLOGY

ERI analysts conducted this aerial photographic analysis by viewing stereo frames of film transparencies through a zoom stereoscope; the film transparencies were backlit on a light table. Stereoscopic viewing creates a three-dimensional effect, which, when combined with viewing at various magnifications, enables an analyst to identify signatures associated with various features and environmental conditions. (The term "signature" refers to a combination of visible characteristics, such as tone, shadow, texture, size, shape, pattern, and association, which enable an analyst recognize a specific object or condition on aerial photography.) At least one other senior imagery analyst reviewed the analysis to ensure completeness and consistency; this quality control step is standard practice in the field of photo interpretation. Mosaics were made from the aerial photography, and findings from the analysis were digitized and included as a data layer on the mosaics. The findings can be viewed on the accompanying compact discs or hard copy map and can be used in combination with this narrative report.

3.0 SWMU 77 (Site 1) AERIAL PHOTOGRAPHY

18 June 1958

Small-arms ranges, on the northeast side of the base at Punta Medio Mundo, were maintained and used as of this date. Three pits, possibly for munitions disposal or detonation, were immediately southwest of the range area.

18, 19, and 26 October 1961

Small-arms ranges, on the northeast side of the base at Punta Medio Mundo, were maintained and used as of this date. The three pits seen on 1958 photography appeared to have been filled.

15 February 1962 (Partial)

Small-arms ranges, on the northeast side of the base at Punta Medio Mundo, were maintained and used as of this date. A pistol range had been constructed so that it was contiguous with the rifle range.

15 January 1964 (Partial)

Small-arms ranges, on the northeast side of the base at Punta Medio Mundo, were maintained and used as of this date. Vegetation was growing on the pistol range seen in 1962, and it was probably no longer in use.

3 March 1965 (Partial)

Not Covered

6 December 1976 (Partial)

Small-arms ranges, on the northeast side of the base at Punta Medio Mundo, were maintained and used as of this date. A new pistol range had been constructed on the southwestern side of the range area, and a bermed area containing light-toned material and/or debris was on the northwestern side of the range area.

February 1977; 18 and 20 December 1977

Small-arms ranges, on the northeast side of the base at Punta Medio Mundo, were maintained and used as of this date. Additional light-toned material and/or debris were in the bermed area on the northwestern side of the ranges.

26 January, 1 February, and 8 March 1979

Small-arms ranges, on the northeast side of the base at Punta Medio Mundo, were maintained and used as of this date. Light-toned material and/or debris were in the bermed area on the northwestern side of the ranges. (Area annotated on 1977 photography.)

6 and 8 February 1983

Small-arms ranges, on the northeast side of the base at Punta Medio Mundo, were maintained and used as of this date. Possible debris was in the bermed area on the northwestern side of the ranges. (Area annotated on 1985 photography.)

1985

At least some of the small-arms ranges, on the northeast side of the base at Punta Medio Mundo, were maintained and used as of this date. No debris was visible in the bermed area on the northwestern side of the ranges. (Area annotated on 1985 photography.)

October 1995

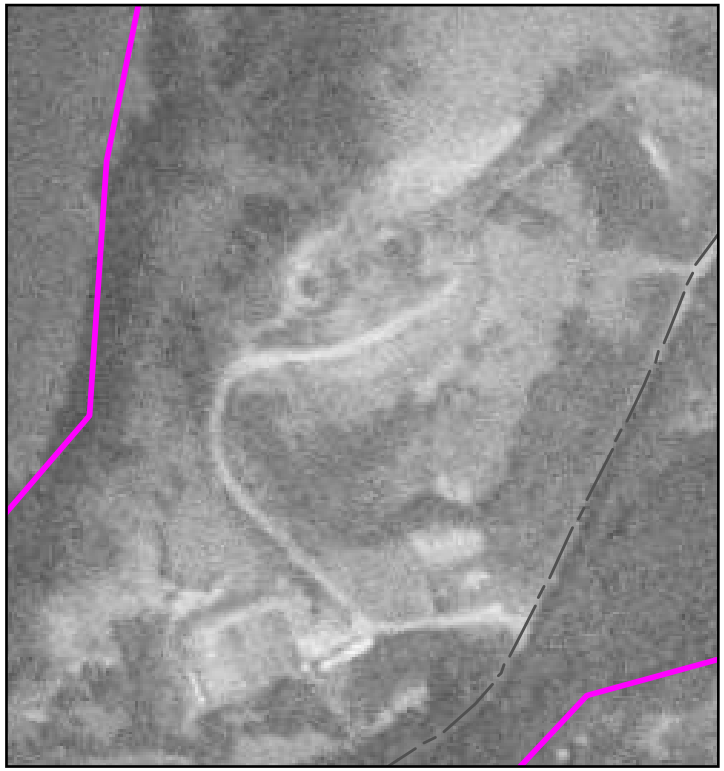
Small-arms ranges, on the northeast side of the base at Punta Medio Mundo, were maintained and used as of this date. (A possible pistol range, constructed immediately southwest of the rifle range between 1985 and 1995, was becoming overgrown.) No debris was visible at the bermed area on the northwestern side of the ranges, and vegetation was growing in that location. (Area annotated on 1995 photography.)

1-2.2 POTENTIAL OB/OD SUBAREA SITE DEVELOPMENT

Potential OB/OD Subarea

1976

1977



1-2.3 POTENTIAL MUNITIONS TRENCH SUBAREA SITE DEVELOPMENT

Potential Munitions Trench Subarea

1958

1995

1-3 SITE WALK AND PHASE I RFI PHOTOGRAPHIC LOGS

500-yard Rifle Range Subarea

Photograph 1 Rifle Range Subarea up range view to the southwest 500-yard firing line in the background, unpaved road between the Rifle Range and the Potential OB/OD Subarea in the foreground. (August, 2009)

Photograph 2 Rifle Range Subarea view down range form the 300-yard firing line, to the northeast, 200-yard firing line beyond trucks, 100-yard firing line not visible, constructed earthen berm/bullet stop and wooded natural embankment/bullet stop in the background. (June, **2009)**

Photograph 3 Rifle Range Subarea up range view, from the 200-yard firing line to the southwest 300-yard firing line beyond the truck, 500-yard firing line in the background. (June, 2009)

Photograph 4 Rifle Range Subarea view to the north, typical firing line showing nine shooting stations (vertical white posts). (June, 2009)

Photograph 5 Rifle Range Subarea view down range, to the northeast from the 200-yard firing line, 100-yard firing line and constructed earthen berm/bullet stop and wooded natural embankment/bullet stop in the background. (June, 2009)

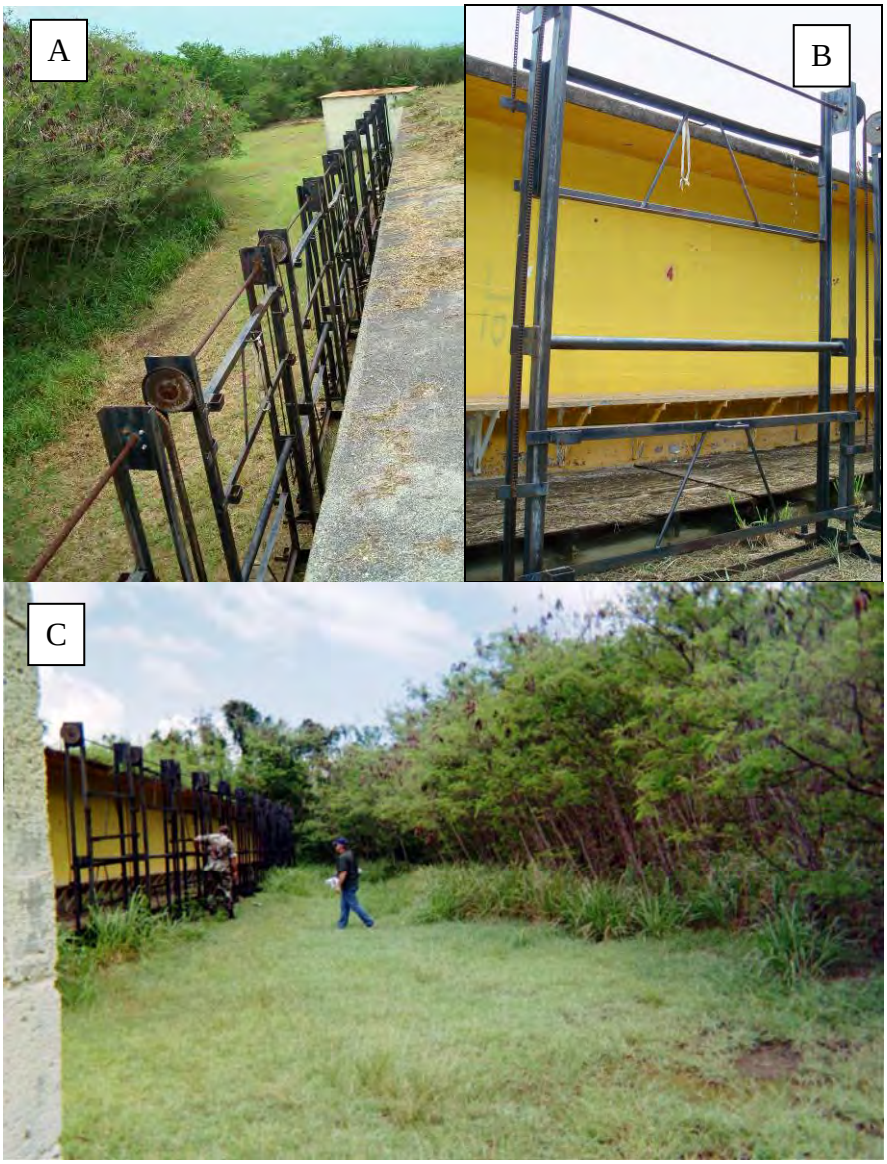
Photograph 6 Rifle Range Subarea view of the 100-yard firing range looking down the firing line. Vertical posts are firing stations. (August, 2009)

Photograph 7 Rifle Range Subarea, view down range from the 100-yard firing line. Note the shooting stations in the foreground (vertical posts). Short-Yardage Range, constructed earthen berm/bullet stop, and wooded natural embankment/bullet stop in the background. The range viewing area is to the right of the white truck. (June, 2009)

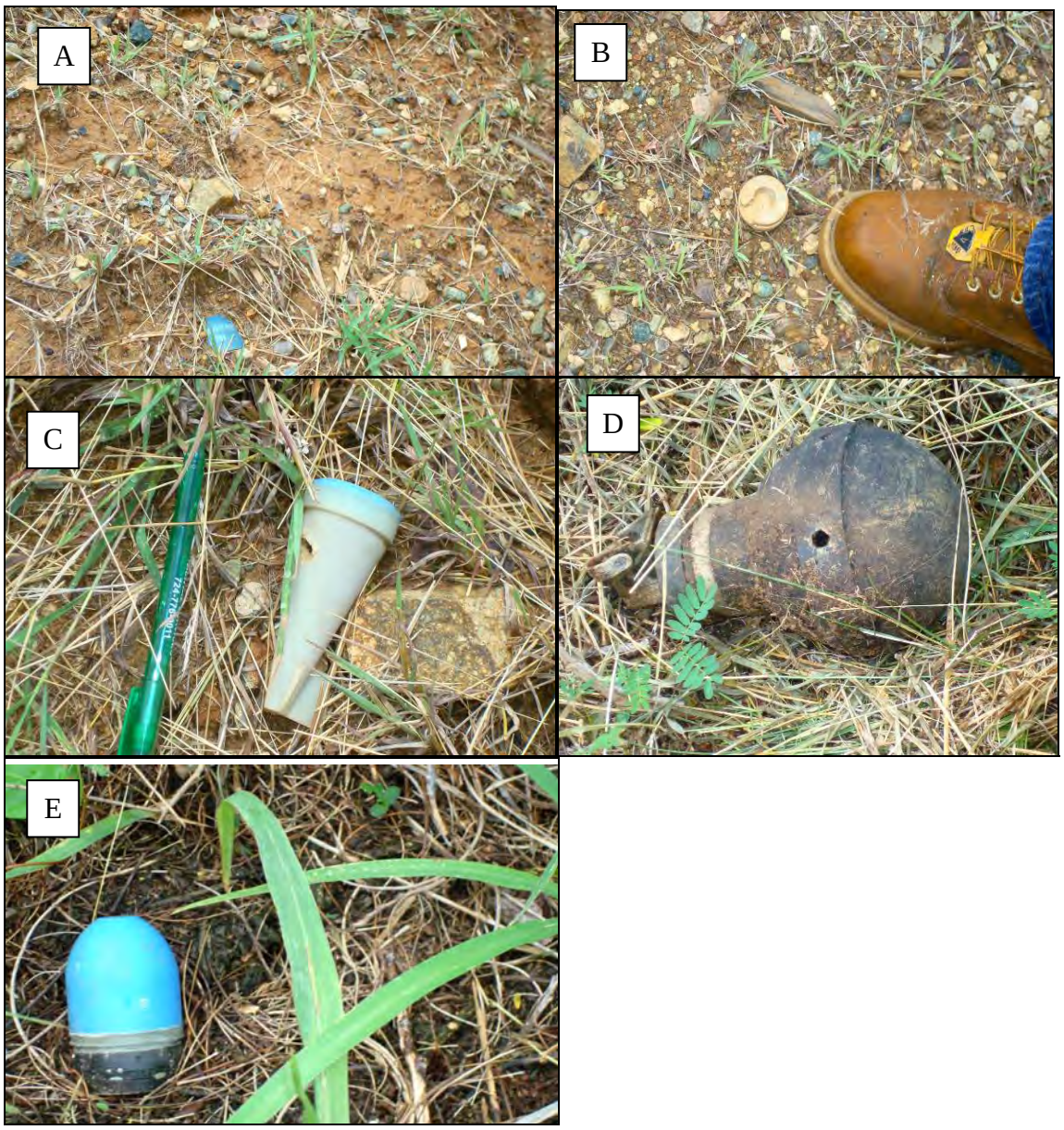
Photograph 8 Rifle Range Subarea, view down range from the 100-yard firing line, viewing area to the right and Short-Yardage Range, constructed earthen berm/bullet stop, and wooded natural embankment/bullet stop in the background. Note constructed earthen berm extends to the south beyond the Short-yardage Range to protect the target storage building behind (not visible). (August, 2009)

Photograph 9 Short-Yardage Range view down range, to the northeast. Note the 25-yard, 15-yard, and 7-yard firing line markers along the right/south edge of the Short-Yardage Range target markers far end of range, and the constructed earthen berm/bullet stop and wooded natural embankment/bullet stop in the background. (August, 2009)

Photograph 10 Short-Yardage Range, view to the south-southwest, note the viewing area in the background. (June, 2009)



Photograph 11 Rifle Range Subarea Target Carrier Mechanism.
A View looking down from the top of the constructed earthen berm/bullet stop. Note concrete wall at the back of the berm. (June, 2009)
B View looking at the target carrier lift mechanism from the rear of the constructed earthen berm. (June, 2009)
C View looking down the cleared path between the constructed earthen berm/bullet stop, target carrier lift mechanism and the wooded natural embankment/bullet stop. (August, 2009)



Photograph 12 Rifle Range Subarea various MEC/MPPEH items and fragments found in the vicinity of the constructed earthen berm and the wooded natural embankment. (June, 2009)
A M781 40 mm practice grenade fragments (blue in foreground) on earthen berm/bullet stop.
B A piece of munitions debris from a 40mm rifle grenade
C Unknown fin on earthen berm/bullet stop
D Smoke grenade at fringe of woods
E M781 40mm practice grenade, intact, at fringe of woods.

Potential OB/OD Subarea

Photograph 13 Potential OB/OD Subarea Beyond two men on unpaved road clear area surrounded by trees. (June, 2009)

Photograph 14 Potential OB/OD Subarea view looking north from the southeast, note the slight surface depression in the left center of the picture. Note: there had been rain throughout the day prior to the photograph the surface depression appears to be a puddle evident only after a rain event. (June, 2009)

Photograph 15 Potential OB/OD Subarea view looking north from the unpaved road, note the slight surface depression on the right side of the picture. Note: there had been rain throughout the day prior to the photograph and the surface depression appears to be a puddle evident only after a rain event. (June, 2009)

Photograph 16 Potential OB/OD Subarea, unpaved road in foreground. Note the steep wooded embankment north of the subarea. (June, 2009)

Photograph 17 Potential OB/OD Subarea with steep wooded embankment north of the subarea beyond Commander Kalal. (August, 2009)

Photograph 18 Potential OB/OD Subarea various bullet cartridges found on the wooded slope beyond (northeast) of the subarea. (June, 2009)

Potential Munitions Trench Subarea

Photograph 19 Potential Munitions Trench Subarea looking south at a man standing on a trench footprint. Note high grass on trench and overgrown brush/trees on terraces between trenches. (August, 2009)

Photograph #-1: Instrument Verification Strip, Industry Standard Object Small

Photograph #-2: Instrument Verification Strip, Industry Standard Object Medium

Photograph #-3: Instrument Verification Strip, Industry Standard Object Large

Photograph #-4: Rifle Range Subarea (eastern berm) UXO Technicians conducting analog detector-aided surface survey

Photograph #-5: Rifle Range Subarea (wooded embankment) UXO Technicians conducting analog detector-aided surface survey in thick woods with limited brush clearance

Photograph #-6: : Rifle Range Subarea (wooded embankment) 40mm CS M651 Grenade fired/spent on surface, top view (Phase 1 RFI Report Table 4-1 Item 1)

Photograph #-7: Rifle Range Subarea (wooded embankment) 40mm CS M651 Grenade fired/spent on surface, front view (Phase 1 RFI Report Table 4-1 Item 1)

Photograph #-8: Rifle Range Subarea (wooded embankment) 37mm CS Grenade fired/spent on surface (Phase 1 RFI Report Table 4-1 Item 2)

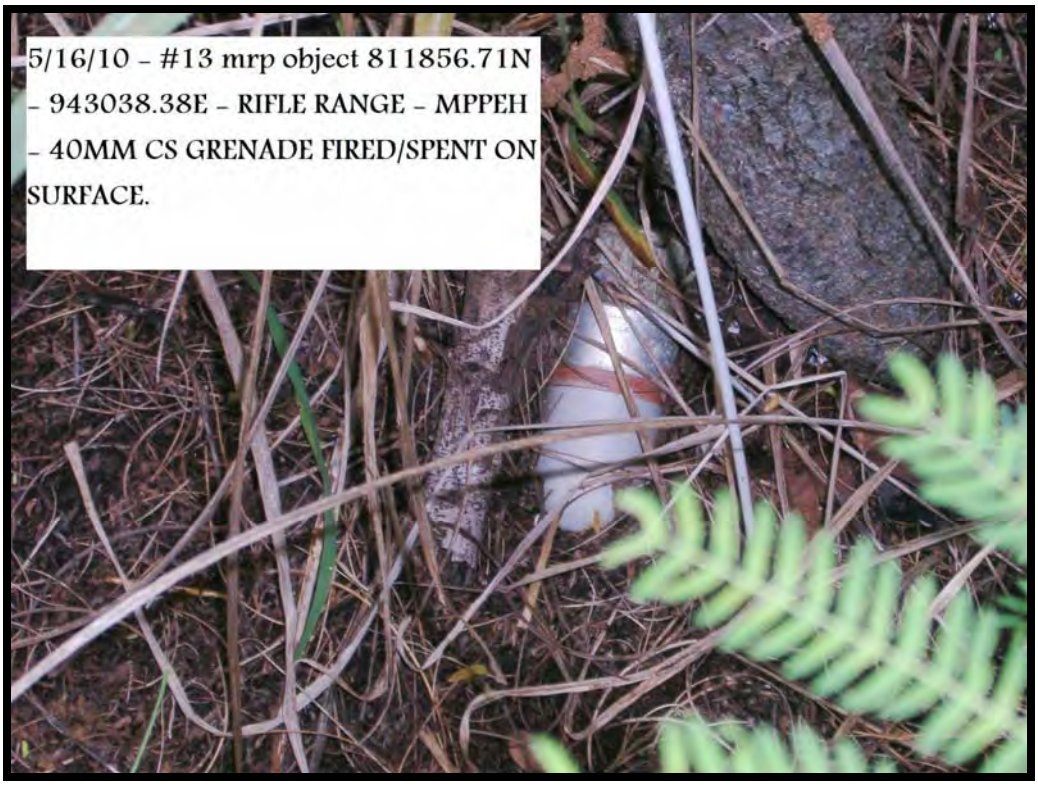
Photograph #-9: Rifle Range Subarea (wooded embankment) 40mm M781 Practice Grenade fired/spent on surface (Phase 1 RFI Report Table 4-1 Item 4)

Photograph #-10: Rifle Range Subarea (wooded embankment) 40mm M781 Practice Grenade fired/spent on surface (Phase 1 RFI Report Table 4-1 Item 5)

Photograph #-11: Rifle Range (wooded embankment) 40mm CS Grenade fired/spent on surface (Phase 1 RFI Report Table 4-1 Item 6)

Photograph #-12: Rifle Range Subarea (wooded embankment) 40mm CS Grenade fired, not known if spent, in good condition but half buried (Phase 1 RFI Report Table 4-1 Item 7)

Photograph #-13: Rifle Range Subarea (wooded embankment) Han-Ball CS 1902 Grenade fired/spent on surface (Phase 1 RFI Report Table 4-1 Item 8)

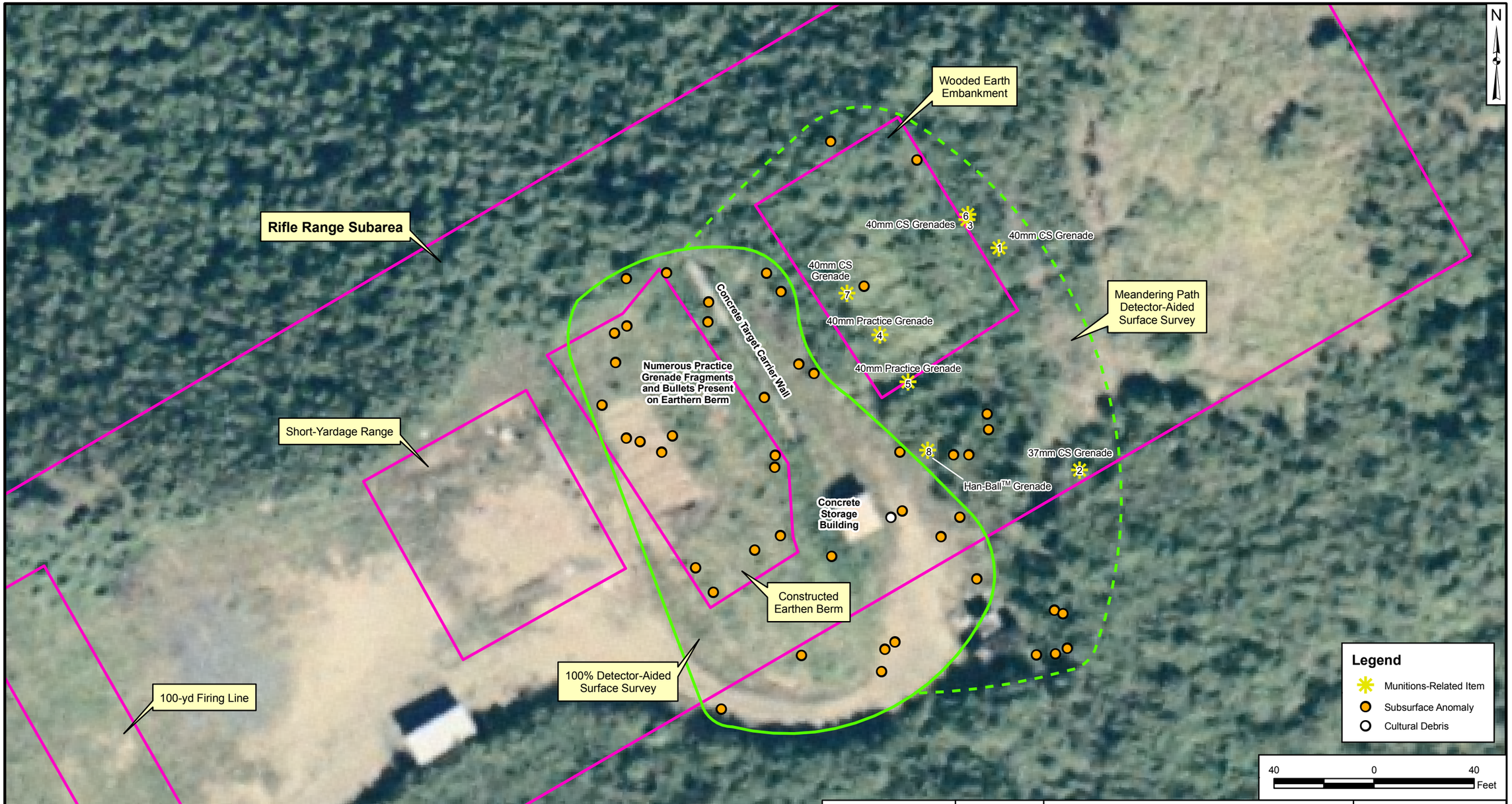


Photograph #-14: Rifle Range Subarea (wooded embankment) 40mm CS Grenade, fired/spent on surface (Phase 1 RFI Report Table 4-1 Item 3)

Photograph #-15: Rifle Range Subarea (wooded embankment) photograph by Mayport EOD of munitions items consolidated for detonation including three 40mm CS Grenades, 08/19/2010

1-4 Phase I RFI Detector-Aided and Geophysical Survey Results

P:\GIS\NA_PUERTORICO\MXD\SWMU77_RIFLE_RANGE_GPS.MXD 09/27/10 JEE



Notes:
1) Refer to Figure 1-2 for a view of the entire Rifle Range, including firing lines.
2) See Table 4-1 for description of munitions-related items.
3) Munitions-related items were addressed by Mayport EOD in August 2010.

DRAWN BY	DATE
K. MOORE	08/18/10
CHECKED BY	DATE
L. KLINK	09/27/10
REVISED BY	DATE
—	—
SCALE AS NOTED	

NAVFAC

UXO DETECTOR-AIDED SURFACE SURVEY RESULTS
FOR BERMED AREAS - MAY 2010
SWMU 77 - RIFLE RANGE SUBAREA
NAVAL ACTIVITY PUERTO RICO
CEIBA, PUERTO RICO

CONTRACT NUMBER 02121	
APPROVED BY —	DATE —
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FIGURE NO. FIGURE 4-1	REV 0

P:\GIS\NA_PUERTO_RICO\MXD\SWMU77_OB-OD_GPS.MXD 09/28/10 JEE

DRAWN BY	DATE
K. MOORE	08/18/10
CHECKED BY	DATE
L. KLINK	09/28/10
REVISED BY	DATE
___	___
SCALE AS NOTED	

NAVFAC

UXO DETECTOR-AIDED
SURFACE SURVEY RESULTS - MAY 2010
SWMU 77 - POTENTIAL OB/OD SUBAREA
NAVAL ACTIVITY PUERTO RICO
CEIBA, PUERTO RICO

CONTRACT NUMBER 02121	
APPROVED BY ___	DATE ___
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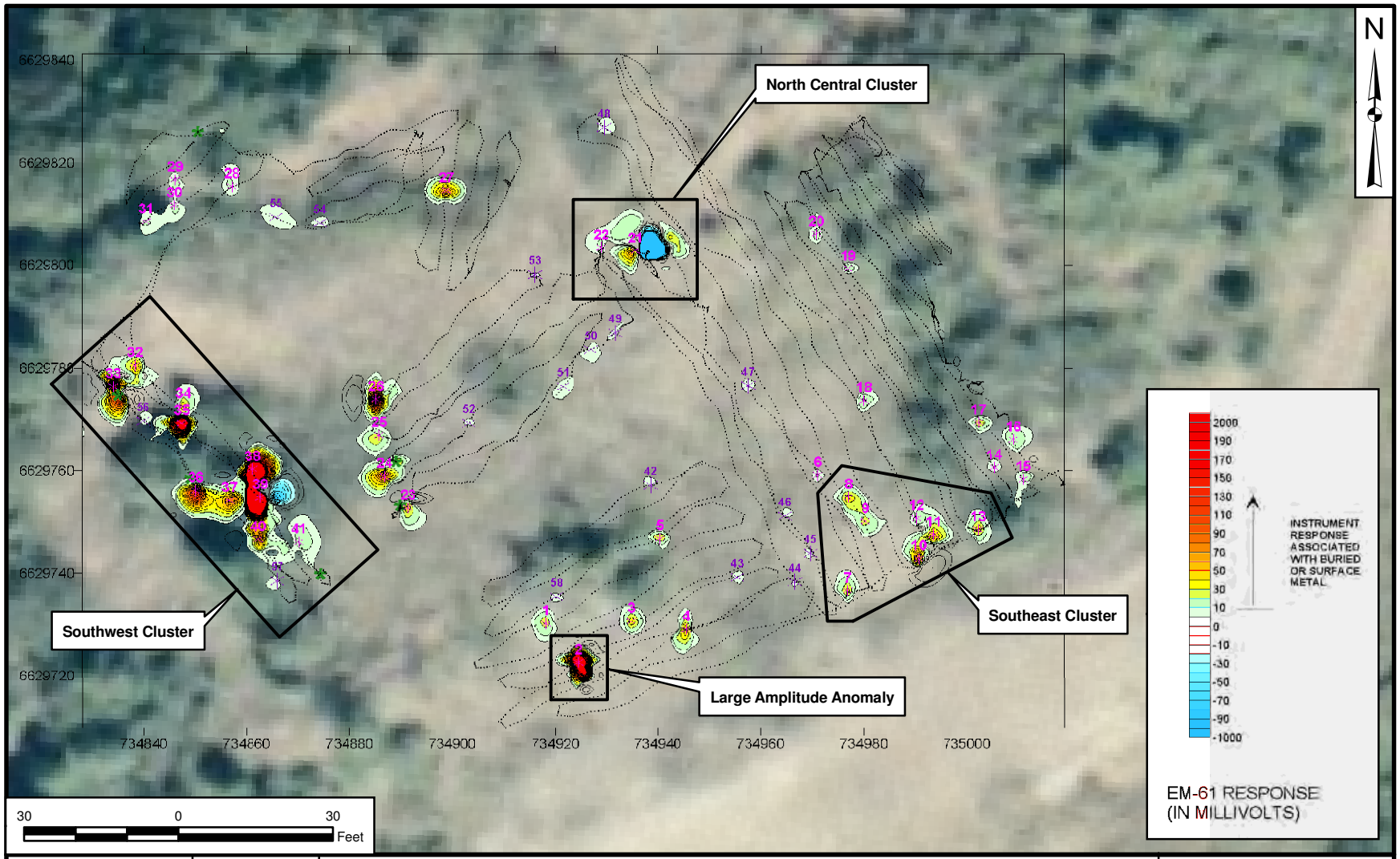
FIGURE NO. FIGURE 5-1	REV 0

P:\GIS\NA_PUERTORICO\MAPDOCS\MXD\SWMU77_ODOB_EM61.MXD 09/28/10 JEE



DRAWN BY J. ENGLISH	DATE 09/14/10	EM61 INPHASE RESPONSE SWMU 77 - POTENTIAL OD/OB SUBAREA NAVAL ACTIVITY PUERTO RICO CEIBA, PUERTO RICO	CONTRACT NUMBER ___
CHECKED BY L. KLINK	DATE 09/28/10		APPROVED BY ___ DATE ___
REVISED BY ___	DATE ___		APPROVED BY ___ DATE ___
SCALE AS NOTED			FIGURE NO. FIGURE 5-2 / REV 0

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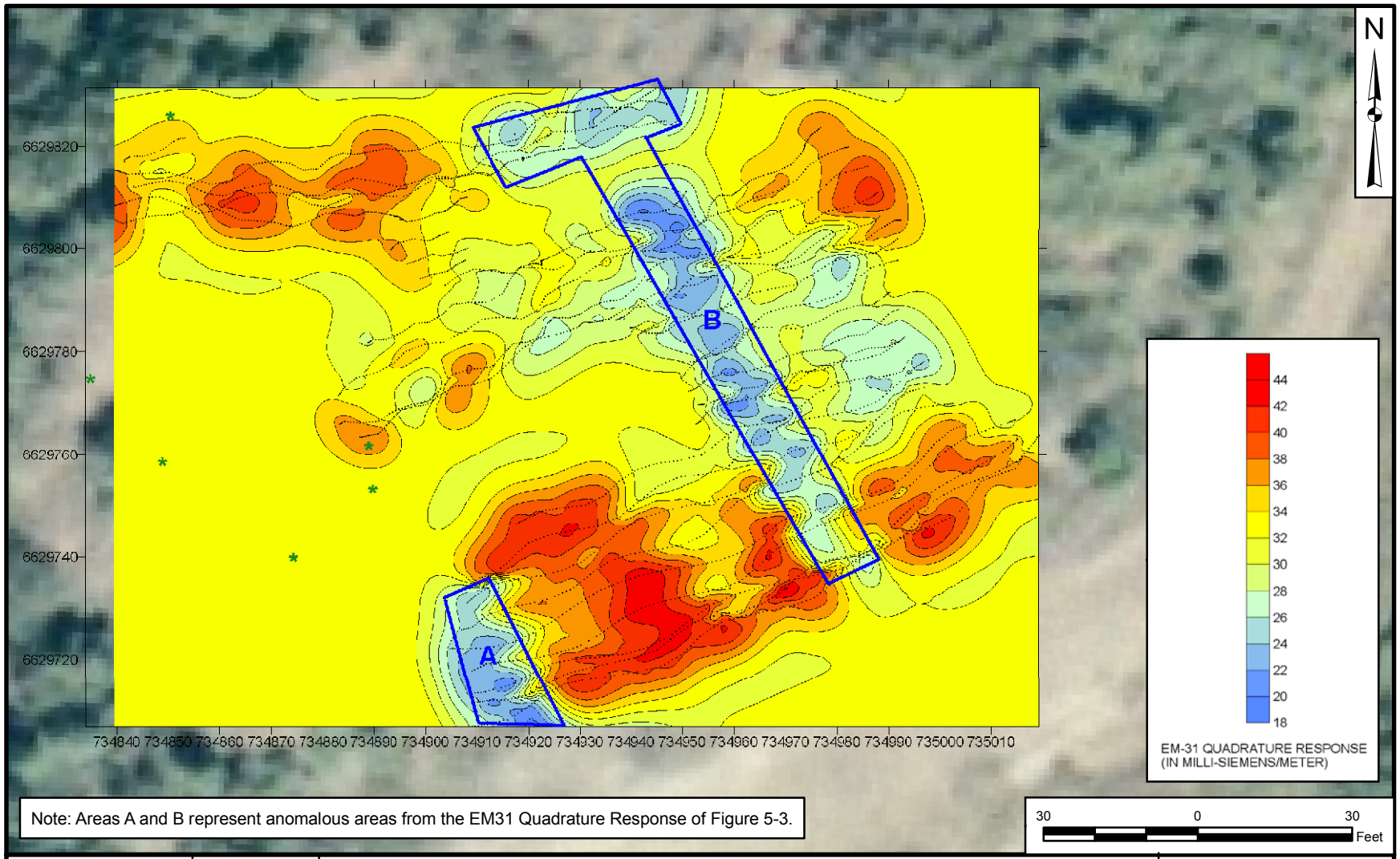
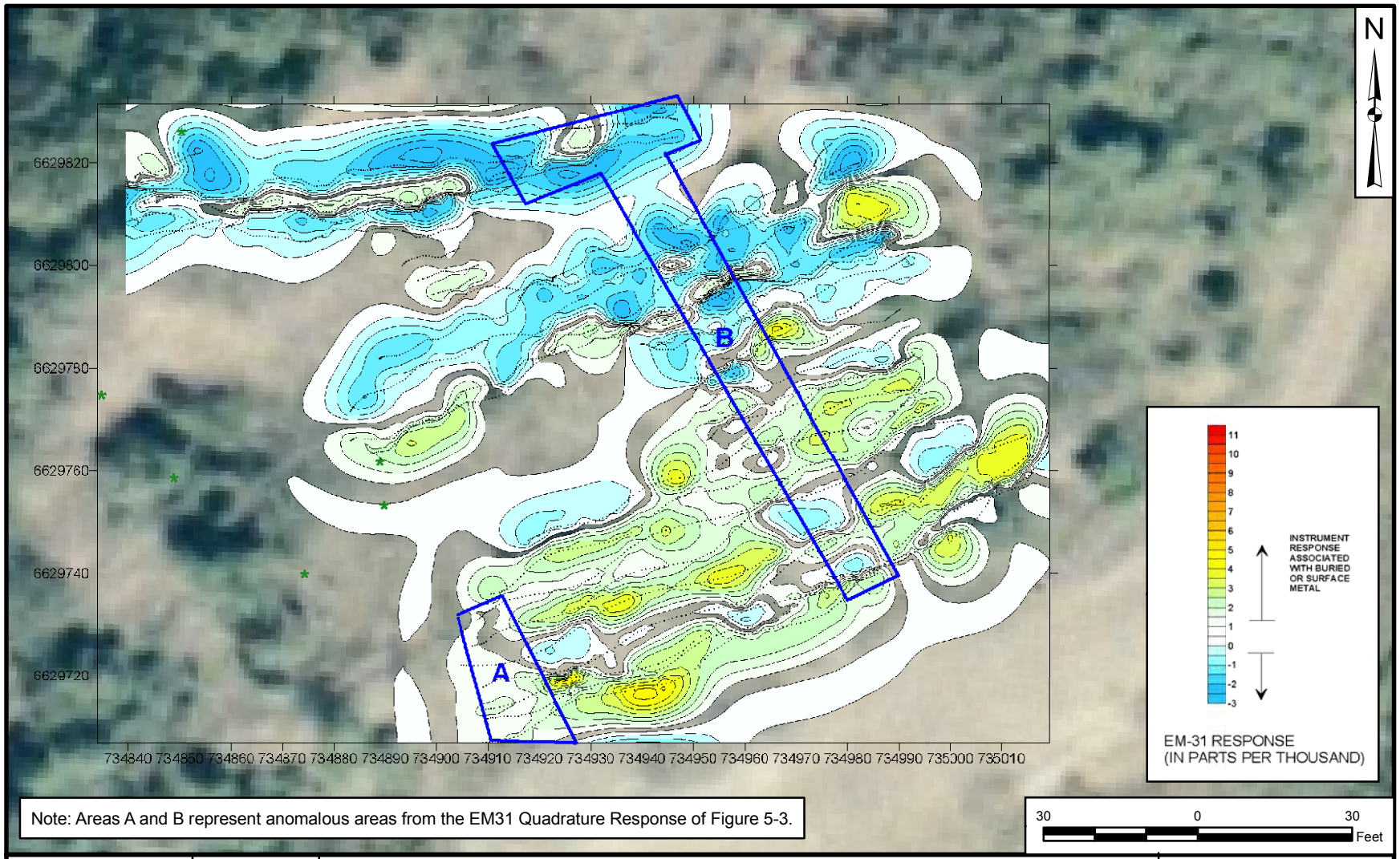


Note: Areas A and B represent anomalous areas from the EM31 Quadrature Response of Figure 5-3.

DRAWN BY J. ENGLISH	DATE 09/14/10	EM31 QUADRATURE RESPONSE SWMU 77 - POTENTIAL OD/OB SUBAREA NAVAL ACTIVITY PUERTO RICO CEIBA, PUERTO RICO	CONTRACT NUMBER —
CHECKED BY L. KLINK	DATE 09/24/10		APPROVED BY — DATE —
REVISED BY —	DATE —		APPROVED BY — DATE —
SCALE AS NOTED			FIGURE NO. FIGURE 5-3 / REV 0

P:\GIS\NA_PUERTORICO\MAPDOCS\MXD\SWMU77_ODOB_EM31_INPHASE.MXD 09/24/10 JEE



Note: Areas A and B represent anomalous areas from the EM31 Quadrature Response of Figure 5-3.

DRAWN BY J. ENGLISH	DATE 09/14/10	EM31 INPHASE RESPONSE SWMU 77 - POTENTIAL OD/OB SUBAREA NAVAL ACTIVITY PUERTO RICO CEIBA, PUERTO RICO	CONTRACT NUMBER —
CHECKED BY L. KLINK	DATE 09/24/10		APPROVED BY — DATE —
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SCALE AS NOTED			FIGURE NO. FIGURE 5-4 / REV 0

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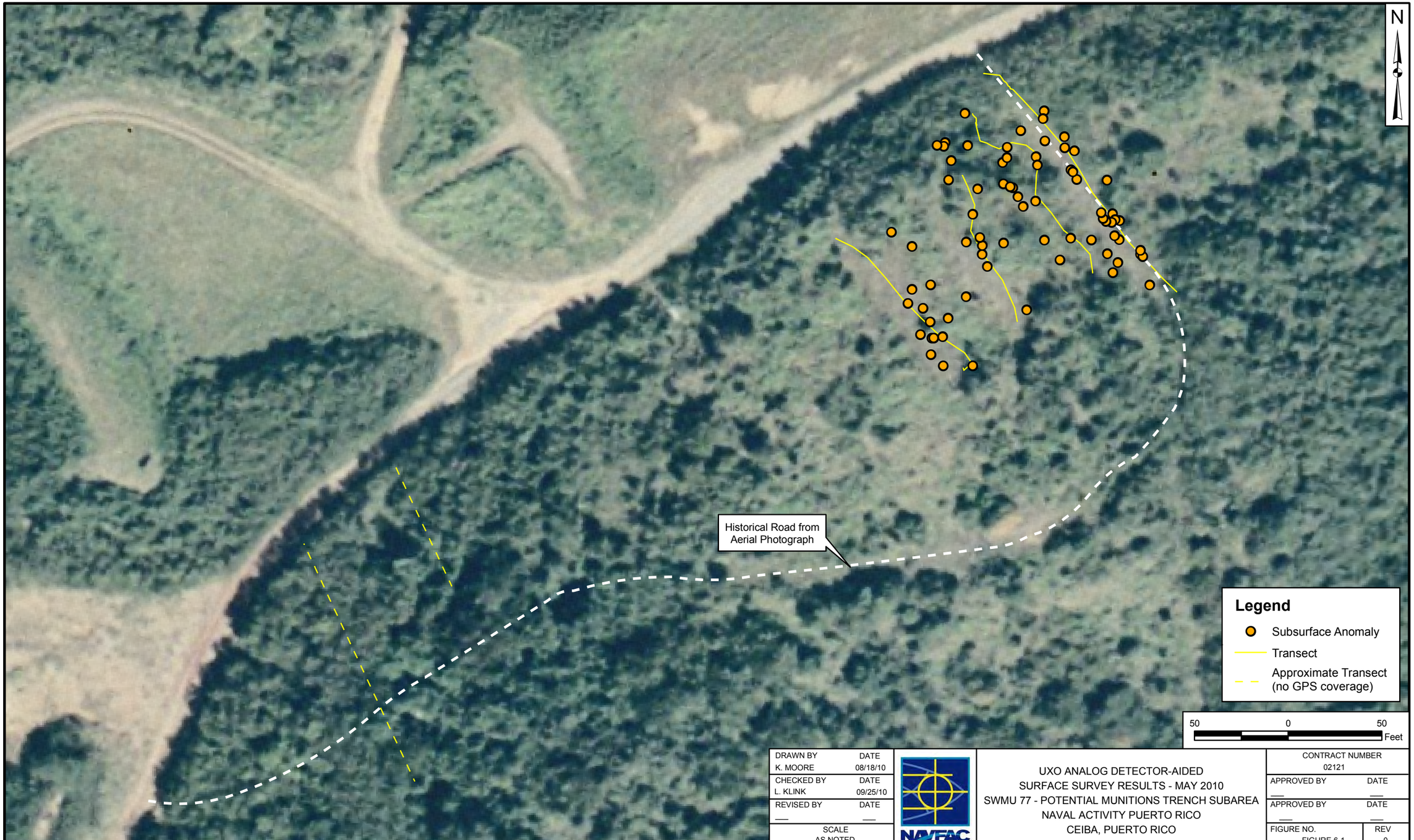

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REVISED BY	DATE
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SCALE AS NOTED	

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UXO ANALOG DETECTOR-AIDED
SURFACE SURVEY RESULTS - MAY 2010
SWMU 77 - POTENTIAL MUNITIONS TRENCH SUBAREA
NAVAL ACTIVITY PUERTO RICO
CEIBA, PUERTO RICO

CONTRACT NUMBER	
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FIGURE NO.	REV
FIGURE 6-1	0

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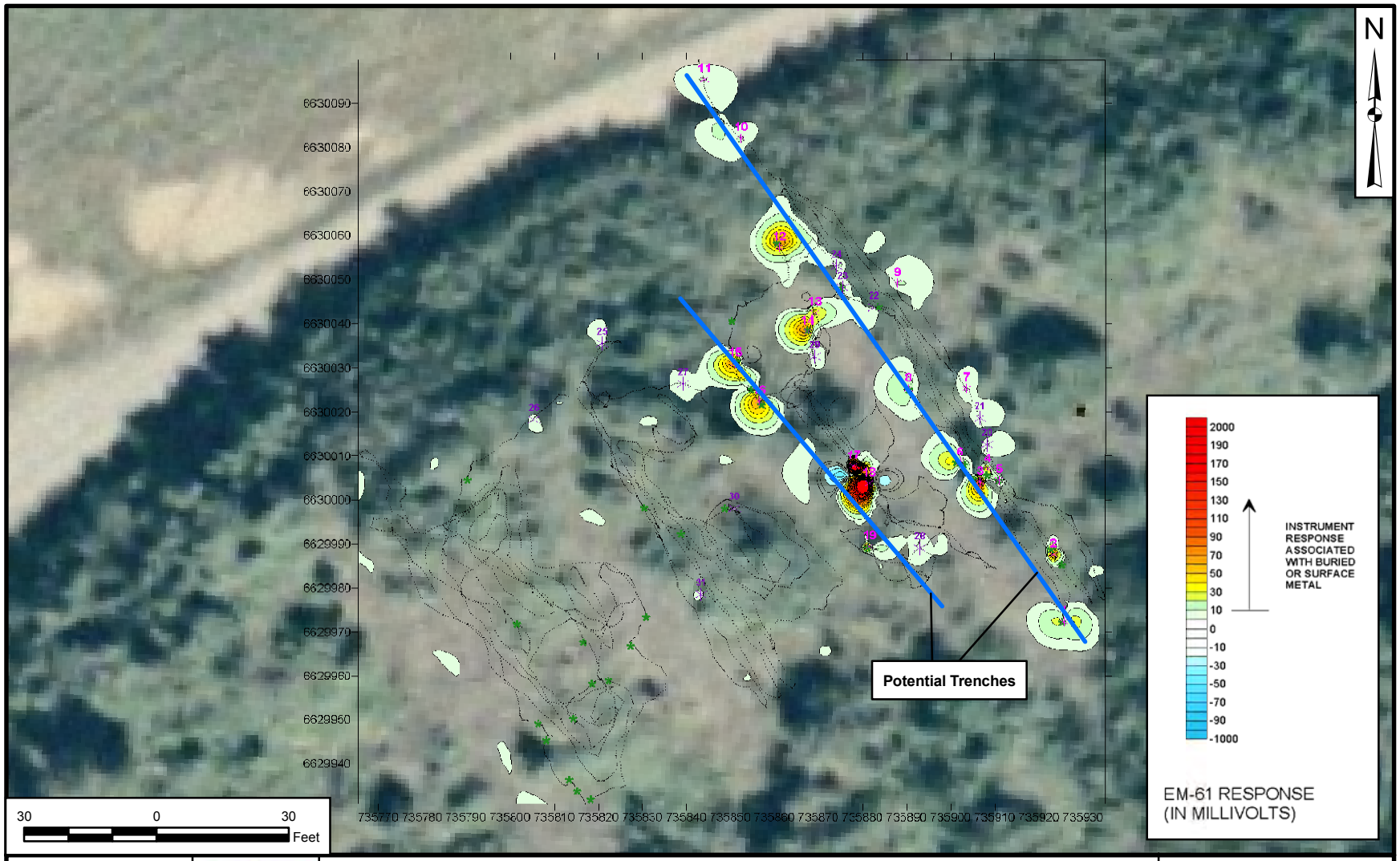

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SCALE	
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EM61 INPHASE RESPONSE

SWMU 77 - POTENTIAL MUNITIONS TRENCH SUBAREA

NAVAL ACTIVITY PUERTO RICO

CEIBA, PUERTO RICO

CONTRACT NUMBER	
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FIGURE NO.	REV
FIGURE 6-2	0

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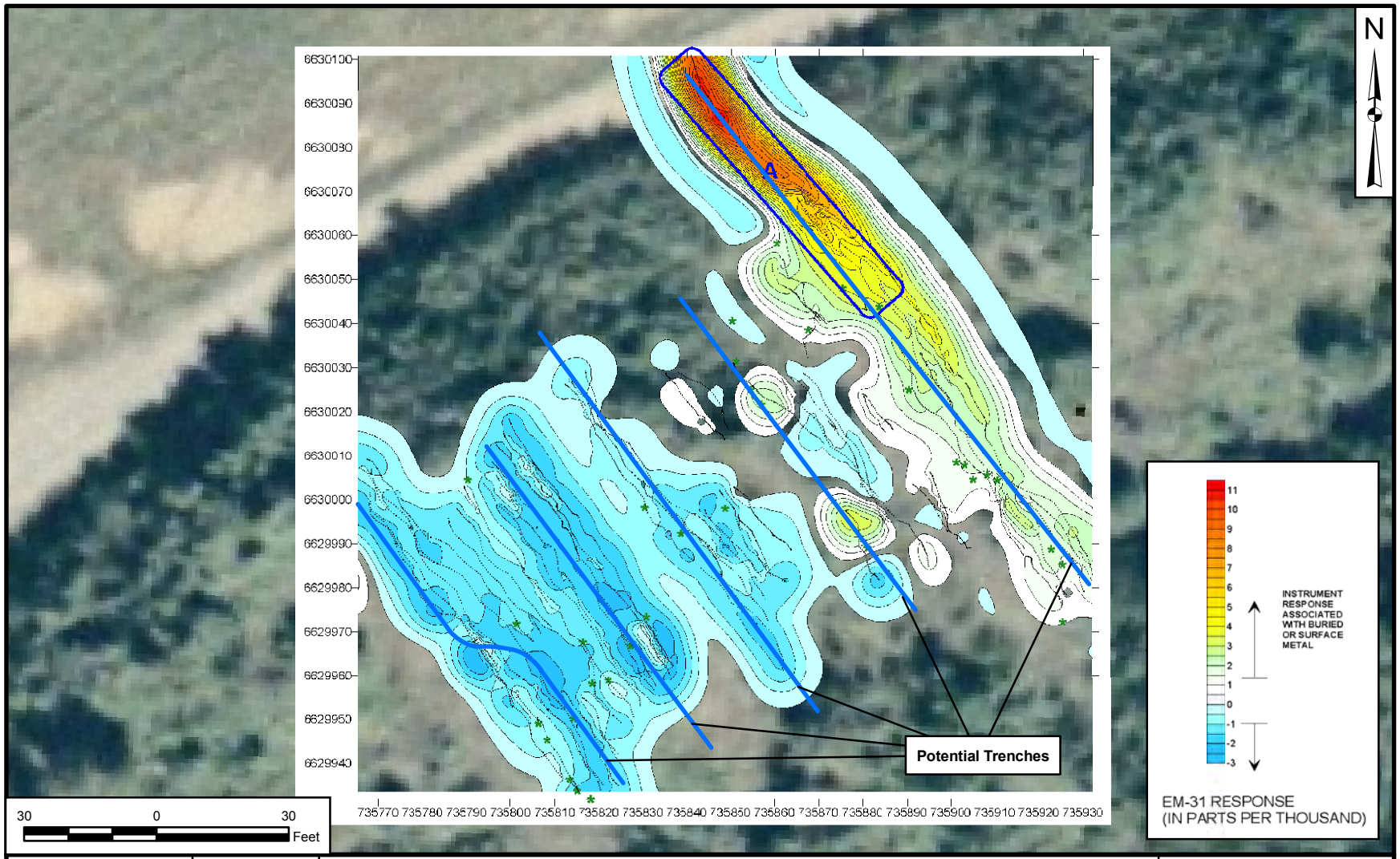

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SCALE	
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EM31 INPHASE RESPONSE

SWMU 77 - POTENTIAL MUNITIONS TRENCH SUBAREA

NAVAL ACTIVITY PUERTO RICO

CEIBA, PUERTO RICO

CONTRACT NUMBER	
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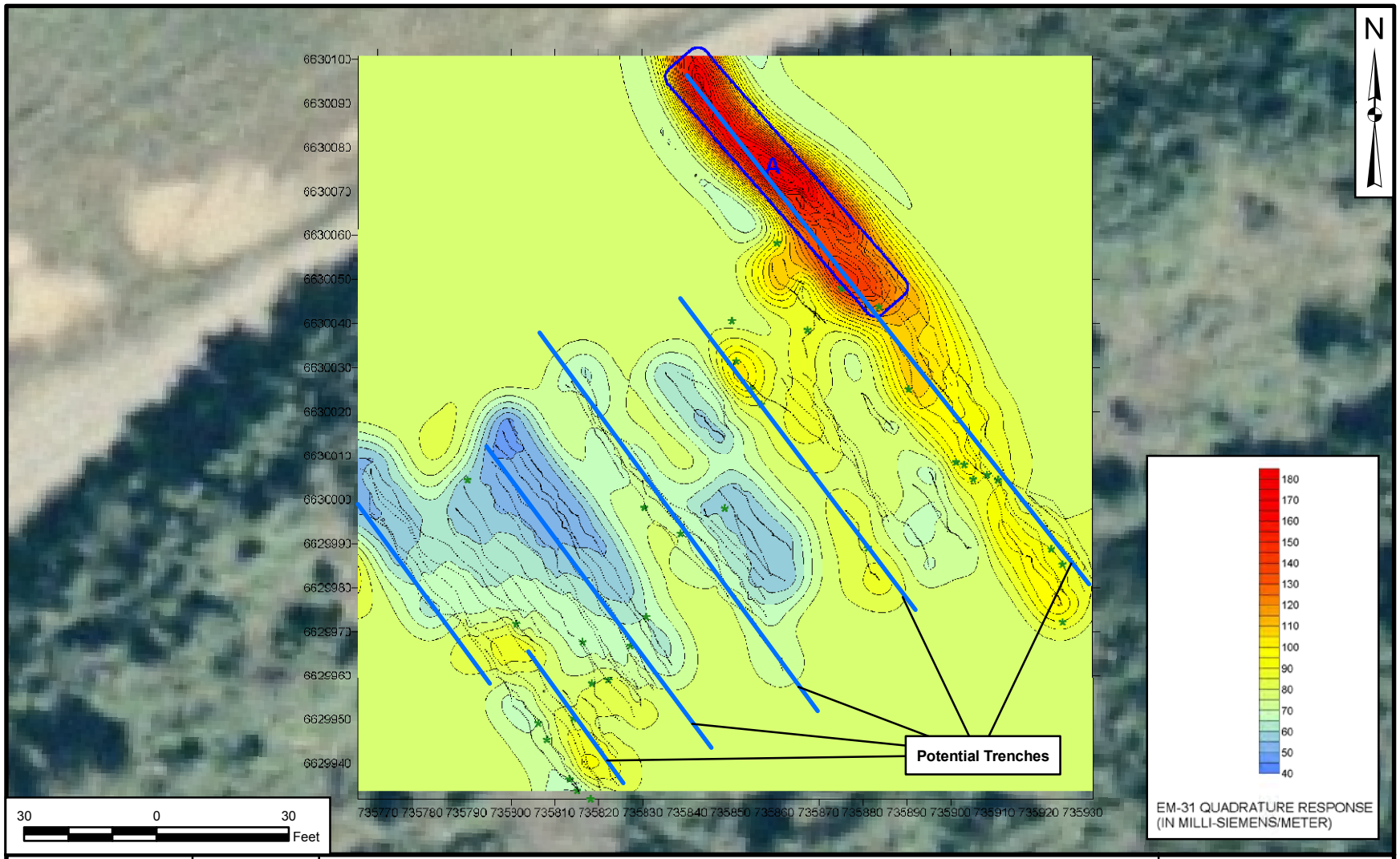
FIGURE NO.	REV
FIGURE 6-3	0

P:\GIS\NA_PUERTORICO\MAPDOCS\MXD\SWMU77_MUNITIONS_EM31_QUAD.MXD 09/28/10 JEE



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L. KLINK	09/28/10
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SCALE	
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EM31 QUADRATURE RESPONSE

SWMU 77 - POTENTIAL MUNITIONS TRENCH SUBAREA

NAVAL ACTIVITY PUERTO RICO

CEIBA, PUERTO RICO

CONTRACT NUMBER	
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FIGURE NO.	REV
FIGURE 6-4	0

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L. KLINK	09/24/10
REVISED BY	DATE
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SCALE AS NOTED	

UXO DETECTOR-AIDED SURFACE SURVEY RESULTS
MAY 2010
SWMU 77 - DETONATION AREA
NEAR CONCRETE PAD SUBAREA
NAVAL ACTIVITY PUERTO RICO
CEIBA, PUERTO RICO

CONTRACT NUMBER 02121	
APPROVED BY	DATE
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APPROVED BY	DATE
___	___
FIGURE NO. FIGURE 7-1	REV 0

ATTACHMENT 2

MEC FIELD STANDARD OPERATING PROCEDURES AND FIELD FORMS

SOPs

STANDARD OPERATING PROCEDURE
MRP SOP 01
UXO DETECTOR-AIDED SURFACE SURVEYS

1.0 SCOPE AND APPLICABILITY

This document is designed to set a standard operating procedure (SOP) for the detector-aided surface Survey field operations during activities performed under the Munitions Response Program (MRP). This SOP is not site-specific, but rather is intended as a general guidance document for a variety of sites and conditions.

2.0 BACKGROUND

Detector-aided surface Survey activities will be performed in accordance with all local, State, and federal regulations and will include all applicable DoD requirements. The scope of the detector-aided surface Survey activities for a specific site will be defined in the project-specific work plans. Generally, all areas identified as suspect for munitions and explosives of concern (MEC) will receive an Unexploded Ordnance (UXO) detector-aided surface Survey. UXO detector-aided surface Survey operations may be used as a stand-alone method for site survey and assessment or in preparation for digital geophysical mapping (DGM) survey operations. UXO escort operations will be required during site visits (initial site assessments, planning, and stakeholders meetings), DGM operations, and munitions constituents (MC) sampling operations and any other time where non-UXO trained personnel are conducting work in an MEC site. This SOP does not address UXO escort operations. UXO escort operations are addressed in the Munitions and Explosives of Concern and Chemical Warfare Agents Activities SOP, which will be attached to the site-specific health and safety plans (HASPs) for those activities.

3.0 PERSONNEL QUALIFICATIONS

UXO personnel conducting detector-aided surface Surveys shall be graduates of a military Explosive Ordnance Disposal (EOD) School of the United States, Canada, Great Britain, Germany, or Australia or a graduate of a formal training course of instruction or EOD assistant course as stated in DDESB TP-18.

UXO Senior UXO Supervisor (SUXOS)

The SUXOS will have a minimum of 10 years experience in all aspects of munitions response actions or range clearance activities. A minimum of 5 years of the experience shall be in supervisory positions.

UXO Team Leader (UXO Technician III)

The UXO Team Leader will have a minimum of 8 years of EOD/UXO experience including prior military EOD and/or commercial UXO experience in munitions response actions, and/or range clearance activities. The UXO Team Leader may supervise up to six UXO technicians. The UXO Team Leader will conduct detector-aided surface Survey activities as directed by the project manager (PM) and UXO Manager. The UXO Team Leader will be under the direct supervision of the UXO Manager.

UXO Quality Control Specialist (UXOQC)

The UXOQC specialist shall have a minimum of 8 years experience in all phases of munitions response actions and/or range clearance activities. The UXOQC specialist shall have completed corporate quality assurance and quality control training.

UXO Safety Officer (UXOSO)

The UXOSO shall have a minimum of 8 years experience in all phases of munitions response actions and/or range clearance activities.

UXO Technicians II

The UXO Technicians II will have prior military EOD experience or a minimum of 3 years of experience in munitions response actions and/or range clearance activities. The UXO technician will conduct detector-aided surface Survey activities as directed by the UXO Team Leader.

UXO Technician I

The UXO Technician I will have training as specified in DDESB TP-18. The UXO technician I will be directly supervised by a UXO Technician III or higher when conducting UXO activities.

4.0 DETECTOR-AIDED SURFACE SURVEY OPERATIONS

Equipment

A magnetic locator such as the Schonstedt, GA-52Cx instrument or equivalent and/or an all-metal detector such as the White's XLT or equivalent will be used for detector-aided surface Survey operations. The detection depth of the instrument is limited by size and orientation of a target and soil characteristics of the work area. The locators provide an audio signal for response, but do not store data. The magnetic locator does not need to be calibrated. The all-metal detector has field calibration. Calibration settings are specific to the make and model of the all metals detector. Table 1 lists the calibration settings for the White's spectrum XLT.

To ensure each detector is operating properly, the operator turns on the instrument and slowly moves the locator towards metal. As the probe advances toward the target, the audio signal will increase. Failure to detect the object is reason to reject the instrument.

The detector will be checked daily before starting detector-aided surface Survey activities and after any battery change. The normal daily check for detector-aided surface Survey operations is the blanket test. To conduct the blanket test, an area near the work site and free of anomalies will be identified. The senior UXO Technician or UXOQC will position several inert munitions, or surrogate munitions items on the surface and cover the items with a tarpaulin or similar cover so the items are not visible the UXO technician. Each UXO technician will conduct a detector-aided surface Survey of the blanket test area and locate the test items. The senior UXO technician or UXOQC will compare the results of the test to the actual placement of the items and make corrections as necessary. UXO Technicians will also conduct random checks during daily operations.

The normal setting for the Schonstedt instrument is 2; setting the instrument to 3 or 4 will make it more sensitive and setting the instrument to 1 will make it less sensitive. The instrument will not detect copper, brass, or aluminum munitions. The normal setting for the White's all-metal detector will vary according to site conditions.

UXO Detector-Aided Surface Survey

The objective of the UXO detector-aided surface Survey is to locate suspect MEC. Materials potentially presenting an explosive hazard (MPPEH) and munitions debris (MD) on the ground surface in a munitions response site, (MRS). Early in the planning for the field activities, usually during the DQO process with the regulators and the client, the level of effort is determined for each MRS within a munitions response area, MRA). The level of effort can vary from a 100% UXO investigation where the entire foot print of the MRS receives a UXO detector-aided surface Survey, to transects where five foot wide lanes receive a UXO detector-aided surface Survey and each lane is separated by a set number of feet depending on the budget and size of the MRS, or even a meandering path where a UXO detector-aided surface Survey is conducted as the UXO technician meanders across the MRS. Each of these will be discussed in some detail below:

100% UXO Detector-aided Surface Survey

The first step in conducting a 100% UXO detector-aided surface Survey is to identify the boundaries of the MRS. This can be done with a GPS with preloaded grid coordinates, or surveyed by a land surveyor.

The next step is to remove brush and small trees within the MRS to allow access to the locations where the surface Survey is to be conducted. The degree of removal will depend on site-specific conditions. This can be accomplished with a bush cutting crew and a UXO escort, or the UXO team can conduct the brush cutting themselves depending on the size of the area and the amount of brush removal needed. Care must be taken to ensure that personnel do not disturb suspect MEC, MPPEH or munitions debris on the surface that may be obscured by vegetation

The next step is to establish a grid system across the MRS. The normal grid is 100ft X 100ft but may be larger or smaller if the MRS would be better covered with a different size. The grid is established using a GPS with preloaded grid corners, or surveyed by a land surveyor to establish the grid corners.

The next step in the set-up process is to divide each grid into search lanes. This is normally done by running a tape measure between the bottom and top east/west corner stakes. Then the UXO team will run rope lines from the 0 point on one tape to the 0 point on the other tape, from the 5ft point on one tape to the 5ft point on the next tape, and so on until the entire 100 ft grid has been divided in to lanes.

The UXO team members will now start the UXO detector-aided surface Survey of each lane. Each UXO team member will start at one of the tapes and using the metal detector, proceed toward the other tape and locate any surface MEC within their lane. If suspect MEC is encountered, its location will be recorded and/or marked using a GPS, tape measure, or other grid coordinate location system. The UXO Team will attempt to determine its condition without moving or disturbing the item prior to proceeding with the surface Survey. Each item will be marked with engineer flagging and given a unique ID number (See MEC Management and Accountability SOP). All available information about the item will be recorded in the logbook/MEC Accountability Log, including suspect MEC location, identification, and ID number. A digital photograph will be taken of each item. The UXO Team will not move or otherwise disturb the item in an attempt to collect information. After all available information is recorded; the UXO Team will resume the detector-aided surface Survey.

When the UXO detector-aided surface Survey of a grid is complete and all items have been located with coordinates and digitally photographed, the tape measures, ropes and other equipment will be moved to the next grid and reestablished as stated above. This process will continue until the entire MRS has been investigated with as close as possible to 100% UXO detector-aided surface Survey.

Transect UXO Detector-aided Surface Survey

The first step in conducting a transect UXO detector-aided surface Survey is to identify the boundaries of the MRS. This can be done with a GPS with preloaded grid coordinates, or surveyed by a land surveyor.

The next step is to establish the end stakes of each transect across the MRS. The transect end stakes are established using a GPS with preloaded end stake locations, or surveyed by a land surveyor. The distance between transects will be established in the site-specific work plan. The direction should be either north/south, or east west although other directions may be appropriate in specific circumstances.

If necessary, each transect may require some brush cutting to aide in the surface Survey. If brush cutting is determined to be necessary, the transect should be at least 5 ft. wide. This can be accomplished with a bush cutting crew and a UXO escort, or the UXO team can conduct the brush cutting themselves depending on the size of the area and the amount of brush removal needed. Care must be taken to ensure that personnel

do not disturb suspect MEC items on the surface that may be obscured by brush and tall grass.

The UXO team members will now start the UXO detector-aided surface Survey of each transect. Each UXO team member will start at one of the end stakes and using the metal detector proceed in a deliberate pattern to locate any surface MEC within their 5ft wide transect, toward the other corresponding end stake. The UXO team member will use a GPS or compass to maintain a generally straight transects during the investigation. If suspect MEC is encountered, its location will be recorded and/or marked using a GPS, tape measure, or other grid coordinate location system. The UXO Team will attempt to determine its condition without moving or disturbing the item prior to proceeding with the surface Survey. Each item will be marked with engineer flagging and given a unique ID number (See MEC Management and Accountability SOP). All available information about the item will be recorded in the logbook/MEC Accountability Log, including suspect MEC location, identification, and ID number. A digital photograph will be taken of each item. The UXO Team will not move or otherwise disturb the item in an attempt to collect information. After all available information is recorded; the UXO Team will resume the detector-aided surface Survey.

When the UXO detector-aided surface Survey of a transect is complete and all items have been located with coordinates and digitally photographed, the UXO team member may proceed to the next transect. This process will continue until the transects have been completed over the entire MRS as planned in the WP.

Meandering Path UXO Detector-aided Surface Survey

Generally the meandering path UXO detector-aided surface Survey is very similar to the transect UXO detector-aided surface Survey. The main difference is there is very little need to cut brush as the UXO team members will meander around heavy brush and other obstacles.

The GPS will have information about the MRS preloaded so as to ensure that the path stays within the MRS. Again the meandering path will be approximately 5ft wide and proceed across the MRS until the objective, (a set amount of time, distance, or suspect MEC items) have been investigated with the UXO detector-aided surface Survey. The site-specific work plans will establish the area within the MRS to be covered with the meandering transects.

If suspect MEC is encountered, its location will be recorded and/or marked using a GPS, compass, and/or tape measure, or other grid coordinate location system. The UXO Team will attempt to determine its condition without moving or disturbing the item prior to proceeding with the surface Survey. Each item will be marked with engineer flagging and given a unique ID number (See MEC Management and Accountability SOP). All available information about the item will be recorded in the logbook/MEC Accountability Log, including suspect MEC location, identification, and ID number. A digital photograph will be taken of each item. The UXO Team will not move or otherwise disturb the item in an attempt to collect information. After all available information is recorded; the UXO Team will resume the detector-aided surface Survey.

Every effort will be made to identify each suspect MEC or MPPEH item located. Under no circumstances will any suspect MEC be moved in an attempt to make a definitive identification. The MEC item will be visually examined for markings and other external features such as shape, size, and external fittings. If unknown military munitions are encountered, the facility point of contact (POC) and Tetra Tech UXO Manager will be notified.

Only UXO-qualified personnel will perform MEC identification procedures. As an exception, a UXO Technician I may assist in the performance of MEC identification procedures when under the supervision of a UXO Technician III or higher. All personnel engaged in field operations will be thoroughly trained and capable of recognizing the specific hazards of the procedures being performed. To ensure that these procedures are performed to standards, all field personnel will be under the direct supervision of a UXO Technician III or higher. All suspect MEC items will be recorded following the requirements of this SOP, the site-specific Work Plan/QAPP, the project site-specific HASP, applicable ordnance operations procedural safety guidelines, and industry-accepted safe work practices and procedures.

All items discovered during the detector-aided surface Survey of the transects/grid will be left in place. No MEC will be moved during this part of the project. The facility POC will be notified of the presence of MEC so that arrangements may be made through the facility for proper disposition of the item(s). If the facility initiates an emergency response or disposal action, follow-up documentation must be obtained to detail the date and method of disposition. This is also needed to ascertain the actual type and condition of the item (live or inert filled) to aid in future classification of the site.

Quality Control

During the detector aided surface Survey the UXOQC, or Senior UXO technician if there is no UXOQC, will recheck 25% of the first four units of work (grids or transects). If quality requirements are not met on any unit, that unit will be rejected and the UXO team will rework the entire unit. Once quality requirements are met for four units in a row, the UXOQC, or Senior UXO technician if there is no UXOQC may reduce the level of rechecks to 10% of each unit (grids or transects). If at any time a unit fails the quality control check, that complete unit will be reworked and the rechecks will be increased to 25% until four units in a row pass the recheck.

Detector-Aided Surface Survey for Geophysical Survey

The UXO Technician will conduct a detector-aided surface Survey of the grid or area to be surveyed and record the location of any MEC items discovered. Each item will be marked and recorded as described above. UXO avoidance will be practiced during the geophysical survey.

When allowed by the conditions of the Explosive Safety Submission (ESS) determination, any non-munitions debris may be moved to facilitate a more effective geophysical survey. Non-munitions debris may be collected and stockpiled in a

designated area within the boundaries of the site. The facility must agree to take possession of this non-munitions debris and arrange the proper disposition of the material before any items may be moved or disturbed.

TABLE 1

White's Spectrum XLT Settings		
Basic Adjustments:	**UXO 1**	
Target Volume	58	
Audio threshold	23	
Tone (audio frequency)	226	
Audio Disc.	on	
Silent Search	off	
Mixed-Mode	on	
A.C. Sensitivity	60	Adjust at a test Grid. Compare with another White's
D.C. Sensitivity	30	Adjust at a test Grid. Compare with another White's
Backlight	0	
Viewing Angle	25	
Pro Options:		
"Audio"		
Ratchet Pinpointing	on	
S.A.T. Speed	7	
Tone I.D.	on	
V.C.O.	on	
Absolute Value	off	
Modulation	on	
"G.E.B/Trac"		
Autotrac	on	
Trac View	off	
Autotrac Speed	14	
Autotrac Offset	+1	
Trac Inhibit	on	
Coarse B.E.B.	54	These numbers are variable and will change automatically.
Fine G.E.B.	160	These numbers are variable and will change automatically.
"Discrimination"		
Disc. Edit	+95 Accept	
Block Edit	+95 Accept	
Learn Accept	off	
Learn Reject	off	
Recovery Speed	20	

White's Spectrum XLT Settings		
Basic Adjustments:	**UXO 1**	
Bottlecap Reject	20	
"Display"		
Visual Disc.	off	
Icons	on or off	
V.D.I. Sensitivity	55	
D.C. Phase	9on	
Graph Averaging	on	
Graph Accumulating	on	
Fade Rate	u	
"Signal"		
Transmit Boost	off	
Transmit Frequency	1 to 7	
Preamp Gain	4	

TABLE 2

Related Field Forms

Form Number	Frequency	Form Name
MRP FF.1	Once	SAP Worksheet No 4-Project Sign-Off
MRP FF.2	Daily	Daily MEC Activity Log
MRP FF.3	Daily	Daily Equipment Checklist
MRP FF.5	Daily	Daily Photographic Log
MRP FF.6	Once	IVS Installation Checklist
MRP FF.7	Daily	Daily IVS Report
MRP FF.8	Daily	Daily MEC_MPPEH Log For UXO Avoidance Activities
MRP FF.10	Daily	MEC Accountability Form
MRP FF.15	Daily	Daily QC Report
MRP FF.16	Once per Definable Feature	Preparatory Phase Inspection Report
MRP FF.17	Once per Definable Feature	Initial Phase Inspection Report
MRP FF.18	Periodic	Follow Up Phase Inspection Report
MRP FF.21	Daily	Daily Safety Log
MRP FF.22	Daily	Daily Tailgate Safety Briefing-Training Record Form

STANDARD OPERATING PROCEDURE
MRP SOP 02
MEC MANAGEMENT AND ACCOUNTABILITY

1.0 SCOPE AND APPLICABILITY

This document is designed to set a standard operating procedure (SOP) for the management and accountability of Munitions and Explosives of Concern (MEC) encountered during activities performed under the Munitions Response Program (MRP).

2.0 BACKGROUND

MEC activities will be performed in accordance with all local, State, and federal regulations and will include all applicable DoD requirements. Generally, MEC will be encountered during the performance of Unexploded Ordnance (UXO) detector-aided surface Survey operations, subsurface geophysics investigations and UXO Escort operations. UXO detector-aided surface Survey operations may be used as a stand-alone method for site survey and assessment or in preparation for geophysical survey and other operations. UXO escort operations may be required during site visits (initial site assessments, planning, and stakeholders meetings), geophysical operations, construction support during subsurface activities, and MC sampling operations.

3.0. PERSONNEL QUALIFICATIONS

UXO personnel shall be graduates of a military Explosive Ordnance Disposal (EOD) School of the United States, Canada, Great Britain, Germany, or Australia or a graduate of a formal training course of instruction or EOD assistant course as stated in DDESB TP-18.

4.0. MEC MANAGEMENT AND ACCOUNTABILITY OPERATIONS

UXO Detector-Aided Surface Survey

If suspect MEC is encountered, its location will be recorded and/or marked using a GPS, tape measure, or other grid coordinate location system. The UXO Team will attempt to determine its condition without moving or disturbing the item prior to proceeding with the surface Survey. Each item will be marked with engineer flagging and given a unique ID number. ID numbers will start with a letter(s) corresponding to the site or grid in which the item is located. This will be followed by the transect number of the site or grid specific to the location of the item. Lastly, a number will be assigned to the individual items within the transect. These numbers will start at 01 and run consecutively. For example:

*The site name is **O**pen **B**urn **P**it. The first transect within the Open Burn Pit is **A1**. The first item encountered in transect A1 is item **01**. The ID number assigned to the item is **OBP-A1-01.***

All available information about the item will be recorded in the logbook/MEC Tracking Log as presented in Attachment 1 to this SOP, including suspect MEC location, identification, and ID number. A digital photograph will be taken of each item. The UXO Team will not move or otherwise disturb the item in an attempt to collect information. After all available information is recorded; the UXO Team will resume the detector-aided surface Survey.

Every effort will be made to identify each suspect MEC item located. Under no circumstances will any suspect MEC be moved in an attempt to make a definitive identification. The MEC item will be visually examined for markings and other external features such as shape, size, and external fittings. Prior to any documentation being developed on an MEC item, all fuzing will be definitively identified if it is possible to safely do so visually without disturbing the ordnance item. This identification will consist of fuze type by

function and condition (armed or unarmed) and the physical state/condition of the fuze, i.e., burned, broken, parts exposed/sheared, etc.

Only UXO-qualified personnel will perform MEC identification procedures. As an exception, a UXO Technician I may assist in the performance of MEC identification procedures when under the supervision of a UXO Technician III or higher. All personnel engaged in field operations will be thoroughly trained and capable of recognizing the specific hazards of the procedures being performed. To ensure that these procedures are performed to standards, all field personnel will be under the direct supervision of a UXO Technician III or higher. All suspect MEC items will be recorded following the requirements of this SOP, the site-specific Work Plan/QAPP, the project site-specific HASP, applicable ordnance operations procedural safety guidelines, and industry-accepted safe work practices and procedures.

Detector-Aided Surface Survey for Geophysical Survey

The UXO Technician will conduct a detector-aided surface Survey of the grid or transect to be surveyed and record the location of each MEC item discovered, if any. Each item will be marked and recorded as described above. UXO avoidance will be practiced during the geophysical survey.

When allowed by the conditions of the Explosive Safety Submission (ESS) determination, any non-munitions debris may be moved to facilitate a more effective digital geophysical mapping (DGM) survey. Non-munitions debris may be collected and stockpiled in a designated area within the boundaries of the site. The facility must agree to take possession of this non-munitions debris and arrange the proper disposition of the material before any items may be moved or disturbed.

UXO Escort Operations

One UXO Technician qualified as a UXO Technician II or higher, will be required to support each field team engaged in operations in areas that might contain MEC. If any MEC is encountered, the item will be avoided during this phase of the project.

The UXO Technician will not attempt to identify the type or condition of the ordnance during escort operations. Any area with visible ordnance or MEC will be clearly marked, and the area will be avoided. The location of visible ordnance or MEC will be recorded and noted in the field logs. If more senior level personnel are present on site, MEC findings will be reported to the UXO Team Leader. No ordnance, munitions, explosives, or ordnance-related materials will be moved, removed, or disposed of during UXO Escort duties.

5.0 NOTIFICATIONS IF MEC IS ENCOUNTERED

Any MEC item discovered during a detector-aided surface Survey, geophysical survey, or UXO escort operation will be left in place and will not be moved. Should MEC be encountered, the following scenarios should be addressed as follows:

(1) <u>If a complete MEC item or ordnance related material is encountered that is believed to pose a hazard, is unexpectedly encountered at a given site, is encountered outside of the current established site boundaries, or is unknown</u>, the UXO Team Leader, with support by UXO Technicians on site as necessary, will document the following information, as indicated on related field forms listed in Table 2, for notification purposes:

- Site Name
- Date/Time Encountered
- Name and UXO Category of Person Providing Notification

- Location of Item (provide coordinates)
- Type of Item (provide digital photograph)
- Apparent Fuze Condition (armed or unarmed)
- Physical Condition (burned, broken, parts exposed/sheared, etc)
- Physical Appearance (buried, staged, etc.)
- Activity in Progress

The UXO Team Leader will attempt to identify the type and/or condition of the ordnance and its location, as described above, and will immediately report this information to the client point of contact at the facility and the Tetra Tech UXO Manager. Prior to any documentation being performed on a suspect MEC item, all fuzing will be definitively identified only if it is possible to safely do so visually without disturbing the item. If directed by the point of contact at the facility, UXO personnel may take emergency non-invasive action such as securing the area until the appropriate exclusion and safety zones have been determined.

The Navy point of contact at the facility will be responsible for notifying appropriate EOD personnel or for designating this notification task to the Tetra Tech UXO Team Leader. The notification to EOD personnel should be immediate if a live MEC item is encountered which could be a hazard to personnel, or if the item is unknown so that arrangements may be made through the facility for proper disposition of the item(s). If the facility initiates an emergency response or disposal action, follow-up documentation should be obtained to detail the date and method of disposition. This information is also needed to ascertain the actual type and condition of the item (live or inert filled) to aid in future classification of the site.

(2) If the MEC item cannot be identified by type as a conventional munition, and/or if in the unlikely event that the MEC is suspected to be potential Chemical Warfare Material (CWM), personnel will withdraw upwind from the area, assemble at a pre-designated rally point, secure the site, and immediately request assistance from the point of contact at the facility and notify the Tetra Tech UXO Manager. If so directed, UXO personnel will take emergency non-invasive actions such as covering the item with plastic sheeting and securing the area until the appropriate exclusion and safety zones have been determined.

(3) If Hazardous, Toxic, or Radiological Waste (HTRW) is encountered on-site, the work site will be evacuated until the Tetra Tech Project Health and Safety Officer, with concurrence of the client point of contact at the facility, identifies and implements appropriate protective measures.

For any of the scenarios, upon receiving notification from the Tetra Tech UXO Team Leader, the Tetra Tech UXO Manager will then immediately inform the Tetra Tech Project Manager, who will then immediately inform the client Project Manager. Tetra Tech Program Management personnel will then be notified. The client Project Manager will then make all other necessary notifications within the client's organization.

TABLE 1
Contact Information

Position	Name	Organization	Direct Dial Phone	Cell Phone
Project Manager				
UXO Manager				
Environmental Site Manager				
Navy Remedial Project Manager				

TABLE 2
Related Field Forms

Form Number	Frequency	Form Name
MRP FF.1	Once	Sap Worksheet No 4-Project Sign-Off
MRP FF.2	Daily	Daily MEC Activity Log
MRP FF.3	Daily	Daily Equipment Checklist
MRP FF.5	Daily	Daily Photographic Log
MRP FF.9	Daily	MEC Cumulative Summary Log
MRP FF.10	Daily	MEC Accountability Form
MRP FF.15	Daily	Daily QC Report
MRP FF.16	Once per Definable Feature	Preparatory Phase Inspection Report
MRP FF.17	Once per Definable Feature	Initial Phase Inspection Report
MRP FF.18	Periodic	Follow Up Phase Inspection Report
MRP FF.21	Daily	Daily Safety Log
MRP FF.22	Daily	Daily Tailgate Safety Briefing-Training Record Form

STANDARD OPERATING PROCEDURE
MRP SOP 03
DIGITAL GEOPHYSICAL MAPPING (DGM)

1.0 SCOPE AND APPLICABILITY

This operating procedure is designed to provide a regular set of guidelines for conducting Digital Geophysical Mapping (DGM) for Munitions Response Programs (MRPs). The general procedure is intended to apply to a wide variety of investigations (targets).

2.0 SUMMARY OF METHOD

Various military operations (transport, training, practice and experimental) over time have resulted in the deposition of a wide assortment of munitions of explosive concern (MEC), and a large effort is underway to search and remove such items from many of the active and inactive military sites across the country. MEC range from small objects (20mm) to large objects (bombs), and their potential abundance on a site can vary considerably as well. Geophysics is a non-intrusive approach often used to locate buried objects that could be MEC. Numerous steps are involved in selecting a geophysical approach, and they are described below.

All Unexploded Ordnance (UXO) survey and avoidance activities will be carried out in accordance with all local, state, and federal regulations, and will include general guidance from applicable United States Army Corps of Engineers (USACE) Data Item Description requirements, including Engineer Pamphlet EP-75-1-2 dated 01 August 2004 (USACE, 2004), Data Item Descriptions; MR-001 (USACE, 2003a), MR-005-05 (2007), and MR-005-07.01 (2007). Additional guidance is provided in EM 1110-1-4009 -Engineering and Design: Military Munitions Response Actions (USACE, 2007).

3.0 PERSONNEL QUALIFICATIONS

Personnel responsible for designing or conducting geophysical processes should possess education and training in geophysics to ensure proper procedures are followed. Sub-contractors should possess similar personnel requirements when implementing a geophysical plan. Personnel will meet the requirements of USACE Data Item Description OE – 025.02 (USACE, 2004) described below.

Project Geophysicist - This individual shall have a degree in geophysics, geology, geological engineering, or a closely related field, and shall have a minimum of 5 years of directly related geophysical experience. This individual has overall responsibility for design, implementation, and management of all geophysical investigations required for the work effort, but may not necessarily be on-site full time. This individual shall be the project geophysicist-of-record.

Site Geophysicist - This individual shall have the same education requirements as the Project Geophysicist, except the 5 years minimum experience requirement is waived, if working under the general supervision of a Project Geophysicist. This individual is responsible for day-to-day operations of the site geophysical investigations. This individual may also be the Project Geophysicist if he/she meets the qualifications of “Project Geophysicist” above.

4.0 SURVEY DESIGN

Several considerations must be taken into account when designing a geophysical survey:

Site Preparation: Sites suspected to contain MEC must be inspected by a properly qualified UXO technician. The inspection will include, as a minimum, a visual inspection as well as possibly assisted by a hand-held magnetic or all-metals locator. This is to ensure safety for setting monuments or survey stakes, and in collecting the survey data. All movable aboveground metal should be removed from the

site prior to commencement of DGM in order to obtain subsurface information (not be interfered with by the aboveground metal that could mask subsurface metal).

Vegetation can also create limitations for survey coverage. Brush cutting and vegetation clearing may be necessary to acquire geophysical data.

Equipment Selection: An understanding of the nature of the suspect MEC must be established first in order to select the proper equipment for the survey site.

Magnetometer surveys are selected when the potential MEC targets are comprised of a substantial ferrous (iron) component, and the site is expected to have low levels of cultural ”noise” (e.g., power lines, scrap mixed in with the soil, numerous aboveground metallic objects that cannot be removed from the survey area). Maximum prospecting depth is limited by the strength of the magnetic field for the potential MEC (controlled by the mass, diameter and orientation of the buried metallic object). Sensor height will be determined by the Geophysicist based on the nature of site conditions and expected target sizes and depths.

Electromagnetic (EM) induction surveys are selected when the potential MEC targets are comprised of a significant component of any type of metal. Normally maximum prospecting depths are limited to about 9 to 15 feet below ground surface (depending on the mode employed). Within this range, larger objects can be detected deeper than smaller ones.

Certain geologic conditions may be prohibitive to the success of a geophysical survey, and in such cases a pilot test or Geophysical Prove Out may be required to determine whether the survey equipment can detect the buried targets. Examples of such conditions include ultra-mafic soils or shallow bedrock, high electrically conductive soils (e.g., fill containing scrap metal) or salt water conditions that can interfere with the detection capabilities of the survey equipment.

Survey Coverage: Expected target sizes, anticipated burial depths and the target metal mass must be evaluated by the Geophysicist in order for proper selection of survey line spacing given the selection of geophysical equipment in order to possess a high level of confidence that the project goals can be accomplished. Surveys conducted using 2.5 ft line spacing with an EM61 or G-858 magnetometer are considered to provide 100 percent effective survey coverage for most MEC targets. Conversely, in cases where a reconnaissance survey is needed, meandering path or non-traditional survey geometries may be substituted to accomplish the project goals. In all cases, consideration must be given to past, current and future land uses to assure that the survey approach meets the client objectives.

Survey Location: Locating survey lines (data) can be accomplished in a few ways. The level of accuracy needed and the surrounding site features will help determine the acceptable location technique. Small survey areas may be located with a high level of accuracy using tape measures to create survey lines (grids). The grids may then be referenced directly to permanent and semi-permanent site features.

Larger survey areas or survey areas in remote areas may need a different location method to maintain a high level of accuracy. Professional surveying or integrating Differential Global Positioning System (DGPS) measurements with the geophysical data can be used in large areas to maintain high location accuracy. Numerous Global Positioning System (GPS) units (DGPS) are readily available to achieve sub-meter accuracy. Specialized GPS units (Real Time Kinematic [RTK]) should be employed when sub-foot accuracies are needed. GPS units do not normally operate effectively in wooded areas, and professional surveying or total stationing methods may be required for high level accuracy in those areas. Alternatively, wooded survey areas may be established by tape measure, followed by GPS (where a clear GPS signal can be received), total stationing or professional surveying of several survey grid points or corners.

Data Sampling: Data must be collected at intervals to satisfactorily sample the anticipated targets. Expected target sizes, anticipated burial depths and the target metal mass must be evaluated by the Geophysicist in order for proper selection of data sampling intervals. Data station intervals will normally be determined from the movement speed along the survey lines with respect to the data initiation interval (normally automatic or sometimes manual as a function of time). Measurements may be triggered by a

survey wheel attached to the survey instrument when sufficient data density can be achieved. Calibration of the survey wheel may be needed depending on the instrument setup.

5.0 EQUIPMENT

Instrument Checks:

Equipment Standardization. Geophysical sensors and support equipment, navigation equipment, and operator performance will be checked and tested at specific intervals and must meet the appropriate acceptance criteria. Table 1 lists the tests, and their required frequencies and acceptance criteria modified from USACE Engineering Pamphlet (EP) 75-1-2 (2004). These tests plus the initial out-of-box tests are detailed below.

Out-of-Box-Tests. The following out-of-box procedures will be conducted before the pre-seed geophysical survey of the test plot area begins:

- Inventory and inspect all equipment to confirm all components are present and in good condition.
- Assemble the equipment and power up.

Regular Tests.

1. **Equipment/Electronics Warm-Up.** This test minimizes sensor drift caused by thermal stabilization. Most instruments need a few minutes to warm up before data collection begins. All manufacturer instructions will be followed or, if none are given, data readings will be observed until they stabilize. Acceptance Criterion: Equipment Specific (typically, 5 minutes). This test will be conducted each time the unit is started.

2. **Equipment Null.** The EM61 and EM31 equipment should be nulled before data collection at each site. The units should be nulled in areas determined to represent background levels (non-anomalous areas ”quiet areas”).

3. **Record Sensor Positions.** The purpose is to document relative navigation and sensor offsets, detector separation, and detector heights above the ground surface. This information will ensure that the detector offset corrections and gradient calculations can be done correctly and that the surveys are repeatable. Acceptance Criterion: ±2 inches for EM61 and G-858 standard units and ±6 inches for EM31. This test will be conducted at the beginning of the 1st day and when an equipment configuration change is made.

4. **Personnel Test.** This test ensures that survey personnel have removed all potential interference (metal) sources from their bodies. Common interference sources are ballpoint pens, steel-toe boots, or large metallic belt buckles, which can produce data anomalies similar to Ordnance Explosive (OE) targets. All personnel who will be coming near the sensor during survey operations should remove metallic items from themselves, and if not possible then readings should be monitored and recorded to judge the effect of the metallic items in order to meet the following acceptance criteria. Acceptance Criterion: EM61 2 millivolts (mV), magnetometer 2 nanoteslas (nT), EM31 1 millisiemen per meter (mS/m) or parts per thousand (ppt). This test will be conducted at the beginning of each day if the operator is wearing metallic items that could interfere with equipment operation.

5. **Static Background and Static Spike (or Standard Response) Test.** These tests quantify instrument background readings and electronic drift, locate potential interference spikes in the time domain, and determine impulse response and repeatability of the instrument to a standard test item (typically a 2-inch-diameter steel trailer hitch ball). Improper instrument function, local sources of ambient noise (e.g., EM transmissions from high-voltage electric lines), and faulty equipment are all potential causes of inconsistent, non-repeatable readings. A minimum of 3 minutes static background test after instrument warm-up, followed by a 1-minute standard response test, in turn followed by an additional 1 minute static background test, will be performed. The field geophysicist

must review the readings to confirm the survey equipment is stable before the geophysical survey continues. Guidance Criteria: Static Background test EM 61 ± 3 mV, magnetometer ± 5 nT, EM31 ± 1 mS/m or ppt ; Static Response Test ±20% of standard item response after background correction. This test will be conducted at the beginning of each day.

6. **Base-Line Test.** This test is conducted in an area that has low background noise and no sources of anomalous response. The test line will be well marked to facilitate data collection over exactly the same line each time the test is performed. The test may need to be conducted at the beginning, middle and end of each day to check for instrument drift (baseline shift in data values) or in the situation where a magnetic base station is not used during a magnetometer survey in order to make any necessary data value adjustments.

7. **Pull-Away Test.** This test demonstrates the effects of the navigational equipment. All equipment will be powered up and operating as it would be during the survey. Acceptance Criterion: document the effects of the navigational equipment on the geophysical readings. Effects should be small. Test should be performed before the geophysical survey begins, and if the equipment configuration changes during the survey.

8. **GPS Positioning.** The GPS positioning system will be tested by against survey control points. The GPS coordinates are compared with the documented coordinates for the control points. Acceptance Criterion: sub-meter or better (based on project requirements). Test should be performed as a minimum at the beginning of the project and if an equipment change is made. GPS survey instruments should also be closely monitored during field acquisition by using Dilution of Precision (DOP) criteria, or as a minimum, number of satellite signals received criteria. DOP should normally be less than 3 to obtain high quality results, and at least 6 satellites should also indicate high quality results (see SOP 05 [GPS Data Collection and Transfer] for detailed discussion of GPS positioning requirements).

   Latency is an issue when a separate GPS controller (from the geophysical controller) is used to acquire the GPS data. If separate controllers are used, care should be taken to synchronize the clocks in both the GPS and geophysical units, and a test must be set up to measure the latency inherent in using two different accuracy clocks. The test should consist of positioning oneself overtop of a linear metallic object (e.g., pipe) at several points and recording data with the all of the survey equipment, and again using only the GPS equipment to compare the results and determine the necessary adjustment.

9. **Azimuth Test.** The purpose of this test is to optimize the sensor orientation to avoid optically pumped magnetometer sensor “dead zones,” and obtain a strong signal strength.

6.0 QUALITY ASSURANCE (QA)/ QUALITY CONTROL (QC)

All documentation will be available to Base personnel. Operational and test procedures will conform to the manufacturer’s standard instructions. QC of the instruments’ data will be achieved daily by field testing, checking the sensor and navigation system against a known target to ensure that they are operating properly. All geophysical instruments and equipment used to gather and generate field data will be calibrated with sufficient frequency and in such a manner that accuracy and reproducibility of the results are consistent with the manufacturer’s specifications. Calibration, repair, or replacement records will be filed and maintained by the field geophysicist and may be subject to audit by the QA manager. Potential data problems include source data errors, data entry errors, data editing errors, and user errors. All data will be reviewed to identify and correct any of these errors should they occur.

7.0 FIELD REPORTING AND RECORDS MANAGEMENT

Field data sheets/notes will be maintained for all geophysical activities. This SOP contains copies of the field forms and checklists. Project documentation will be collected and managed on-site during the life of all field activities. Geophysical data will be recorded digitally and downloaded to a field computer for

review in the field. In addition to the copy of data saved on the field computers hard drive, a copy of the data will be saved on a compact disk (CD) for backup before the data are erased from the equipment. The project geophysicist will review the downloaded data to verify that the download system is functioning properly. This review will also check the field data for QC review. The review will verify that the data are valid and useable for the intended purpose.

8.0 INSTRUMENT VERIFICATION STRIP

An Instrument Verification Strip (IVS) is normally performed prior to site survey work to evaluate geophysical surveying techniques and personnel that will apply to MEC sites. IVSs are important in testing the survey technique to determine whether it is capable of detecting the target items.

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IVS-

The specific objectives for the IVS will be:

- Determine whether the proposed geophysical technique is appropriate for this type of investigation.
- Provide a safe area with a known set of standardized isolated objects (e.g., single inert UXO, and industry standard objects (ISOs)). The sensor signatures from these items may be used to evaluate the equipment limitations in the site geologic setting and to optimize equipment, procedures, and data analysis. Response curves to industry standard objects (ISOs) and standard munition items will be compared to IVS survey data to assess whether or not the technique appears to have typical detection capabilities for survey work.
- Assess the operators' performance and update related procedures to assist in the development of operator measurement techniques.
- Establish a baseline of performance capabilities for the selected instruments.
- Evaluate average speed and minimum along-track sampling required to detect target items.
- Evaluate data processing (see SOP-04 [Geophysical Data Processing and Analysis]), including distance corrections, map production, and target selection, to produce final datasets.
- Detect items within the USACE's 11x rule, which states that generally munitions can typically be detected within a depth equal to 11 times their diameter.
- Identify horizontal positions of detected seed items to be within project specified accuracy or better (depending on investigation goals).

Test Plot/Test Strip Design. The proposed test plot/test strip layout shall be included in the work plan/QAPP/SAP, and the following recommendations from USACE Data Item Description MR-005-05A, Revision 1 December 2003 should be used as guidelines for establishing the IVS:

a. Plot Size and Location. Selection of the plot area should be based upon the technical and site-specific considerations developed and finalized during the Technical Project Planning (TPP) process and/or project team meetings. It may be advantageous to plan the IVS location outside of areas where digging is restricted to UXO technicians and/or oversight by UXO technicians.

b. Seed Items. Describe the planned seeding methodology. Once placed, all seeded items and corner markers should be surveyed and photographed. The planned IVS target layout plan shall be updated to reflect the "as built" configuration. The seeded items should be tagged with a non-biodegradable label identifying the items as inert and providing a contract reference, a point of contact address, phone number, and a target identifier.

A tabulated list, available in digital format, containing the seed items, Identification (ID) numbers, depths, proposed orientation (or survey information on the nose, tail, and center point of the item) shall be included. If munition seeds are employed, actual inert items could be more useful than surrogate items, as response curves can be used with the former items.

c. Site Preparation. Describe any preparation that may be necessary to allow accessibility with geophysical instruments. This may include vegetation removal and/or surface clearance. After this step, the test plot should duplicate, as closely as possible, the conditions under which the geophysical surveys will be conducted.

d. Location Surveying. Describe the location methods to be employed. The location of the test plot corners and seed items shall be surveyed to a horizontal accuracy established during the TPP process and/or project team meetings.

e. Pre-Seeding (Background) Geophysical Mapping. Describe background geophysical mapping. After a site has been selected and the surface prepared, pre-seeding geophysical surveys shall be performed with each detector type in order to determine and document base-line geophysical conditions at the site.

f. QC. Describe QC measures to be implemented.

g. Anomaly Avoidance. Anomaly avoidance will be performed by all site workers for all anomalies located, visually or with metal detectors, during preparation of the test plot site. A statement that the contractor shall use anomaly avoidance techniques shall be included. This is to ensure the location of each excavation and corner marker/stake is clear of metallic anomalies before placing seed items or site corner markers, and includes utilizing the background geophysical data.

h. Data Collection Variables. It is important to collect and analyze test plot data using the same equipment and procedures that are planned for field use. It is strongly recommended that key personnel from the IVS perform the production survey to minimize the learning curve and provide project continuity. Some data collection elements are subject to modification and evaluation and multiple geophysical surveys using each proposed geophysical instrument may be performed. These elements include: instrument height, instrument orientation and direction of travel, instrument channel selections, measurement interval along survey line, lane width, etc.

i. Data Analysis and Interpretation. All data collected from each geophysical instrument will be post-processed and analyzed. It is required that all data channels are analyzed to ensure the best methodology is established for each site.

j. Data Evaluation. The geophysical data must be evaluated so that different geophysical approaches can be compared and ranked. No single geophysical system is likely to achieve maximum scores in all evaluated areas. Therefore, the evaluation team must determine which approach is likely to be most efficient for the site.

<u>IVS Approval and Reporting.</u>

After the IVS field work has been completed, the contractor shall present the data to the Project Geophysicist and Project Manager, or the Project Manager's designee for approval prior to site work. The stationary positioning of the seed items must be shown relative to the data to provide comparison of the anomaly location with the seed item location to evaluate positional accuracy. The results of the IVS will be summarized in the geophysical report and will include:

a. As-built drawing of the IVS plot;
b. Pictures of the seed items;
c. Profile and/or contour maps of the geophysical data;
d. Summary of the IVS results and comparison of IVS data to response curves;
e. Proposed geophysical equipment, techniques, and methodologies; and
f. Sufficient supporting information to justify the project team's recommendations.

The Contractor may not proceed with production geophysical mapping until the designated project team member approves the IVS results.

9.0 BLIND SEEDING PROGRAM

Blind seeds are planted in site survey areas as an important QA procedure to test survey procedure effectiveness during site survey work (production). QC documentation should demonstrate pass/fail on seed detection. Failures should be documented after a root cause analysis has been performed. At a minimum, one blind seed per crew per day should be planted; however, more seeds may be judged more appropriate to reduce survey amount between seeds. A failure to detect a blind seed that is judged to be caused by faulty surveying will result in a repeat of data collection in that bad lot of data (between successfully detected blind seeds or from last detected blind seed) with blind seeds replaced in new locations along the repeat lot.

Blind seeds should be representative of expected target sizes for the project, and may include ISOs or inert munition items. Blind seeds are not intended to test the limits of detection, but rather to provide a simple check of survey function. Project QC documentation will include a table of blind seed descriptions, locations (including depths), and blind seed symbols plotted on top of survey data that can show data response with respect to blind seed location. Applicable horizontal accuracy requirements for this program will be outlined in the sampling and analysis plan.

Table 1: Geophysical Equipment QC Tests
Munitions and Explosives of Concern Sites
Military Munitions Response Program

Test No.	Test Description	Acceptance Criteria	Power On	Beginning of Day	Beginning, Middle and End of Day	1st Day on Site
1	Equipment Warm-up	Equipment Specific (typically 5 minutes)	X			
2	Equipment Null	Conduct in non-anomalous areas				X
3	Record Sensor Positions	± 2 inches (standard EM61/858), ±6 inches EM31				X
4	Personnel Test	EM61 2 mV p-p (channel 3 on MkII), magnetometer 2 nT, EM31 1 mS/m or ppt		X		
5	Static Background and Static Spike	Background: EM61 ± 3 mV p-p, magnetometer ± 5 nT, EM31 ±1 mS/m or ppt. Spike: ± 20% of standard item response, after background correction		X		
6	Base-Line Test	Check for instrument drift /diurnal ch. (to correct data readings if needed)			X (EM31 or MAG)	
7	Pull Away Test	Navigation equipment should have minimal effect on readings				X
8	GPS Positioning	Positional Accuracy: sub-mete		X		
9	Azimuth Test	Strong signal strength, no dropouts		X		

Notes: cm – centimeters, mV – millivolts, ppt – parts per thousand, nT – nanoteslas, mS/m – millisiemens per meter

TABLE 2: RELATED FIELD FORMS

Form Number	Frequency	Form Name
MRP FF.1	Once	Sap Worksheet No 4-Project Sign-Off
MRP FF.3	Daily	Daily Equipment Checklist
MRP FF.5	Daily	Daily Photographic Log
MRP FF.14	Daily	Geophysical Survey Field Forms
MRP FF.14.1	*Daily*	*Daily DGM Quality Control Report*
MRP FF.14.2	*Daily*	*DGM Instrument Verification Strip (IVS) Installation Checklist*
MRP FF.14.3	*Daily*	*DGM Daily IVS Checklist*
MRP FF.14.4	*Daily*	*DGM Initial Instrument Checklist*
MRP FF.14.5	*Daily*	*DGM Daily Instrument Checklist*
MRP FF.14.6	*As Needed*	*DGM Field Editing Checklist*
MRP FF.21	Daily	Daily Safety Log
MRP FF.22	Daily	Daily Tailgate Safety Briefing-Training Record Form

TETRA TECH
MRP FF.14.1
DAILY DGM QUALITY CONTROL REPORT

Facility/Location: _____

Site(s): _____

Project Number:	Date:
Personnel Present:	
List Features of Work and Equipment Used, Locations (areas surveyed)	
Rework Items Identified Today (Not Corrected by Close of Business)	Rework Items Corrected Today
Remarks/Describe any Idle or Downtime and/or Equipment Problems	
On behalf of the contractor, I certify that this report is complete and correct and the equipment and material used and work performed during this reporting period is in compliance with the contract drawings and specifications to the best of my knowledge except as noted in this report.	_____ ERT Representative Date
Tetra Tech Quality Assurance	
Quality Assurance Representative Remarks and/or Exceptions to the Report	
Inspection of Field Activities Performed	_____ Tetra Tech QA Representative Date

TETRA TECH

MRP FF.14.2

DGM INSTRUMENT VERIFICATION STRIP (IVS) INSTALLATION CHECKLIST

Facility/Location: _____

Site(s): _____

Project No:	**Date**:

I. Test Plot Information

Have survey objectives been determined, clarified, and documented?	Y	N	NA
Will the IVS be available during the project for the evaluation of suspected instrument malfunctions or evaluation of new equipment and operators?	Y	N	NA
Has surface clearance been performed?	Y	N	NA
Has background geophysical survey been performed before burial?	Y	N	NA
Measure depth to top and center of mass of each object?	Y	N	NA

Item No.	Inert Item/Surrogate Description	Depth (inches)	Azimuth/ Inclination Angle (Degrees)	GPSed (Y/N0	Expected Response Range (DGM)	Comment
1						
2						
3						
4						
5						
6						
7						

II. Instrument Information

Instrument Type/Manufacture	Instrument Serial Number	Measured Response (DGM)	Test Results - Initials of personnel Testing Equipment ☒ indicates good for operation				Comments (pass/fail) Explain below
			AM	AM	PM	PM	
			☐		☐		
			☐		☐		
			☐		☐		
			☐		☐		
			☐		☐		
			☐		☐		
			☐		☐		

III. Problems Encountered / Corrective Actions Taken.

explain in space below:

IV. Supervisor

Name and Signature:	**Title/Company**:	**Date**:

TETRA TECH

MRP FF.14.3

DGM DAILY IVS CHECKLIST

Facility/Location: _____

Site(s): _____

Project No:	**Date**:

I. Test Plot Information

Location: (See IVS Installation Checklist)

Item No.	Inert Item/Surrogate Description	Depth (inches)	Expected Response Range (DGM)	Comments
1				
2				
3				
4				
5				
6				
7				

II. Instrument Information

Instrument Type/ Manufacture	Instrument Serial Number	Measured Response (DGM)	GPS Monuments	Test Results,- Personnel Testing Equipment ☒ indicates good for operation				Comments
				AM	AM	PM	PM	
				☐		☐		
				☐		☐		
				☐		☐		
				☐		☐		
				☐		☐		
				☐		☐		
				☐		☐		
				☐		☐		
				☐		☐		
				☐		☐		

III. Problems Encountered / Corrective Actions Taken.
explain in space below:

IV. Supervisor

Name and Signature:	**Title/Company**:	**Date**:

TETRA TECH

MRP FF.14.4

DGM INITIAL INSTRUMENT CHECKLIST

Facility/Location: _____

Site(s): _____

Name and Title: _____

Date: _____

Has the sensor travel test been performed (for underwater surveys), and are the results acceptable to meet survey objectives?	Y	N	NA
Has the GPS unit been checked for accuracy requirements against two known locations?	Y	N	NA
Has the optimum sensor height for each instrument been determined?	Y	N	NA
Have the pull-away and/or interferences tests been performed and successfully demonstrated no influence for navigational or towing equipment?	Y	N	NA
Has an appropriate data acquisition rate been selected?	Y	N	NA

TETRA TECH
MRP FF.14.5
DGM DAILY INSTRUMENT CHECKLIST

Facility/Location: _____

Site(s): _____

Name and Title: _____
Date: _____

Has the operator been checked for presence of metal?	Y	N	NA
Has the instrument been warmed-up?	Y	N	NA
Have the sensor positions been measured and recorded?	Y	N	NA
Has a static background and spike test been performed successfully?	Y	N	NA
Has the equipment function test been performed with detection of all the test targets?	Y	N	NA
Have all loose cables been secured?	Y	N	NA
Has the EM61 or EM31 been nulled (power on)?			
Has the geophysical equipment been set up according to manufacturer's specifications?	Y	N	NA
Were the data monitored during data collection for anything unusual?	Y	N	NA

TETRA TECH
MRP FF.14.6
DGM FIELD EDITING CHECKLIST

Facility/Location: _____

Site(s): _____

Name and Title: _____
Date: _____

Have the following items been evaluated for correctness and edited if necessary:

Line numbers?	Y	N	NA
Start and end points?	Y	N	NA
Line direction?	Y	N	NA
Fiducial locations?	Y	N	NA

Have the data been examined for geophysical noise?	Y	N	NA
Have the data been examined for the presence of drop-outs and spikes?	Y	N	NA
Have the edited data been converted to the appropriate .xyz format?	Y	N	NA

If using magnetics, have the following steps been taken:

Examined base station data for any problems?	Y	N	NA
Performed diurnal correction to field magnetometer data?	Y	N	NA

Have the positional data been evaluated for accuracy and completeness?	Y	N	NA

STANDARD OPERATING PROCEDURE
MRP SOP 04
GEOPHYSICAL DATA PROCESSING AND ANALYSIS

1.0 SCOPE AND APPLICABILITY

This operating procedure is designed to provide a regular set of criteria to be taken into account during data processing and analysis for geophysical surveys performed as part of Munitions Response Programs (MRPs). The general procedure is intended to apply to a wide variety of investigations (targets).

2.0 BACKGROUND

The way in which data processing and analysis is performed is dependent on the type of geophysical method employed. We focus here on the two most common general methods used on MRP sites: magnetics or magnetometry (MAG) and electromagnetic induction (EMI). Initially data are recorded electronically during fieldwork and subsequently downloaded to computer. From there, specific equipment-related (proprietary) software is used to process the data for navigation, correction factors, filtering and ultimately for exporting data files that can be read by a data contouring package. The government has partnered with Geosoft, Inc. in order to develop a data contouring package specifically optimized for MRP geophysical data (Oasis Montaj w/UX Detect module). Contour maps or data profiles and dig sheets (anomaly locations) are normally produced as end products of the geophysical survey.

3.0 PERSONNEL QUALIFICATIONS

Personnel responsible for processing should possess education and training in geophysics to insure proper procedures are followed. Personnel will meet the requirements of USACE Data Item Description OE – 025.02 (USACE 2004) for a Project Geophysicist or for a Site Geophysicist that is directly under the supervision of the Project Geophysicist.

4.0 PROCESSING AND ANALYZING

Standard corrections will be applied to the data using equipment-specific (proprietary) software and by using Geosoft's Oasis Montaj software. Instrument settings and survey line spacing should be taken into account during data processing to properly represent the data. Diurnal corrections, corrections to navigation (geometry) and rotation or translation of coordinate systems, removal of data spikes (judged to be artificial) and dropouts, corrections for fiducial marks, instrument drift and leveling, heading error corrections, and latency corrections may be items to address during processing. Filtering and enhancements may also be needed depending on the nature or quality of the data.

The data analysis performed by the Project Geophysicist or under his/her direct supervision will focus on identifying anomaly responses that could represent MEC. A detailed map and anomaly investigation report will be produced [ex. dig sheet, Data Item Description MR-005-05.01 (USACE, 2007)] depicting the northing and easting of all anomalies that meet the identification

criteria of potential ordnance items for the site, and actual data stations locations will also be provided. Each anomaly will be assigned a unique reference number for potential field reacquisition.

STANDARD OPERATING PROCEDURE
MUNITIONS RESPONSE PROGRAM (MRP) SOP 05
GPS DATA COLLECTION AND TRANSFER

1.0 OVERVIEW

The primary purpose of this Standard Operating Procedure (SOP) is to provide the Field Technicians with basic instructions for operating a handheld Global Positioning System (GPS) unit allowing them to set GPS parameters in the receiver, record GPS positions on the field device, and transfer the data for integration into existing Geographic Information System (GIS) figures.

This SOP is specific to GIS quality data collection for Trimble-specific hardware and software.

If possible, the Trimble GeoXT or XH Operators Manual should be downloaded onto the operator's personal computer for reference before or while in the field. The manual can be downloaded at the following website:
http://trl.trimble.com/docushare/dsweb/Get/Document-311749/TerraSyncReferenceManual.pdf

Unless the operator is proficient in the setup and operation of the GPS unit, the Project Manager (or designee) should have the GPS unit shipped to the project-specific contact listed below in the Pittsburgh, Pennsylvania office at least five working days prior to field mobilization so project-specific data files (i.e. shape files), background images, data dictionaries, and correct coordinate systems can be uploaded into the unit.

Tetra Tech NUS
Attn: Ralph Basinski
661 Anderson Drive, Bldg #7
Pittsburgh, PA 15220

The SOP also describes how field collected data is to be transferred through the use of the MRP Website. (http://www.ttnus.com/MRPRepository/). This website serves as a centralized portal to facilitate data exchange for field personnel, GIS staff, and project managers. The website contains a "Reference" page that will contain the latest version of this SOP and other valuable documentation.

For general questions about this SOP, technical questions regarding operation of the GPS units and data collection, please contact Kevin Moore (kevin.moore@tetratech.com). For use of the MRP website, please contact Doug Schloer (douglas.schloer@tetratech.com).

2.0 REQUIRED EQUIPMENT

The following hardware and software should be utilized for locating and establishing GPS points in the field:

2.1 GPS Hardware & Equipment

- Hand-held GPS Unit capable of sub-meter accuracy. This includes the docking cradle, a/c adapter, stylus, and USB cable for data transfer. Two models, the GeoXH and GeoXT, are acceptable for use. The XH yields higher accuracy (in both real-time and post-processed) and **should always be requested** when highly precise data is required.

- An external antenna will yield better satellite reception, especially in heavy tree canopy. Associated accessories include a range pole and hardware clamp, for mounting the GPS unit to the pole.

- Indelible marker.

- Non-metallic pin flags for temporary marking of positions.

2.2 GPS Software

The following software is required to transfer data from the handheld GPS unit to a personal computer:

- Trimble TerraSync version 2.6 or later (pre-loaded onto GPS unit from vendor)

- Microsoft ActiveSync version 4.5 or later. Download to personal computer from:
  http://www.microsoft.com/windowsmobile/en-us/downloads/microsoft/activesync-download.mspx

  Note: Windows Vista and Windows 7 users should download Windows Mobile Device Center version 6.1 or later from the following site, if it is not already loaded on the machine:
  http://www.microsoft.com/windowsmobile/en-us/downloads/microsoft/device-center-download.mspx

- Trimble Data Transfer Utility (freeware version 2.1 or later). Download to personal computer from:
  http://www.trimble.com/datatransfer.shtml

3.0 START-UP PROCEDURES

Prior to utilizing the GPS in the field, ensure the unit is fully charged. The unit may come charged from the vendor, but an overnight charge is recommended prior to fieldwork.

The Geo-series GPS units require a docking cradle for both charging and data transfer. The Geo-series GPS unit is docked in the cradle by first inserting the far domed end in the top of the cradled, then gently seating the contact end into the latch. The power charger is then connected to the cradle at the back end using the twist-lock connector. Attach a USB cable as needed between the cradle (B end) and the laptop/PC (A end).

It is recommended that the user also be familiar and check various Windows Mobile settings. One critical setting is the Power Options. The backlight should be set as needed to conserve power when not in use.

3.1 Initial Start Up

1) Power on the GPS unit by pushing the small green button located on the lower right front of the unit.

2) Utilizing the stylus that came with the GPS unit, launch **TerraSync** from the Windows Operating System by tapping on the start icon located in the upper left hand corner of the screen and then tap on **TerraSync** from the drop-down list.

3) If the unit does not default to the Setup screen, tap the Main Menu (uppermost left tab, just below the Windows icon) and select Setup.

4) If the unit was previously shipped to the Pittsburgh office for setup, you can skip directly to Section 4.0. However, to confirm or change settings, continue on to Section 3.1.

3.2 Confirm Setup Settings

Use the Setup section to confirm the TerraSync software settings. To open the Setup section, tap the Main Menu and select Setup. (Note that if the unit was shipped from the Pittsburgh office, these settings should have been set for your specific project. Feel free to contact Pittsburgh staff with any questions.)

1) Tap on the Coordinate System.
2) Verify the project specs are correct for your specific project by scrolling through the various settings. Edit as needed and then tap OK; otherwise, tap Cancel to return to Setup Menu. **Note:** It is always best to utilize the Cancel tab rather than the OK tab if no changes are made since configurations are easily changed by mistake.
3) Tap on the Units.
4) Verify the user preferences are correct for your specific project by scrolling through the various settings. Edit as needed and then tap OK; otherwise, tap Cancel to return to Setup Menu.
5) Tap Real-time Settings.

6) Verify the Real-time Settings are correct for your specific project by scrolling through the various settings. Edit as needed and then tap OK; otherwise, tap Cancel to return to Setup Menu.
7) The GPS unit is now configured correctly for your specific project.

3.3 Antenna Connection

1) If a connection has been properly made with the internal antenna, a satellite icon along with the number of usable satellites will appear at the top of the screen next to the battery icon. If no connection is made (e.g.: no satellite icon), tap on the GPS tab to connect antenna.
2) At this point the GPS unit is ready to begin collecting data.

3.4 Loading a Background file

This section provides instructions on pulling in a pre-loaded background file. These files are helpful in visualizing your current location.

1) From the Main Menu select Map, then tap on Layers, select the background file from drop down list.
2) Select the project-specific background file from the list of available files.
3) Once the selected background file appears, the operator can manipulate the screen utilizing the +/- and <-/-> functions at the bottom of the screen.
4) In operating mode, the operator's location will show up on the background file as a floating "x".

4.0 FIELD DATA COLLECTION

For MRP data collection activities, a new GPS file should be created **every day** and transferred **nightly** using the MRP website (see Section 9.0). This is to insure the timely transfer of data, file organization in the database, and allow for next-day GIS mapping. Also, individual GPS data files should be **unique to a particular site** or unit (typically a UXO number). If multiple sites are visited in a single data, multiple files should be created.

4.1 Creating a Data File

1) From the Main Menu select Data.
2) From the Sub Menu (located below the Data tab) select New which will bring up the New Data File menu.
3) An auto-generated filename appears and should be edited for your specific project. For example, the following naming convention should be followed as closely as possible: **IH-UXO4-01012010-TeamA**, where "IH" is the installation abbreviation (Indian Head), "UXO04" is the site, and "01012010" is the data in MMDDYYYY format. If multiple teams are being deployed across an individual site on the same day, it is important to

specify the field team name at the end of the file name ("TeamA"). If the integral keyboard does not appear, tap the small keyboard icon at the bottom of the screen.

4) Select the data dictionary that will be used to collect features. The data dictionary provides predefined fields and drop-down menus to facilitate data collection as it relates to specific MRP data types. The MRP data dictionary is entitled "**MRP Data Collection**" and should appear in the data dictionary drop-down list. This should have been pre-loaded into the GPS prior to use. The data dictionary file is available on the MRP website under the "Reference" section.
5) After entering the file name and selecting the data dictionary, tap Create to create the new file.
6) Confirm antenna height if screen appears. Antenna height is the height that the GPS unit will be held from the ground surface (Typically 3 to 4 feet)
7) The Choose Feature screen appears.

4.2 Collecting Features

1) If not already open, the Collect Feature screen can be opened by tapping the Main Menu and selecting Data. The Sub Menu should default to Collect.
2) **<u>Do not</u> begin the data logging process until you are at the specific location for which you intend to log the data.**
3) A known reference or two should be shot at the beginning and at the end of each day in which the GPS unit is being used. This allows for greater accuracy during post-processing of the data.
4) Upon arriving at the specific location, select the proper feature type from the data dictionary list (MEP Object, Transect End Point, GPS QC Point, or General Point).
5) Tap Create to begin data logging.
6) As the GPS is collecting positions, enter the feature attributes, starting with the Item ID. This field is required and will not allow the user to continue or save the position without entering a value. Enter any additional notes or feature descriptions in the appropriate fields.
7) Data logging can be confirmed by viewing the writing pencil icon in the upper part of the screen. Also, the logging counter will begin. As a Rule of Thumb, accumulate a minimum of 20 readings on the counter, per point, as indicated by the logging counter before saving the GPS data.
8) Once the counter has reached a minimum number of counts (i.e. 20), tap on OK to save the data point to the GPS unit. Confirm the feature. All data points are automatically saved within the GPS unit.
9) Repeat steps 2 through 8, giving each data point a unique name or number.

Note: If the small satellite icon or the pencil icon is blinking, this is an indication the GPS unit is not collecting data. A possible problem may be too few satellites. While still in data collection mode, tap on Main Menu in upper left hand corner of the screen and select Status. Skyplot will display as the default showing the number of available satellites. To increase productivity (number of usable satellites) use the stylus to move the pointer on the productivity and precision line to the left. This will decrease precision, but increase productivity. The precision and productivity of the GPS unit can be adjusted as the number of usable satellites changes throughout the day. To determine if GPS is correctly

recording data, see Section 5.2. If the precision toggle is decreased, the user should frequently check the Skyplot display to restore the default values as soon as possible.

4.3 Navigation

This section provides instructions on navigating to saved data points in an existing file within the GPS unit.

1) From the Main Menu select Map.
2) Using the Select tool, pick the point on the map to where you want to navigate.
3) The location you select will have a box placed around the point.
4) From the Options menu, choose the Set Nav Target (aka set navigation target).
5) The location will now have double blue flags indicating this point is you navigation target.
6) From the Main Menu select Navigation.
7) The dial and data on this page will indicate what distance and direction you need to travel to reach the desired target.
8) Follow the navigation guide until you reach the point you select.
9) Repeat as needed for any map point by going back to Step 1.

4.4 Data Quality Control

Quality control checks should be performed each day of data collection and/or data navigation. QC checks are important both to understand real-time accuracy while in the field, and also to provide control data needed during post-processing.

1) Known survey benchmarks, surveyed monitoring wells, or other established and documented control points should be identified
2) GPS equipment should be placed on known control points and positions recorded
3) For data collection tasks - QC check data should be collected at least at the start and completion of the fieldwork for the day of data collection. Additional occupation and collection of control point data should occur as possible during the work day, and should increase in frequency as the number of data points increase and the need for accurate data collection increases
4) For navigation tasks such as stake placement for planned sample locations, QC data checks should be done at least at the start and completion of the fieldwork for each day. Known visible targets should be occupied and observed by the user, while the GPS satellite status and other user interface data is reviewed. The user should assess whether the real-time accuracy settings on the GPS are within the tolerance of the observed visual reference points.

4.5 Viewing Data or Entering Additional Data Points to the Current File

1) To view the stored data points in the current file, tap on the Main Menu and select Map. Stored data points for that particular file will appear. Use the +/- and <-/-> icons in lower left hand corner of screen to zoom in/out and to manipulate current view.
2) To return to data collection, tap on the Main Menu and select Data. You are now ready to continue to collect additional data points.

4.6 Viewing Data or Entering Data Points from an Existing File

1) To view data points from a previous file, tap on Main Menu and select Data, then select File Manager from the Sub Menu.
2) Highlight the file you want to view and select Map from the Main Menu.
3) To add data points to this file, tap on Main Menu and select Data. Continue to collect additional data points.

4.7 Shutting Down

This section provides instruction for properly shutting down the GPS unit.

1) When shutting down the GPS unit for the day, first click on the "X" in the upper right hand corner.
2) You will be prompted to ensure you want to exit TerraSync. Select Yes.
3) Power off the GPS unit by pushing the small green button located on the bottom face of the unit.
4) Place the GPS unit in its cradle to recharge the battery overnight. Ensure the green charge light is visible on the charging cradle.

5.0 DATA TRANSFER

This section describes how data should be downloaded from the GPS units and uploaded to a central website for post-processing and integration into GIS datasets. GPS data collected on a given day should be transferred **that night** for post-processing by GIS staff the next morning. Once post-processed, the GPS data will be plotted on a map and be immediately provided to the project team for review. Data upload, download, and review will be facilitated through a secure MRP website: http://www.ttnus.com/MRPRepository/

5.1 Load Data from the GPS Unit to Your Computer

1) Install the Data Transfer and ActiveSync software installed on your PC (see section 2.2)
2) Connect the GeoXH/XT to your PC via an A/B USB cable (blade end and square end type "HP printer" style)
3) ActiveSync should auto-detect the connection and recognize the data collector
4) Make sure the data file desired is CLOSED in TerraSync prior to transfer
5) Connect via ActiveSync as a guest (not a partnership)

6) Run the Trimble Data Transfer Utility program on your PC
7) Select "***GIS Datalogger on Windows CE***" or similar selection
8) Hit the green connect icon to the right - the far right area should say "***Connected to ....***" if successful
9) Select the "***Receive***" data tab (under device)
10) Select "***Data***" from file types on the right
11) Find the file(s) needed for data transfer. You can sort the data files by clicking on the date/time header
12) Select or browse to a C-drive folder you can put this file for upload
13) When the file appears on the list, hit the "***Transfer All***". Once complete, a packet of multiple data files will appear on your computer in the specified folder.

5.2 Gain Access to MRP Website

1) Confirm that your computer has internet access
2) Click on the following link: http://www.ttnus.com/MRPRepository/
3) To register for the website, click on the "Register here" link. Enter your information and click "Submit." NOTE: Requests for registration are sent to Ralph Basinski, Program Manager, for approval. Please contact doug.schloer@tetratech.com if you experience any access issues.
4) Enter your username (Tetra Tech email address) and password to log in.

5.3 Upload GPS Data from Your Computer to the MRP Website

1) From the main page, select "Upload" from the menu at left.
2) Select the type of data you are uploading, typically "GPS Field Data"
3) Select the appropriate Installation and Site. Remember that GPS files should be unique for each site, even if multiple sites are visited in one day. If collected data is not associated with a site, select "Other."
4) Select "browse" to navigate to the appropriate *.SSF file on your computer. When you use the Trimble download utility to grab data from the GPS unit, multiple files will appear on your computer. You only need to the upload the *.SSF file.
5) Populate the "Comments" field to describe the dataset and any other pertinent information. This information will be provided to the GIS analyst who will be integrating the dataset, so be sure to be as descriptive as possible especially if there are any issues with the data. (For example, if you were to sample 16 points and for some reason you believe only 15 were logged, it is helpful to share this information.)
7) Select "Upload." Users will be notified if the files were uploaded successfully.

5.4 Download Data from the MRP Website to Your Computer

The download utility on the MRP website will serve different user types. **Field staff** will use the utility to download GIS figures (in PDF format) and view the previous day(s) field data on aerial photographs, checking for any discrepancies or missing data elements. **Project Managers** will also have the ability to download and view these figures, to visualize the data and track project

progress. This utility will also allow **GIS Analysts** to download the *.SSF files posted by field staff for post-processing and map plotting.

To download GIS Figures:

1) From the main page, select "Download" from the menu at left.
2) Select an Installation and Site
3) Users can view Figures for a particular date or by a range of dates, by selecting the ` appropriate options. To search all dates, leave all of these fields as the default.
4) Select "Search"
5) A table will appear showing the files available for download. Simply click on the link to the file and you will be prompted to save it to your computer.

TABLE 1

Related Field Forms

Form Number	Frequency	Form Name
MRP FF.3	Daily	Daily Equipment Checklist

STANDARD OPERATING PROCEDURE
MRP SOP 06
VEGETATION MANAGEMENT AT MEC SITES

1.0 SCOPE AND APPLICABILITY

This document is designed to set a standard operating procedure (SOP) for vegetation management during activities performed at Munitions and Explosives of Concern (MEC) sites. Inherently, a strong possibility exists that MEC and material potentially presenting an explosive hazard (MPPEH) may be encountered. The procedures detailed in MRP SOP 01, UXO Detector-Aided Surface Surveys, provide specific guidance for UXO survey operations and equipment. MRP SOP 02, MEC Management and Accountability, provides instructions and procedures to be followed in the event that suspect MEC/MPPEH is encountered. Additionally, MEC activities will be performed in accordance with all local, State, and federal regulations and will include all applicable DoD requirements.

2.0 BACKGROUND

Vegetation management may be required in preparation for field activities at MEC sites. Trees, brush, grass, and other vegetation can impede the performance of MEC operations, geophysical surveys, and related investigation and remediation activities. The degree of vegetation removal will be site-specific and based upon the conditions encountered and activities to be conducted. Following is a general discussion of the type of equipment/techniques that will be used.

- Hand held brush cutters (string or blade) will be used to cut light vegetation and small grassy areas.
- Mechanized lawn mowers will be used to mow larger grassy areas.
- Chain saws will be used in heavier brush areas, to trim tree limbs, and to cut small trees up to 2 inches in diameter.
- Tractor-mounted brush hogs will be used in larger areas and heavier brush areas.
- Brush/vegetation cutting will be left at the site of the area cleared. If this is impractical, a wood chipper may be utilized.

Smaller brush cutting/vegetation management operation will be conducted by the Unexploded Ordnance (UXO) staff. On larger project sites, subcontractors may be utilized. If it is necessary to utilize subcontractors, an UXO escort will be provided during subcontracted brush/vegetation management operation.

3.0. PERSONNEL QUALIFICATIONS

UXO personnel shall meet the training requirements as stated in DDESB TP-18. Subcontractors will meet the training and medical surveillance requirements as stated in the Tetra Tech NUS Health and Safety Guidance Manual. Where applicable, vegetation management equipment will only be operated by personnel licensed or certified on that equipment.

4.0. VEGETATION MANAGEMENT

Vegetation management at MEC sites may range from minor grass cutting and tree limb trimming to the total removal of all site vegetation. The extent and methods of vegetation management are driven primarily by the project specific scope of work, but will also be influenced by such factors as munition sensitivity, terrain, impacts to the environment, threatened or endangered species, current and future land use, available technology, and cost.

Prior to conducting vegetation management operations, a visual UXO surface survey will be conducted. All suspect MEC/MPPEH will be located and marked. UXO avoidance will be practiced during vegetation management operations. Vegetation management crews will not work within marked areas containing suspect MEC/MPPEH. Additionally, brush and grass will be cut no closer than 6 inches from the ground surface to avoid inadvertent contact with partially buried or shallow subsurface MEC.

Site Setup

The boundary of the work area will be established by land survey or GPS coordinates. Corner points of grids and start and end points of transects will also be located. Boundary lines of grids and transect lines will be marked using engineers flagging tape to provide visual guidance for the vegetation management crew when line of sight between stakes or markers is impeded.

UXO Escort will be provided for survey personnel and no stakes or markers will be driven into the ground until the immediate area of the stake or marker is surveyed and declared clear of surface and shallow subsurface anomalies.

Tree Cutting

Tree cutting will occur on a case-by-case basis as required to accomplish the site-specific scope of work. Trees will be cut using chainsaws or hand tools. Generally, trees 2 inches in diameter and smaller will be cut as necessary to facilitate the planned site activities. Trees will be sectioned, if necessary, and removed from the immediate work area to avoid interfering with site operations.

Brush Cutting

Brush cutting will be accomplished using hand held brush cutters equipped with string or blade cutting attachments. Larger or heavier brush may require the use of

chainsaws. Where appropriate, a tractor or skid-steer with a bush hog mower attachment may also be used. Brush will be cut to a height that allows clearance for UXO operations and geophysical equipment operation but no closer than 6 inches above the ground surface.

Grass Cutting

Grass cutting will be accomplished using mechanized lawn mowing equipment or hand held brush cutters equipped with string attachments. Grass will be cut to a height that allows clearance for UXO operations and geophysical equipment operation but no closer than 6 inches above the ground surface.

Alternative Methods

In rare instances, large scale vegetation clearance methods such as controlled burning or hydraulic ax deforestation may be necessary. An UXO escort will be provided during large scale vegetation clearance operations. At no time will UXO staff directly engage in controlled burning operations or in the operation of hydraulic ax deforestation equipment.

5.0 VEGETATION DISPOSAL

Vegetation disposal must be coordinated with the facility environmental office. Provided that site activities do not result in significant quantities of material, the preferred method of vegetation disposal will be on-site disposal. Vegetation will be removed from the immediate work area to avoid interfering with site activities, and allowed to naturally decompose.

A wood chipper may also be used to effectively dispose of vegetation without removing the vegetation from the work site. Wood chips will be disposed of away from the immediate work area to avoid interfering with site activities when possible. If necessary, wood chips will be spread over the work site to a depth of no greater than 4 inches to avoid interference with detection depth capabilities of UXO and geophysics equipment.

6.0 SAFETY

General safety precautions are located in the Tetra Tech NUS Health and Safety Guidance Manual. Specific guidelines are located in the site-specific Health and Safety Plan (HASP) and the Accident Prevention Plan (APP).

Personal Protective Equipment (PPE)

PPE for vegetation management operations will be level D protection with the following additions:

- Logging helmet with attached face shield
- Chainsaw chaps

- Hearing protection
- Leather work gloves

Personnel Safety

The UXO Safety Officer (UXOSO) will be on-site at all times during vegetation management operations. The primary responsibilities of the UXOSO during vegetation management activities are:

- To provide a safety brief detailing the operation, safety, and maintenance of the specific equipment being utilized;
- To insure that MEC/MPPEH hazards remain a primary concern for personnel involved in vegetation management activities;
- To insure that PPE is serviceable and worn properly during vegetation removal activities; and
- To insure that individual personnel utilizing vegetation removal equipment maintain safe working distances from other personnel within the work area.

Additionally, an UXO Escort will be provided at all times during vegetation management activities. The UXO Escort will be utilized even when UXO Staff perform vegetation management. This will provide a more focused observation of the work area for MEC/MPPEH and related hazards.

Equipment Safety

Equipment will be inspected for serviceability daily prior to the commencement of vegetation management activities. Periodic spot checks will also be conducted throughout the day to insure that chains and blades remain properly tightened and sharpened. All equipment will be operated and maintained in accordance with the manufacturer's recommendations.

TABLE 1

Related Field Forms

Form Number	Frequency	Form Name
MRP FF.1	Once	Sap Worksheet No 4-Project Sign-Off
MRP FF.3	Daily	Daily Equipment Checklist
MRP FF.5	Daily	Daily Photographic Log
MRP FF.15	Daily	Daily QC Report
MRP FF.16	Once per Definable Feature	Preparatory Phase Inspection Report
MRP FF.17	Once per Definable Feature	Initial Phase Inspection Report
MRP FF.18	Periodic	Follow Up Phase Inspection Report
MRP FF.21	Daily	Daily Safety Log
MRP FF.22	Daily	Daily Tailgate Safety Briefing-Training Record Form
MRP FF.24	As Needed	Equipment Maintenance-Repair Form

STANDARD OPERATING PROCEDURE
MRP SOP 07
UXO DEMOLITION/DISPOSAL OPERATIONS

1.0 SCOPE AND APPLICABILITY

The purpose of this Standard Operating Procedure (SOP) is to provide the minimum procedures and safety and health requirements applicable to the conduct of demolition/disposal operations on sites contaminated with Munitions and Explosives of Concern (MEC). This SOP is not site-specific, but rather is intended as a general guidance document for a variety of sites and conditions.

2.0 BACKGROUND

This SOP applies to all site personnel, including contractor and subcontractor personnel, involved in the conduct of demolition/disposal operations on an MEC contaminated site. This SOP is not intended to contain all of the requirements needed to ensure complete compliance, and should be used in conjunction with project plans and applicable Federal, state and local regulations. Applicable sections and paragraphs in the documents listed below will be used as references for the conduct of demolition/disposal operations:

- Tetra Tech NUS, Inc. Corporate Safety and Health Program;
- EP 385-1-95a, Basic Safety Concepts and Considerations for OE Operations;
- EP 1110-1-17, Establishing a Temporary OB/OD Site for Conventional Ordnance and Explosives Projects;
- USACE EM 385-1-1, Safety and Health Requirements Manual;
- DoD 4145.26-M, Contractor's Safety Manual for Ammunition and Explosives;
- DoD 6055.9-STD, DoD Ammunition and Explosives Safety Standards;
- DA PAM 385-64, Ammunition and Explosives Safety Standards;
- TM 60A-1-1-31, EOD Disposal Procedures;
- AR 190-11, Physical Security of Arms, Ammunition and Explosives;
- ATF 5400.7, Alcohol Tobacco and Firearms Explosives Laws and Regulations; and
- Applicable sections of DOT, 49 CFR Parts 100 to 199.

3.0 PERSONNEL QUALIFICATIONS AND RESPONSIBILITIES

UXO personnel conducting explosive demolition and disposal operations shall be graduates of a military Explosive Ordnance Disposal (EOD) School of the United States, Canada, Great Britain, Germany, or Australia or a graduate of a formal training course of instruction or EOD assistant course as stated in DDESB TP-18.

3.1 UXO Project Manager

The UXO Project Manager (PM) shall be responsible for ensuring the availability of the resources needed to implement this SOP, and shall also ensure that this SOP is incorporated in plans, procedures and training for sites where this SOP is to be implemented.

3.2 Senior UXO Supervisor

The Senior UXO Supervisor (SUXOS) will be responsible for assuring that adequate safety measures and housekeeping are taken during demolition activities, and shall visit demolition locations to ensure that demolition operations are carried out in a safe, clean, efficient, and economical manner.

3.3 UXO Technician III (Demolition Supervisor)

A designated UXO Tech III shall act as the Demolition Supervisor (DS). There may be more than one DS assigned to a project site due to conducting simultaneous operations and divergent sites. The demolition activities shall be conducted under the direct control of the DS, who will have the responsibility of supervising all demolition operations assigned to him. The DS shall be responsible for training all on-site UXO demolition personnel on his team regarding the nature of the materials handled, the hazards involved, and the precautions necessary to conduct a safe demolition operation. The DS will also ensure that the Daily Operational Log/MEC Activity Log, Demolition Shot Records, and inventory records are properly filled and accurately depict the demolition events and demolition material consumption for each day's operations. The DS shall be present during all demolition operations.

3.4 UXO Safety Officer

The UXO Safety Officer (UXOSO) for the site is responsible for ensuring that all demolition operations are being conducted in a safe and compliant manner, and is required to be present during all demolition operations. The only exception to this rule is when the project site has multiple sites conducting concurrent munitions response (MR) operations, and it is impossible for the UXOSO to be present at each shot. In that event, a demolition team safety officer will be designated. This individual will report to the UXOSO and assume the UXOSO's responsibilities at the designated demolition operation. In this situation, the UXOSO will conduct periodic safety audits of the demolition teams and assist the demolition team's safety officers in the performance of their duties. The UXOSO or demolition team safety officer will inspect the demolition shot(s) for hazards and then assisted by the DS and UXO Tech IIs, will inspect each demolition pit and an area of up to 250 feet in radius after each demolition shot to ensure that no kick-outs of hazardous MEC components or other hazardous items has occurred.

3.5 UXO Quality Control

The UXO Quality Control Specialist (UXOQC) is responsible for inspecting, the Daily Operational Log/MEC Activity Log, the Demolition Shot Record, and the inventory of MEC and demolition material. The UXOQC will check the pit/demolition site with a magnetometer and large metal fragments exceeding the pass/fail requirements of the SOW will be removed.

4.0 GENERAL OPERATIONAL AND SAFETY PROCEDURES

All personnel, including contractor and subcontractor personnel, involved in operations on MEC contaminated sites shall be familiar with the potential safety and health hazards associated with the conduct of demolition/disposal operations, and with the work practices and control techniques used to reduce or eliminate these hazards. During demolition operations, general safety provisions listed below will strictly followed by all demolition personnel. Non-compliance with the general safety provisions will result in disciplinary action, to include termination of employment if warranted.

- All safety regulations applicable to BIP and/or demolition range activities and the destruction of MEC materials involved shall be complied with.

- Demolition of any kind is prohibited without the express authorization from the client.

- The quantity of MEC to be destroyed will be determined by the agreed to limit, with the net explosive weight (NEW) of the demolition explosives factored into the total NEW.

- In the event of an electrical storm, or heavy snow or dust storms, immediate action will be taken to cease all demolition operations and evacuate the area.

- In the event of a fire or unplanned explosion, if possible, put out the fire. If unable to do so, notify fire and police departments, and evacuate the area. If injuries are involved, remove victims from danger, administer first aid, and seek medical attention.

- The DS is responsible for reporting all injuries and accidents that occur to the UXOSO.

- Demolition team personnel will not tamper with any safety devices or protective equipment.

- Any defect in demolition material or an unusual condition that is not covered by this SOP will be reported immediately to the DS and UXOSO.

- Demolition procedures shall be conducted in accordance with this SOP and applicable references in Section 2.0.

- Adequate fire protection and first aid equipment shall be provided at all times.

- All personnel engaged in the destruction of MEC shall wear under and outer garments made of close-weave natural fiber, such as cotton. Synthetic material such as nylon is not authorized unless treated with anti-static material.

- Care will be taken to minimize exposure to the smallest number of personnel, for the shortest time, to the least amount of hazard, consistent with safe and efficient operations.

- Work locations will be maintained in a neat and orderly condition.

- All demolition hand tools shall be maintained in a good state of repair.

- Each heavy equipment and/or vehicle operator will have in his possession a valid operator's permit, i.e., state driver's license, certificate of training for backhoe/excavator etc.

- Leather or leather-palmed gloves will be worn when handling wooden boxes, munitions, or MEC. If bulk or binary explosives are being handled then rubber gloves, such as Nitrile, will be worn.

- Lifting and carrying require care. Improper methods cause unnecessary strains. Observe the following preliminaries before attempting to lift or carry:
    - When lifting, keep your arms and back as straight as possible, bend your knees and lift with your leg muscles; and
    - Be sure you have good footing and hold, and lift with a smooth, even motion.

- The demolition BIP location and/or range shall be provided with telephone and radio communication.

- Motor vehicles and material handling equipment (MHE) used for transporting MEC or demolition materials must meet the following requirements:
    - Exhaust systems shall be kept in good mechanical repair.
    - Lighting systems shall be an integral part of the vehicle.
    - One 20 BC rated portable fire extinguisher shall be, if possible, mounted on the vehicle outside of the driver's cab or two 10BC fire extinguishers, with one inside the cab and the other near the front portion of the vehicle bed, nearest the driver.
    - Wheels of carriers must be chocked and brakes set during loading and unloading.

- No demolition material or MEC shall be loaded into or unloaded from, motor vehicles while the engine is operating.

- Motor vehicles and MHE used to transport demolition material and MEC shall be inspected prior to use to determine that:
    - Fire extinguishers are filled and in good working order.
    - Electrical wiring is in good condition and properly attached.
    - Fuel tank and piping are secure and not leaking.
    - Brakes, steering and safety equipment are in good condition.
    - The exhaust system is not exposed to accumulations of grease, oil, gasoline, or other fuels, and has ample clearance from fuel lines and other combustible materials.

- A red warning flag, such as a "Bravo Flag", a windsock, or rag will be displayed at the entrance to the demolition range and, if applicable, the entrance gate shall be locked when demolition work is in process. This is only applicable if an open detonation (OD) range has been established with demo pits for all shots.

- Unless otherwise directed, all demolition shots will be tamped with a minimum of two feet of clean earth/dirt or the appropriate thickness of sand bags as indicated on the Fragmentation Data Review Form.

- An observer will be stationed at a location where there is a good view of the air and surface approaches to the demolition range before material is detonated. It shall be the responsibility of the observer to order the DS to suspend firing if any aircraft, vehicles or personnel are sighted approaching the general demolition area.

- Two-way radios shall not be operated while the shot is primed or during the priming process. The charts shown in Attachment 1 of this SOP shall be used for determining the safe distances from transmitter antennas.

- No Demolition operation will be left unattended during the active portion of the operation (i.e., during the burn or once any explosives or MEC are brought to the BIP location or range).

- A minimum area of 200 feet in diameter shall be cleared of dry grass, leaves, and other extraneous combustible materials around the demolition shot/pit area if a demolition range has been established. The area around the BIP location shall be free of any combustible material and wetted down if necessary.

- No demolition activities will be conducted if there is less than a 2,000-foot ceiling or if wind velocity is in excess of 20 mph.

- Demolition-shots must be fired during daylight hours (i.e., between 30 minutes after sunrise and 30 minutes before sunset).

- No more than two individuals shall ride in a truck transporting demolition material or MEC, and no one shall be allowed to ride in the trailer/bed.

- Vehicles shall not be refueled when carrying demolition material or MEC, and must be 100 feet from magazines or trailers containing such items before refueling.

- All vehicles used for the transport of explosives will be cleaned of visible explosive and other contamination before releasing the vehicles for other tasks.

- Prior to conducting any other task, personnel shall wash their face and hands after handling demolition material or MEC.

- At the demolition site, prior to “check-out” procedures, all blasting caps will be stored in approved containers (IME 22 or equivalent) and separated a minimum of 50 feet from all other explosives until they are needed.

- Demolition shots/pits shall be spaced at least 50 feet apart, with no more than 10 shots/pits prepared for a series of shots at any one time.

5.0 SPECIAL REQUIREMENTS FOR DEMOLITION

The following safety and operational requirements shall be followed during demolition operations. Any deviations from this procedure shall be allowed only after approval from the Tetra Tech UXO PM. Failure to adhere to the requirements and procedures listed in the paragraphs below could result in serious injury or death; therefore, complete compliance with these requirements and procedures will be strictly enforced.

5.1 General Requirements

The general demolition range/shot requirements listed below shall be followed at all times:

- Attachment 1 of this SOP, "Procedures for Demolition of Multiple Rounds (Consolidated Shots) on Ordnance and Explosives (OE) Sites," will be followed when destroying multiple munitions by detonation.

- Attachment 2 of this SOP, Use of Sandbags for Mitigation of Fragmentation and Blast Effects Due to Intentional Detonation of Munitions.

- Attachment 3 of this SOP, “Use of Water for Mitigation of Fragmentation and Blast Effects Due to Intentional Detonation of Munitions” may be used when fragmentation throws and fire is a concern.

- Items awaiting explosive destruction and demolition material shall be protected against accidental ignition or explosion from fragments, grass fires, burning embers or detonating impulses originating in materials being destroyed.

- MEC or bulk explosives, acceptable to move, and destroyed by detonation can be detonated in a pit not less than three feet deep and covered with earth which protrudes not less than two feet above existing ground level or IAW the Fragmentation Data Guide for the item which is to be detonated. The components should be placed on their sides or in a position to expose the largest area to the influence of the demolition material. The demolition material should be placed in intimate contact with the item to be detonated and held in place by tape or earth packed over the demolition materials. The total NEW to be destroyed below ground at one time shall not exceed the agreed to limit.

- Prevailing weather condition information will be obtained from the U.S. Weather Service and the data logged in the Demolition Shot Log before each shot or round of shots.

- All shots shall be dual primed.

- A minimum of 30 seconds will be maintained between each detonation.

- Detonations will be counted to ensure detonation of all shots. After each series of detonations, a search shall be made of the surrounding area for hazardous items. Items such as lumps of explosives or unfuzed ammunition may be picked up and prepared for the next shot. Fuzed ammunition or items that may have internally damaged components will be detonated in place, if possible.

- After each-detonation and at the end of each day's operations, surface exposed munitions debris, shall be recovered from the demolition site and disposed of in accordance with contracted procedures, as well as all applicable environmental regulations. All collected munitions debris metal will be 100% inspected for absence of explosive materials by demolition range personnel and certified by the SUXOS and the UXOQC.

- When operated in accordance with the conditions of this procedure the demolition shot should not present a noise problem to the surrounding community. However, if a noise complaint is received, the name, address and phone number of the complainant should be recorded and reported to the SUXOS, who in turn will report it to the UXO PM and Facility POC.

- Whenever possible, during excavation of demolition pits contour the ground so that runoff water is channeled away from the pits. If demolition operations are discontinued for more than two weeks, the pits should be back filled until operations resume.

- Upon completion of the project, all disturbed demolition areas will be thoroughly inspected for MEC. According to the SOW, the site may have to be leveled and seeded to establish a permanent vegetative cover to inhibit erosion. If necessary, this will be coordinated with the contractor representative. At a minimum, the holes/pits will be filled in and contoured.

- Prior to and after each shot, the Demolition Shot Record is to be filled out by the DS with all applicable information.

5.2 Electric Detonator Use

The following requirements are necessary when using electric detonators and blasting circuits:

- Electric detonators and electric blasting circuits may be energized to dangerous levels from outside sources such as static electricity, induced electric currents, and radio transmission equipment. Safety precautions will be taken to reduce the possibility of a premature detonation of an electric detonator and explosive charges of which they form a part. Demolition Team radios will not be operated while the pit/shot is primed or during the priming process.

- Demolition team members handling detonators will first ground themselves by bending down and touching the ground, which will discharge any static electricity.

- The shunt shall not be removed from the leg wires of the detonator until the continuity check.

- When uncoiling or straightening the detonator leg wires; keep the explosive ends of the detonator pointing away from the body and away from other personnel. When straightening the leg wires, do not hold the detonator itself; rather hold the detonator leg wires approximately one inch from the detonator body. Straighten the leg wires by hand, do not throw, or wave the wires through the air to loosen them.

- Prior to use, the detonators shall be tested for continuity. To conduct the test, place the detonators in a pre-bored hole in the ground or place them in a sand bag and walk facing away from the detonators and stretch the wires to their full length, or to 25 feet, whichever is less, being sure to not pull the detonators from the hole or sand bag. With the leg wires stretched to their full length, test the continuity of the detonators one at a time by un-shunting the leg wires and attaching them to the galvanometer and checking for continuity. After the test, re-shunt the wires by twisting the two ends together. Repeat this process for each detonator until all detonators have been tested. This process shall be accomplished at least 50 feet down wind from any MEC/demolition materials and out of the personnel and vehicle flow patterns. In addition, all personnel on the demolition range/shot shall be alerted prior to the test being conducted.

NOTE: When testing the detonator, prior to connecting the detonator to the firing circuit, the leg wires of the detonator must be shunted by twisting the bare ends of the wires together immediately after testing. The wires shall remain short circuited until time to connect them to the firing line.

- At the power source end of the blasting circuit, the ends of the firing line wires shall be shorted or twisted together (shunted) at all times, except when actually testing the circuit or firing the charge. The connection between the detonator and the circuit firing wires must not be made unless the power end of the firing wires are shorted and grounded or the firing panel is off and locked.

- The firing line will be checked using pre-arranged hand signals or through the use of two-way radios if the demolition pit/shot is not visible from the firing point. If radios are used, communication shall be accomplished a minimum of 50 feet from the demolition pit/shot and detonators. The firing line will be checked for electrical continuity in both the open and closed positions, and will be closed and shunted prior to connecting the detonator leg wires.

- MEC to be detonated or vented shall be placed in the demolition pit/shot and the demolition material placed/attached in such a manner as to ensure the total detonation and/or venting of the MEC. A section of detonation cord, time fuze, or Non-El shock tube will extend from the demolition material to a point outside the tamping material. Once the MEC and demolition material are in place and the shot has been tamped, the detonators will be connected to the demolition material. Prior to handling detonators that are connected to the firing line, personnel shall ensure that they once again ground themselves. The detonators will then be carried to the demolition pit/shot with the end of the detonators pointed away from the individual. The detonators are then connected to the detonation cord, Non-El, etc., ensuring that the detonator is not covered with tamping material to allow for ease of recovery/investigation in the event of a miss-fire.

- Prior to making connections to the blasting machine, the entire firing circuit shall be tested with a galvanometer for electrical continuity and ohmic resistance to ensure the blasting machine has the capacity to initiate the shot.

- The individual assigned to make the connections at the blasting machine or panel will not complete the circuit at the blasting machine or panel and will not give the signal for detonation until satisfied that all personnel in the vicinity have been evacuated to a predetermined distance. When in use, the blasting machine or its actuating device shall be in the blaster's possession at all times. When using the panel, the switch must be locked in the open position until ready to fire, and the single key must be in the blaster's possession.

- Prior to initiating a demolition shot(s), a warning will be given, the type and duration of such will be determined by the prevailing conditions at the

demolition range/shot. At a minimum, this should be an audible signal using a siren, air horn, or megaphone, which is sounded for 1 minute duration, 5 minutes prior to the shot and again 1 minute prior to the shot.

5.3 Detonating Cord Use

The following procedures are required when using detonating cord (det cord):

- Det cord should be cut using approved crimpers and only the amount required should be removed from inventory.

- When cutting det cord, the task should be performed outside the magazine.

- For ease of inventory control, only remove det cord in one-foot increments.

- Det cord should not be placed in clothing pockets or around the neck, arm or waist, and should be transported to the demolition location in either an approved "day box" or a cloth satchel, depending upon the magazine location and proximity to the demolition area.

- When ready to "tie in" either the det cord to demolition materials, or det cord to detonator, the det cord will be connected to the demolition material and secured to the MEC. The cord is then strung out of the hole/tamping material and secured in place with soil, being sure to leave a one-foot tail exposed outside the hole/tamping material.

- Once the hole is filled or tamping in place, make a loop in the det cord large enough to accommodate the detonator, place the detonator in the loop and secure it with tape. The detonator's explosive end will face down the det cord toward the demolition material or parallel to the main line.

- In all cases, ensure there is sufficient det cord extending out of the hole/tamping material to allow for ease of detonator attachment and detonator inspection/replacement should a misfire occur.

- If the det cord detonators are electric, they will be checked, tied in to the firing line and shunted prior to being taped to the loop as described above. If the det cord detonators are non-electric, the time/safety fuse will be prepared with the igniter in place prior to taping the detonators to the det cord loop. If the det cord detonators are Non-EI, simply tape the detonators into the loop as described above.

- In the event that a time/safety fuse is used, and an igniter is not available and a field expedient initiation system must be used (i.e., matches), do not split the safety fuse until the detonator is taped into the det cord loop.

5.4 Shock Tube Splicing Procedures

The high reliability of the shock tube initiating system is due to the fact that all of the components are sealed and unlike standard non-electric priming components, cannot be easily degraded by moisture. Cutting the shock tube makes the open end vulnerable to moisture and foreign contamination, therefore care must be taken to prevent moisture and foreign matter from getting in the shock tubes exposed ends. Some general rules to follow are listed below.

- After cutting a piece of shock tube, either immediately tie a tight overhand knot in one or both cut ends or splice one exposed end and tie off the other.
- Always use a sharp knife or razor blade to cut shock tube so as to prevent the tube from being pinched or otherwise obstructed.
- Always cut shock tube squarely across and make sure the cut is clean.
- Use only the splicing tubes provided by the manufacturer to make splices
- Every splice in the shock tube reduces the reliability of the priming system; therefore keep the number of splices to a minimum.

5.4.1 Shock Tube Assembly

Step 1. If you are using a new role of shock tube cut off the sealed end, dispose of the small piece IAW local laws as they relate to flammable material and proceed to the directions listed in Step 3. If you are using a pre-assembled shock tube/detonator assembly proceed to Step 1 in paragraph 5.4.2.

Step 2. If you are using a previously cut piece of shock tube, using a sharp knife or razor blade cut approximately 18 inches from the previously cut end, whether or not it was knotted IAW the above guidance. Dispose of the 18-inch piece of shock tube IAW local regulations.

Step 3. Using a sharp knife or razor cut the sealed end off of the detonator assembly and dispose of the small piece as above.

Step 4. Loosely tie the two shock tube ends to be sliced together in a square knot, leaving at least a two-inch free end of each end of the shock tube beyond the knot. Push the shock tube lightly to tighten the knot, but not so tight as to significantly deform the shock tube.

Step 5. Push one of the shock tube ends to be spliced firmly into one of the precut splicing tubes provided by the manufacturer, at least ¼ inches. Push the other shock tube end firmly into the other end of the splicing tube at least ¼ inches.

Step 6. Spool out the desired length of shock tube and cut it off with a sharp knife or razor blade.

Step 7. Immediately seal off the shock tube remaining on the spool by tying a tight overhand knot in the cut off end.

5.4.2 Firing Assembly Setup

Step 1. Lay out the required length of shock tube from demo area to firing point.

Step 2. If there are multiple items to be destroyed using bunch block(s), supplied by the manufacturer, lay out lead lines at demo site to the shot(s) and secure the bunch block with a sandbag, or some other item which will keep it from moving. Figure 1 illustrates the procedure.

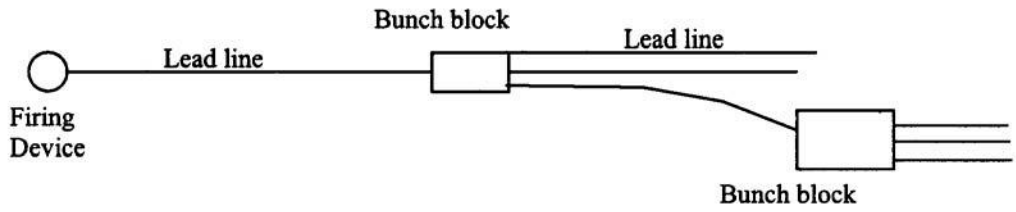

Figure 1

Note: No more than six leads may be used from any one bunch block.

Step 3. If the detonator assembly has not been attached yet then using the splicing tube, splice the detonator assembly to the shock tube lead line as explained in the splicing instructions above.

Step 4. If this is a non-tamped shot place the detonator assembly into the demolition material. If the shot is to be tamped then prepare the demolition material with a detonating cord lead long enough to stick out of the tamping at least one foot.

Step 5. Tape the detonator assembly to the detonating cord lead as shown in Figure 2.

Step 6. Clear the area IAW the approved demolition plan, return to the firing position.

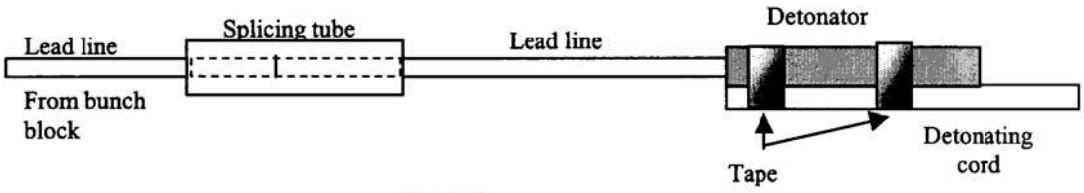

Figure 2

Step 7. Insert a primer into the firing device and connect the shock tube lead line to the firing device ensuring that the shock tube is properly seated in the firing device.

Step 8. Proceed IAW the approved demolition procedures.

5.5 Time/Safety Fuse Use

The following procedures are required when using a time/safety fuse:

- Prior to each daily use, the burn rate for the time/safety fuse must be tested to ensure the accurate determination of the length of time/safety fuse needed to achieve the minimum burn time of five minutes needed to conduct demolition operations.

- To ensure both ends of the time/safety fuse are moisture free, use approved crimpers to cut 6 inches off the end of the time/safety fuse roll and place the 6 inch piece in the time/safety fuse container.

- If quantity allows, accurately measure and cut off a 6 foot long piece of the time/safety fuse from the roll, and take the six-foot section out of the magazine and attach a fuse igniter.

- In a safe location, removed from demolition materials and MEC, ignite the time/safety fuse, measure the burn time from the point of initiation to the "spit" at the end, and record the burn time in the DS's Log.

- To measure the burn time, use a watch with a second hand, stopwatch, or chronograph.

- To calculate the burn rate in seconds per foot, divide the total burn time (in seconds) by the length (in feet) of the test fuse.

- Whenever using time/safety fuse, for demolition operations, the minimum amount of fuse to be used will be the amount needed to permit a minimum burn time of five minutes.

5.6 Perforator Use

The following procedures are required when using perforators:

- Only remove from inventory the number of perforators required to perform the task.

- Transport perforators in an approved "day box", cloth satchel or plastic container, depending upon magazine location and proximity to the demolition operations.

- When ready to use, place the det cord through the slot on the perforator and knot the det cord, ensuring the cord fits securely and has good continuity with the perforator.

- Once the det cord is secure, place the perforator in the desired location and secure it in place.

- Proceed from this point as described in paragraph 5.3.

5.7 Use of Two-Component Explosives

The following procedures are required when using two-component (binary) demolition materials:

- Only remove from inventory the amount of two-component required to perform the task.

- When transporting the solid and liquid, they need only be placed apart in the bed of a truck.

- Do not mix the solid and liquid components until certain that it will be used, since the resulting mixture is classified as a Class 1.1 explosive by Department of Transportation.

- When mixing the solid and liquids components, follow the manufacturer's instructions, while being sure to wear rubber gloves and goggles. Mix components in an area away from other demolition materials, the MEC, and if possible, sheltered from the wind.

- Once the components have been mixed, it is essential that the lid to the solid bottle be put on securely as soon as possible after mixing to prevent evaporation of the liquid.

- Attach the det cord as recommended by the manufacturer, place the assembled unit in the desired location in the hole/shot and secure the unit.

- Proceed from this point as described in paragraph 5.3.

5.8 Demolition Range/BIP Inspection Schedule

The demolition range/BIP inspection schedule outlined in Table 5-1 will be followed at all sites where demolition operations are being conducted. This inspection shall be conducted by the UXOSO and will be documented in the Site Safety Log. If any deficiencies are noted, demolition operations shall be suspended and the deficiency reported to the SUXOS and DS. Once the deficiencies are corrected, demolition operations may be resumed.

Table 5-1 - Demolition Range Inspection Schedule

Check List Item	Inspection Schedule	Check List Item	Inspection Schedule
Site and Explosive Carrier Vehicle	Weekly or Prior to Use	Personal Protective Equipment	Prior to Use
Range Access/Egress Route	Weekly or Prior to Use	Circuit Testing Device	Prior to Use
Entrance Gate/Lock	Weekly or Prior to Use	Demolition Site	Prior to Use
Storage Trailer/Magazine	Daily, Prior to Use and After Use	Operating Equipment	Prior to Use
Fire Extinguishers	Daily, Prior to Use and After Use	Hospital Route	Prior to Use

6.0 METEOROLOGICAL CONDITIONS

In order to control the effects of demolition operations and to ensure the safety of site personnel, the following meteorological limitations and requirements shall apply to demolition operations:

- Demolition operations will not be conducted during electrical storms or thunderstorms.
- No demolition operations shall be conducted if the surface wind speed is greater than 20 miles per hour.
- Demolition operations will not be conducted during periods when visibility is less than 1 mile caused by, but not limited to, dense fog, blowing snow, rain, sand or dust storms.
- Demolition shall not be carried out on extremely cloudy days that are defined as: overcast (more than 80% cloud cover) with a ceiling of less than 2,000 feet.
- Demolition operations will not be conducted during any atmospheric inversion condition (low or high altitude).
- Demolition operations will not be conducted during periods of local air quality advisories.
- Demolition operations will not be initiated until 30 minutes after sunrise, and will be secured at least 30 minutes prior to sunset.

7.0 PRE-DEMOLITION/DISPOSAL PROCEDURES

7.1 Pre-Demo/Disposal Operational Briefing

The DS will brief all personnel involved in range/shot operations in the following areas:

- Type of MEC being destroyed.
- Type, placement, and quantity of demolition material being used.
- Method of initiation (electric, non-electric or Non-EI).
- Means of transporting and packaging MEC, if applicable.
- Route to the disposal site.
- Emergency procedures.
- Equipment being used (i.e., galvanometer, blasting machine, firing wire, etc.).
- Misfire procedures.
- Post shot clean up of range.

7.2 Pre-Demo/Disposal Safety Briefing

The UXOSO and DS will conduct a safety brief for all personnel involved in range operations in the following areas:

- Care and handling of explosive materials.
- Personal hygiene.
- Two-man rule and approved exceptions.
- Potential trip/fall hazards.
- Horseplay on the range.
- Stay alert for any explosive hazards.
- Location of emergency shelter (if available).
- Vehicle parking (vehicles must be oriented out of the site for immediate departure, with keys in the ignition).
- Location of emergency vehicle (keep engine running).
- Wind direction (to assess potential toxic fumes).
- Location of first aid kit and fire extinguisher.
- Route to nearest hospital or emergency aid station.
- Type of communications in event of an emergency.
- Storage location of demolition materials and MEC awaiting disposal.

7.3 Task Assignments

Individuals with assigned tasks will report the completion of the task to the DS. The types of tasks that may be required are:

- Contact local Police, Fire department, USCG and FAA as required.
- Contact hospital/emergency response personnel if applicable.
- Secure all access roads to the range/shot area.
- Visually check range/shot area for any unauthorized personnel.
- Check firing wire for continuity and shunt.
- Prepare designated pits/shots as required.
- Check continuity of detonators.
- Check time/safety fuse and its burn rate.
- Designate a custodian of the blasting machine, fuse igniters or Non-EI initiator.
- Secure detonators in a safe location.
- Place MEC in pit, if applicable, and place charge in desired location.

7.4 Preparing Explosive Charge for Initiation

To prepare the explosive charge for initiation, the procedures listed below will be followed:

- Ensure firing wire is shunted.
- Connect detonator to the firing wire.
- Isolate or insulate all connections.
- Prime the demolition charge.
- Place demolition charge on MEC.
- Depart to firing point (if using non electric firing system, obtain head count, pull igniters and depart to designated safe area).
- Obtain a head count, and test blast machine for proper operation.
- Give 1-minute duration warning signal, using a bullhorn or siren, 5 minutes prior to detonation, and again at 1 minute prior to detonation.
- Check the firing circuit with a galvanometer.
- Yell "fire in the hole" three times (or an equivalent warning) and take cover.
- If using electric firing system connect firing wires to blasting machine and initiate charge.
- Remove firing wires from blasting machine and shunt.
- Remain in designated safe area until DS announces "All Clear". This will occur after a post-shot waiting period of 5-minutes and the UXOSO has and inspected the pit(s)/shot(s).

8.0 POST DEMOLITION/DISPOSAL PROCEDURES

Do not approach a smoking hole or allow personnel out of the designated safe area until cleared to do so, and follow the below listed procedures:

- After the "All Clear" signal, check pit/shot for low orders or kick outs.
- Check pit with a magnetometer and remove any large fragmentation.
- Any MEC items, failing to be properly disposed of, discovered during the post demolition procedures, will be destroyed prior to the end of the day.

- Back fill hole as necessary.
- Secure all equipment.
- Notify police, fire, etc. that the operation is complete.

9.0 MISFIRE PROCEDURES

A thorough check of all equipment, firing wire and detonators will prevent most misfires. However, if a misfire does occur, the procedures outlined below shall be followed.

9.1 Electric Misfires

To prevent electric misfires, one technician will be responsible for all electrical wiring in the circuit. If a misfire does occur, it must be cleared with extreme caution, and the responsible technician will investigate and correct the situation, using the steps outlined below:

- Check firing line and blasting machine connections and make a second initiation attempt.
- If unsuccessful, disconnect and connect to another blasting machine (if available) and attempt to initiate charge.
- If unsuccessful, commence a 60-minute wait period.
- After the maximum delay predicted for any part of the shot has passed, the UXOSO will proceed down range to inspect the firing system, and a safety observer must watch from a protected area.
- Disconnect and shunt the detonator wires from the leg wires, connect a new detonator to the firing circuit, check the replacement detonator for continuity, and prime the charge without disturbing the original detonator.
- Follow normal procedures for effecting initiation of the charge.

9.2 Non-Electric Misfires

Working on a non-electric misfire is the most hazardous of all operations. Occasionally, despite all painstaking efforts, a misfire will occur. Investigation and corrective action should be undertaken only by the technician that placed the charge, using the following procedure:

- If charge fails to detonate at the determined time, initiate a 60-minute wait period plus the time of the safety fuse, i.e., 5-minute safety fuse plus 60 minutes for a total of 65 minutes.
- After the wait period has expired, the designated technician will proceed down range to inspect the firing system. A safety observer must watch from a protected area.
- Prime the shot with a new non-electric firing system and install a new fuse igniter.
- Follow normal procedures for initiation of the charge.

9.3 Non-EL Misfire The most common cause of misfires is known as "black tube failure"

The shock tube propagates up to the detonator but the detonator fails to function, or there is a crimp in the line causing the shock wave to be interrupted. The following steps will be taken in the event of a misfire:

- If the shock tube fails to propagate and the tube remains clear, remove the shock tube from the firing device, cut off 6 inches of the shock tube, insert a new primer, reinsert the shock tube ensuring that it is properly seated and re-fire. If when you activate the firing device and the shock tube is blown out of the firing device without activating, cut off 6 inches of the shock tube, replace the primer and re-insert the shock tube into the firing device.

- If the primer functioned properly and the shock tube was heard or seen to fire, observe the standard 1 hour waiting period prior to going downrange.

- After the 1 hour waiting period has passed, proceed downrange and check the first component in the priming train i.e. splice, bunch block or detonator assembly. Repeat this process until you reach the detonator assembly. As you conduct this inspection and discover the problem, replace the firing train, which functioned (tube is no longer clear) with a new one and ensure that all the connections are correct and secure.

- After the system has been checked and repaired/replaced return to the firing point and repeat the firing process.

9.4 Detonating Cord Misfire

Det cord may be used to tie in multiple demolition shots and to ensure that electric detonators are not buried. Since det cord initiation will be either electrical or non-electrical, the procedures presented in paragraphs 9.1, 9.2, or 9.3, as appropriate to the type of detonator used, will be used to clear a det cord misfire. In addition, the following will be followed:

- If there is no problem with the initiating system, wait the prescribed amount of time and inspect the initiator to the cord connection to ensure it is properly connected. If it was a bad connection, simply attach a new initiator and follow the appropriate procedures in paragraph 6.0.

- If the initiator detonated and the cord did not, inspect the cord to ensure it is det cord and not time fuze. Also, check to ensure there is PETN in the cord at the connection to the initiator.

- It may be necessary to uncover the det cord and replace it. This must be accomplished carefully to ensure that the demolition charge and the MEC item are not disturbed.

9.5 Perforator Misfire

The use of perforators is considerably safer than the use of C-4 and many other demolition materials. If the perforator is not initiated properly, it could malfunction. Since the perforator is covered with tamping material, det cord is used as the initiator. Therefore, in the event of a misfire, the procedures presented in paragraph 9.4 will be followed, along with the items presented below:

- If everything went but the perforator, one of four things has occurred:

1. Det cord grain size was insufficient to initiate the perforator;

- Check to ensure the grain size of the det cord is sufficient, with 80-grain size or greater being the recommended size.

2. The det cord was dislodged from the perforator when placing tamping materials;

- If the det cord connection to the perforator was the problem, ensure that the next connection is secured (use duct tape if necessary).

3. The perforator was defective;

4. The perforator was moved during the placement of tamping materials.

- If it is evident that the perforator was moved, ensure it is properly secured for the next shot.
- If cord size and connection are sufficient, replace the perforator, leaving the defective one on the shot.

10.0 RECORD KEEPING REQUIREMENT

To document demolition operations and the destruction of MEC, the following record keeping requirements shall be met:

- Tetra Tech will obtain and maintain all required permits.

- The DS will ensure the accurate completion of the logs, and the SUXOS and UXOQCS will monitor the entries in the log for completeness, accuracy, and compliance with meteorological conditions.

- The DS shall enter the appropriate data on the Demolition Shot Record, to reflect the MEC destroyed, and shall complete the appropriate information on the Magazine Data Card, which indicates the demolition materials used.

- The quantities of MEC recovered must also be the quantities of MEC destroyed or disposed of as munitions debris or munitions constituents.

- Tetra Tech and/or its subcontractors will retain a permanent file of all Demolition Records, including permits, Magazine Data Cards, training records, inspector reports, waste manifests if applicable, and operating logs.

- Copies of ATF License and any state or local permits must be on hand.

Table 10-1
Related Field Forms

Form Number	Frequency	Form Name
MRP FF.1	Once	Sap Worksheet No 4-Project Sign-Off
MRP FF.2	Daily	Daily MEC Activity Log
MRP FF.5	Daily	Daily Photographic Log
MRP FF.10	Daily	MEC Accountability Form
MRP FF.21	Daily	Daily Safety Log
MRP FF.22	Daily	Daily Tailgate Safety Briefing-Training Record Form

11.0 SAFETY AND PPE REQUIREMENTS

The following safety measures and personal protective equipment shall be used in preventing or reducing exposure to the hazards associated with MEC demolition/disposal operations. These requirements will be implemented unless superseded by site-specific requirements stated in the Accident Prevention Plan (APP):

- Steel-toed safety boots will not be worn by demolition team personnel conducting demolition/disposal operations, unless a toe crush hazard exists, in which case personnel will wear boots with plastic or fiber toed safety toes;

- Unless a serious head, eye or face hazard exists, demolition team personnel will not be required to wear hard hats, safety glasses or face shields when conducting operations involving the handling of demolition explosives or MEC, except as stated previously; and

- In the event that a serious head, eye or face hazard does exist, demolition team personnel will wear the required PPE, but positive restraining means shall be required to secure the PPE to the head, face etc. and prevent it from falling and causing an accidental detonation.

12.0 AUDIT CRITERIA

The following items related to demolition/disposal operations on an MEC contaminated site will be audited to ensure compliance with this SOP:

- The Demolition Shot Record
- The Site Daily Operational and Safety Logs;
- The MEC Operations Daily/Weekly Report;
- The Safety Training Attendance Forms, for the initial site hazard training;
- The Safety Training Attendance Forms, for the Daily Tailgate Safety Briefings;
- The Daily Safety Inspection and Audit Log.

13.0 ATTACHMENTS

The following attachment to this SOP will be reviewed by all UXO-qualified personnel participating in demolition/disposal activities.

- Attachment 1 "Procedures for Demolition of Multiple Rounds Consolidated Shots on Ordnance and Explosives (OE) Sites"

- Attachment 2 Use of Sandbags for Mitigation of Fragmentation and Blasts Effects due to Intentional Detonation of Munitions (HNC-ED-CS-S-98-7)

- Attachment 3 Use of Water for Mitigation of Fragmentation and Blasts Effects due to Intentional Detonation of Munitions (HNC-ED-CS-S-00-3)

US Army Corps of Engineers
Engineering and Support Center, Huntsville

Procedures for Demolition of Multiple Rounds (Consolidated Shots) on Ordnance and Explosives (OE) Sites

AUGUST 1998 (Terminology Update March 2000)

DEPARTMENT OF DEFENSE EXPLOSIVES SAFETY BOARD
2461 EISENHOWER AVENUE
ALEXANDRIA, VIRGINIA 22331-0600

OCT 27 1998

DDESB-KO

MEMORANDUM FOR DIRECTOR US ARMY TECHNICAL CENTER FOR EXPLOSIVES SAFETY (ATTENTION: SIOAC-ES)

SUBJECT: Procedures for Demolition of Multiple Rounds (Consolidated Shots) on Ordnance and Explosives Sites

References: (a) Memorandum from SIOAC-ESL to Chairman DDESB (ATTN: DDESB-KO), 14 September 1998, SAB

(b) M. Crull and Wayne Shaw, US Army Corps of Engineers, Huntsville, "Procedures for Demolition of Multiple Rounds (Consolidated Shots) on Ordnance and Explosives (OE) Sites" (August 1998)

The subject procedures forwarded by reference (a) and defined in reference (b) have been reviewed with respect to explosives safety criteria. Based on the information furnished, the procedures proposed in reference (b) for the demolition of consolidated ordnance at OE sites are approved.

Point of contact is Dr. Chester E. Canada, DDESB-KT2 (PH: 703-325-1369, FAX: 703-325-6227, E-MAIL: canadce@hqda.army.mil).

for DANIEL T. TOMPKINS
Colonel, USAF
Chairman

Procedures for Demolition of Multiple Rounds (Consolidated Shots) on Ordnance and Explosives (OE) Sites

August 1998

Prepared By

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Reviewed by: _____ 8/27/98
Chief, Structural Branch — Date

Reviewed by: _____ 8/27/98
Chief, Civil-Structures Division — Date

Reviewed by: _____ 8/27/98
Chief, OE Center of Expertise — Date

Reviewed by: _____ 8/31/98
Chief, Ordnance & Explosives Team — Date

Reviewed by: _____ 8/31/98
Chief, OE Safety — Date

FOREWORD

The terminology in this report has been updated (March 2000) to reflect terminology used in the field. Specifically the term “personnel separation distance” has been replaced with the term “minimum separation distance for intentional detonations.” This is a change in terminology only, no change in content.

Per discussions with Dr. Chester Canada, Department of Defense Explosives Safety Board (DDESB) and Mr. Cliff Doyle, U.S. Army Technical Center for Explosives Safety (USATCES) this report is not re-submitted to the DDESB for approval.

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1.0 Introduction

The U.S. Army Engineering and Support Center, Huntsville (USAESCH) includes the Ordnance and Explosives Center of Expertise (OE-CX). Part of the OE-CX mission is development of procedures for removal and destruction of munitions found on OE sites. Standard procedures are to destroy the munitions by detonation on site. This includes both single round detonation in-place and multiple round detonation (or consolidated shots) at a pre-determined location. The procedures for multiple round detonation are described in this paper.

There are two situations that may describe the consolidated shot process: 1) munitions may be collected from anywhere on site and detonated at a designated, sited disposal area or 2) munitions may be collected within a grid and detonated at a designated spot within the grid. In either situation the same procedures, as described in the following paragraphs, must be followed.

2.0 Placement of Munitions

Munitions shall be placed with their sides touching such that their axis is horizontal as shown in Figure 1. The munitions shall be placed so that the nose of each munition is pointing in the same direction. Munitions shall be oriented so that lugs and/or strong-backs, and nose and/or tail plate sections are facing away from personnel locations.

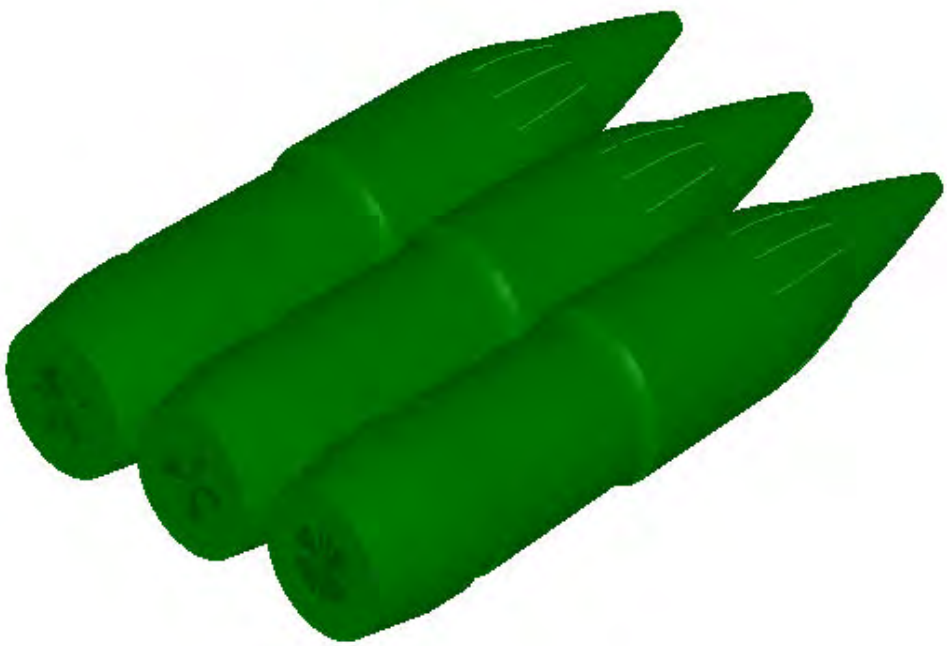

Figure 1 – Placement of Munitions for Consolidated Shots

3.0 Minimum Safe Separation Distance for Intentional Detonations

3.0.1 This document covers procedures for intentional detonations only.

3.0.2 In accordance with DoD 6055.9-STD Chapter 5 paragraph E.4.a(2), the minimum safe separation distance for all personnel will be the greater of the overpressure distance or the appropriate fragment range as determined by the maximum fragment range or the mitigated fragment range.

3.1 Overpressure Distance

In accordance with DoD 6055.9-STD Chapter 5 paragraph E.4.a(2), the allowable overpressure distance will be determined as the scaled distance, K328, based on the total net explosive weight (NEW) of all munitions plus the initiating explosives.

3.2 Fragment Criteria

3.2.1 Maximum Fragment Range

The maximum fragmentation characteristics shall be computed in accordance with HNC-ED-CS-S-98-1. The maximum fragment range shall be computed using these fragmentation characteristics with a trajectory analysis such as the computer software TRAJ. The maximum fragment range shall be the maximum fragmentation distance computed for the most probable munition (MPM) for an OE area at a site, and this shall be the maximum fragment range for a consolidated shot.

3.2.2 Fragment Mitigation

Fragment mitigation may be provided by an appropriate Department of Defense Explosives Safety Board (DDESB) approved engineering control. Typical engineering controls for intentional detonation include tamping and sandbags. The design of such an engineering control shall be based on the maximum fragmentation characteristics of the MPM. The NEW used for the design of the engineering control shall be the total NEW of all munitions plus the initiating explosives. Engineering controls not already approved by DDESB may be submitted (along with appropriate technical data) as part of a site specific explosive safety submission for use at that site. Engineering controls will not be put into use until approved by DDESB and specific applications verified by the appropriate agency; for example, the OE-CX verifies applications for U.S. Army Corps of Engineers.

4.0 Initiation

The consolidated shot shall be initiated in such a manner that detonation of all munitions is simultaneous.

5.0 References

DoD 6055.9-STD, “Department of Defense Ammunition and Explosives Safety Standards”, August 1997.

HNC-ED-CS-S-98-1, Methods for Predicting Primary Fragmentation Characteristics of Cased Explosives, January 1998.

Memorandum, DDESB, DDESB-KO, 27 January 1998, subject: Guidance for Clearance Plans.

US Army Corps of Engineers
Engineering and Support Center, Huntsville

Use of Sandbags for Mitigation of Fragmentation and Blast Effects Due to Intentional Detonation of Munitions

HNC-ED-CS-S-98-7
AUGUST 1998

DEPARTMENT OF DEFENSE EXPLOSIVES SAFETY BOARD
2461 EISENHOWER AVENUE
ALEXANDRIA, VIRGINIA 22331-0600

DDESB-KO

23 February 1999

MEMORANDUM FOR DIRECTOR US ARMY TECHNICAL CENTER FOR EXPLOSIVES SAFETY (ATTENTION: SIOAC-ES)

SUBJECT: Use of Sandbags for Mitigation of Fragmentation and Blast Effects Due to Intentional Detonations of Munitions, Report HNC-ED-CS-S-98-7 (August 1998)

References: (a) SIOAC-ESL memorandum, dated 30 Nov 98, same subject

(b) Joseph M. Serena and Michelle Crull, "Use of Sandbags for Mitigation of Fragmentation and Blast Effects Due to Intentional Detonations of Munitions, Report HNC-ED-CS-S-98-7," (August 1998)

The subject site plan forwarded by reference (a) has been reviewed with respect to explosives safety criteria. The site plan addresses the use of sandbags, IAW reference (b) to mitigate hazards and protect personnel from intentional detonations of munitions up to the 155-mm M107. Based on the information furnished, the proposed use of sandbags for intentional detonations at ordnance and explosives (OE) sites, IAW reference (b) is approved.

A copy of this site plan package and this letter of approval must be available at OE sites where intentional detonations are conducted that use procedures of this siting package.

Point of contact is Dr. Chester E. Canada, DDESB-KT2 (PH: commercial: 703-325-1369, FAX: 703-325-6227, E-MAIL: canadce@hqda.army.mil).

Daniel T. Tompkins

DANIEL T. TOMPKINS
Colonel, USAF
Chairman

cc:
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Commander, U.S. Army Corps of Engineers, ATTN: CESO, 20 Massachusetts Avenue NW, Washington DC 20314-1000
Commander, U.S. Army Engineering and Support Center Huntsville, ATTN: CEHNC-ED-CS and CEHNC-OE-CX-Q, P.O. Box 1600, Huntsville, AL 35807-4301

Use of Sandbags for Mitigation of Fragmentation and Blast Effects Due to Intentional Detonation of Munitions

Prepared by
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August 1998

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Reviewed by: _____ 8/[illegible]
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Chief, Civil-Structures Division

EXECUTIVE SUMMARY

The U.S. Army Engineering and Support Center, Huntsville (USAESCH) is currently engaged in projects which require the disposal of uncovered/discarded ordnance and explosives (OE) on public and private lands. The uncovered OE item is often detonated in place if it is too dangerous to move. In some cases, covering and tamping with loose earth is used to contain the blast and fragments. Another method to mitigate the fragmentation and blast effects is to cover the item with sandbags. However, traditionally there has been no method to determine the optimum configuration or the required thickness of such a sandbag enclosure.

The Structural Branch, USAESCH, sponsored a test program in 1997 to evaluate the use of sandbag enclosures for fragment and blast mitigation, for intentional detonations at Ordnance and Explosives (OE) sites. Southwest Research Institute (SwRI), under contract to USAESCH, performed a two phase test program of sandbag enclosures. In phase one, the preliminary explosive test phase, four tests on a 155-mm projectile were performed to refine and optimize the test procedure. This test procedure was used in phase two, the comprehensive explosive test phase. In phase two, a total of fourteen tests with five different munitions were performed to determine the thickness of sandbags required to capture all primary fragments. Measurements were made of the overpressures at various places, sandbag throw distances, depth of fragment penetration, and noise levels. High-speed film cameras, video recorders and digital cameras were used to visually record the events.

Required Wall and Roof Thicknesses for Sandbag Enclosures, with Expected Sandbag Throw Distances and Pressures, for Five Tested Munitions

Munition	Charge Weight, Comp B, lb	Required Wall and Roof Sandbag Thickness, in	Expected Maximum Sandbag Throw Distance, ft	Expected Peak Pressure @ 40 feet, psi	Expected Peak Pressure @ 80 feet, psi	Expected Sound Level @ 100 feet, dB
155-mm M107	15.4	36	220	0.18	0.09	115
4.2-in M329A2	8.17 (TNT)	24	125	0.16	0.06	116
105-mm M1	5.08	24	135	0.18	0.08	120
81-mm M374A2	2.1	20	125	0.14	0.05	119
60-mm M49A3	0.43	12	25	0.08	0.03	118

The results of these tests have been used to develop guidelines for the use of sandbag enclosures. The guidelines include required sandbag thicknesses, configuration and construction of the sandbag enclosures, and withdrawal distances based on the greater of sandbag throw distances or 200 ft. This document provides a summary of the test results and these guidelines.

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1.0 Introduction

The U.S. Army Engineering and Support Center, Huntsville (USAESCH) is currently engaged in projects which require the disposal of uncovered/discarded ordnance and explosives (OE) on public and private lands. The uncovered OE item is often detonated in place if it is too dangerous to move. In some cases, covering and tamping with loose earth is used to contain the blast and fragments. Another method to mitigate the fragmentation and blast effects is to cover the item with sandbags. However, traditionally there has been no method to determine the optimum configuration or the required thickness of such a sandbag enclosure.

The Structural Branch, USAESCH, sponsored a test program in 1997 to evaluate the use of sandbag enclosures for fragment and blast mitigation, for intentional detonations at Ordnance and Explosives (OE) sites. Southwest Research Institute (SwRI), under contract to USAESCH, performed a two phase test program of sandbag enclosures. In phase one, the preliminary explosive test phase, four tests on a 155-mm projectile were performed to refine and optimize the test procedure. This test procedure was used in phase two, the comprehensive explosive test phase. In phase two, a total of fourteen tests with five different munitions were performed to determine the thickness of sandbags required to capture all primary fragments. Measurements were made of the overpressures at various places, sandbag throw distances, depth of fragment penetration, and noise levels. High-speed film cameras, video recorders and digital cameras were used to visually record the events.

The results of these tests have been used to develop guidelines for the use of sandbag enclosures. The guidelines include required sandbag thicknesses, configuration and construction of the sandbag enclosures, and withdrawal distances based on the greater of sandbag throw distances or 200 ft. This document provides a summary of the test results and these guidelines.

2.0 Test Program

2.1 Fragmentation Characteristics of Munitions

Prior to beginning this test program the fragmentation characteristics of a variety of munitions frequently encountered during OE site operations were determined. The fragmentation characteristics were calculated in accordance with procedures outlined in TM5-1300, “Structures to Resist the Effects of Accidental Explosions” [1] and detailed in CEHNC-ED-CS-S-98-1, “Methods for Predicting Primary Fragmentation Characteristics of Cased Explosives” [2]. The fragmentation characteristics were used to predict preliminary thicknesses of sand required to prevent perforation for the five munitions tested.

Optimally, the fragments from the munition will strike the sandbags before the blast wave so that the fragments are penetrating undisturbed sand. To ensure that this will occur it is necessary to reduce the coupling between the explosive charge and the

surrounding soil. This coupling is dependent on the separation distance between the charge and the soil. Full coupling implies that the maximum amount of energy, or velocity, is transferred from the explosive into the soil immediately adjacent to the charge. If an explosive charge is placed in a cavity, so that an air gap exists between the charge and the walls of the cavity, coupling between the explosive and soil is reduced. Therefore, a standoff of some distance is required to reduce the coupling effect. Calculations to determine the velocity of sand particles from a buried explosion were performed. The velocity of the sand particles was compared to the velocity of the design fragment through sand. These calculations suggest that at a distance between 6 and 12 inches from the explosion, the fragment velocity exceeds the particle velocity. Therefore, the initial standoff distances for the tests were 6 and 12 inches.

2.2 Preliminary Explosive Test Phase

In the preliminary explosive tests, four tests of statically detonated 155-mm M107 projectiles were performed. These tests provided the data needed to specify the amount and configuration of sandbags that are required to safely detonate a 155-mm projectile in place, verified that the general test procedure was satisfactory, and defined the instrumentation and data acquisition systems for the subsequent comprehensive explosive tests. Figure 1 shows the site layout for the tests of sandbag enclosures. Although, munitions are rarely oriented vertically for demolition in place, the vertical orientation provided the opportunity to evaluate a greater number of combinations of wall thicknesses and standoff distances. Figures 2 and 3 show the sandbag enclosure configurations for vertical and horizontal weapon tests.

The test matrix for the preliminary explosive tests is shown in Table 1. Two tests were run with the 155-mm in the vertical orientation and two in the horizontal orientation. Each test allowed five standoff distances and five sandbag thicknesses to be evaluated.

The sandbags were made of woven polypropylene, as is commonly used by explosives and ordnance disposal (EOD) personnel, and the volume/weight of the sandbags was either 0.5 ft^3/50 lbs for the large bags or 0.25 ft^3/25 lbs for the small bags. The small bags were used for test two. No additional information was provided by using the small bags so these were not used for any other tests. The bags were filled with a “washed river” sand that was judged to be “typical” by a local soil consultant (Fugro-McClelland Southwest, Inc.).

To determine the sandbag throw distribution some of the sandbags in the first two tests were filled with sand colored with dye. The dye did not improve the quality of the test results. Spray paint was used in the subsequent tests to mark each bag with its original position in the sandbag enclosure. A different color was used to indicate the wall or the roof and numbers were used to indicate the layer in which the sandbag was located.

Detailed descriptions of all tests and results are provided in “Evaluation of Sandbags for Fragment and Blast Mitigation” by Southwest Research Institute [3].

Table 1 – Test Matrix for Preliminary Explosive Tests

Test No.	Orientation	Standoff, in.					Wall Thickness, in. (Bag Size)				Wall Height, in. (Bag Size)	
		S_1	S_2	S_3	S_4	S_R	T_1	T_2	T_3	T_4	H_1	H_2
155-1	Vertical	12	6	6	12	6	32	32.5	45	43	32	20
155-2	Vertical	6	6	6	6	6	18(s)	54	18(s)	53(s)	32	22
155-3	Horizontal	6	6	6	6	6	30	48	24	24	12	30
155-4	Horizontal	6	6	6	6	6	35	36	34	36	12	36

Note: All walls were constructed with large bags, except for those designated with an “s” for small bags.

2.2.1 Preliminary Explosive Test Results

For tests 1 and 2, the 155-mm M107 projectile was detonated using a donor charge of 200 g of C-4 placed in the fuze well and initiated with an Exploding Bridge Wire. For tests 3 and 4, the 155-mm M107 projectile was detonated using a well perforator shaped charge. This approach is typically used for on-site detonations. Time of arrival (TOA) pins were used for all tests to determine if a high order detonation was achieved.

All detonations were high order and results were obtained. The make screens and their frames and the assorted witness screens were scattered across the site. Where possible, each screen was identified and photographed and the number of fragment holes or the condition of the screen was recorded. The results of the first three tests suggested that a wall and roof thickness of 36 inches should be sufficient to contain all of the fragments and to reduce the overpressure levels. The dimensions of test 4 confirmed this configuration.

From the limited data collected on standoff distance, it appears that for standoffs of 6 and 12 inches there is no difference in the thickness of sandbags required to stop fragments. Test 2 showed that the size of the sandbag did not affect the fragment penetration. Test 3 showed that the horizontal orientation of the munition did not greatly effect the fragment penetration. Tests 3 and 4 showed that the base plate of the munition broke up and was stopped by 24 inches or less of sandbags.

The data collected showed that approximately 20 inches of sandbags will completely contain the fragments from the 155-mm M107 projectile. The only indications of fragments exiting the sandbag enclosure came from the two identical 18 inch walls of test 2 (external witness screens on sides 1 and 3 both registered fragment impacts). Internal witness screens at depths of 20 inches to 24 inches for all 4 tests did not indicate any fragment impacts. In tests 2 through 4, the roof witness screens also showed no penetrations for 20 to 36 inches of roof depth. The CONWEP software [4] predicts that 24 inches of sand will stop the design fragment from the 155-mm M107 projectile.

Sandbag throw distances were recorded in 10 foot increments from ground zero to the furthest sandbags. The maximum sandbag throw distances were 150 feet, 191 feet,

157 feet, and 150 feet for tests 1 through 4, respectively. All of the furthest thrown sandbags came from the roof. In most cases, the roof sandbags were found relatively intact while the wall sandbags were often disintegrated. The bulk of the sandbags fell within 100 feet with only a few beyond this distance. An examination of the sandbag throw distances show that the standoff, the size of the bag, and the weapon orientation did not affect the throw distance to any significant degree.

Blast overpressures were recorded for all 4 tests (see Table 2). As shown, the sandbag enclosures greatly reduced the magnitude of the pressure. In test 3, a digital sound meter was placed 100 feet from ground zero and the maximum sound level recorded was 114.7 decibels.

Table 2 – Blast Overpressures from Preliminary Explosive Tests

Test No.	Side 1				Side 4			
	P1 @ 40', psi	P2 @ 40', psi	P3 @ 80', psi	P4 @ 80', psi	P5 @ 40', psi	P6 @ 40', psi	P7 @ 80', psi	P8 @ 80', psi
155-1	0.67	0.71	ND	ND	0.37	0.38	ND	ND
155-2	1.31	1.18	ND	ND	0.74	0.97	ND	ND
155-3	0.16	0.16	0.07	0.06	0.16	0.18	0.09	ND
155-4	0.04	0.04	0.03	0.03	0.07	0.08	ND	0.05

ND = no data

2.3 Comprehensive Explosive Tests

An additional fourteen tests were performed: one more using 155-mm M107 projectiles, four using 105-mm M1 projectiles, three using 4.2-in M329A2 projectiles, four using 81-mm M374A2 mortars, and two using 60-mm M49A3 mortars. The test matrix for the comprehensive explosive tests is shown in Table 3. For all tests performed with the munition in the vertical orientation, detonation was achieved using a donor charge of 100 grams (50 grams for test 60-1) of C-4 in the fuze well. For all tests performed with the munition in the horizontal orientation, detonation was achieved using a well perforator. TOA pins were used for all tests to check if a high order detonation was achieved.

For each of the comprehensive explosive tests, woven polypropylene 0.5 ft^3 sandbags were filled with 50 lbs of washed river sand. The sandbags were painted and numbered as described in Section 2.2 to indicate their original position in the sandbag enclosure. Moisture content was not controlled nor monitored during the test program.

Pressure gages, a sound meter, high speed cameras, digital cameras and video cameras were used for data acquisition during each test. Internal and external witness screens were used to determine how deeply the fragments moved into the sandbag mass and whether any fragments exited the sandbag enclosure.

Table 3 – Test Matrix for Comprehensive Explosive Tests

Test No.	Orientation	Standoff, in.					Wall Thickness, in.				Wall Height, in.	
		S_1	S_2	S_3	S_4	S_R	T_1	T_2	T_3	T_4	H_1	H_2
155-5	Horizontal	7	7	5	6	7	36	36	36	36	13	36
4.2-1	Vertical	5.5	5.5	5.5	5.5	6	20	24	31	36	19	24
4.2-2	Horizontal	6.5	6.5	6	6	7	24	25	24	24	11	24
4.2-3	Horizontal	6	5	5	6	7	24	25	25	24	11	24
105-1	Vertical	5.5	5.5	5.5	5.5	6	20	26	31	35	25	24
105-2	Vertical	0	0	4	6	6	29	25	19	25	26	23
105-3	Horizontal	7	5	5	5	9	24	24	24	24	13	24
105-4	Horizontal	6.5	6	5	6	7	25	25	24	24	11	23
81-1	Vertical	5	5	6	6	6	12	19	23	30	15	18
81-2	Horizontal	7	6	5.5	7	6	18	24	18	24	9	18
81-3	Horizontal	7	6	5	6	7	18	19	18	19	10	18
81-4	Horizontal	6	5.5	5.5	5.5	8	19	20	19	20	11	18
60-1	Vertical	6	6	6	6	6	13	19	23	30	11	12
60-2	Horizontal	6.5	3	5.5	3	6	12	12	12	12	8	13

All detonations were high order and results were obtained. The assorted witness screens were scattered across the site. Where possible, each screen was identified and photographed and the number of fragment holes or the condition of the screen was recorded. Sandbag throw distances were recorded in 10 foot increments from ground zero to the furthest sandbags. Blast overpressures were recorded for all tests at 40 feet and 80 feet from ground zero. A digital sound meter was placed 100 feet from ground zero. A summary of the results is shown in Table 4.

The final test for each munition was a confirmation test. These included tests 155-5, 4.2-3, 105-4, 81-3 and 60-2. The purpose of the confirmation tests was to model as closely as possible the actual use of sandbags in field conditions. In each test the internal witness screens were omitted. Sandbags were staggered both horizontally and vertically. External witness screens were placed over the roof and the two sides facing away from the pressure gages. After each test, the external witness screens were recovered and inspected for fragment penetrations. No such penetrations were identified. Therefore, the sandbag thicknesses defined in Table 4 are those used in the confirmation tests. For two munitions, the penetration data from internal witness panels suggests that somewhat smaller sandbag thicknesses may be sufficient to capture all fragments. As stated above for the 155-mm M107, internal witness screens show no fragment penetrations for sandbag thicknesses of about 24 inches or more. For the 4.2-inch M329A2 mortar, the internal witness screens show no fragment penetrations deeper than about 18 inches. However, the thicknesses of 36 inches for the 155-mm M107 and 24 inches for the 4.2-inch M329A2 are retained for use in the field, since sandbag throw distances are based on these thicknesses. While possibly thicker than necessary from capturing fragments, the increased total mass of the sandbags results in reduced sandbag throw distances.

Detailed descriptions of all tests and results are provided in “Evaluation of Sandbags for Fragment and Blast Mitigation” by Southwest Research Institute [3].

3.0 Guidelines for Use of Sandbags

3.1 Enclosure Geometry

Table 5 summarizes the results of the tests. This table specifies the minimum thickness of sandbag walls and roof that is needed to completely contain the fragments for the five munitions that were tested in this project. It also gives the expected maximum sandbag throw distances, the peak pressures at 40 feet and 80 feet, and the sound level at 100 feet, for the five munitions. For safety and conservatism, the expected sandbag throw distances are approximately 10% larger than the largest distances actually measured in the tests. Thus, the expected sandbag throw distances given in Table 5 are conservative in two ways: first, the largest measured sandbag throw distance from all tests of a particular round is used and second, this value is increased by 10%. Due to the already low values of peak pressures, a similar increase in the expected peak pressures was not deemed necessary or justified.

Table 4 – Summary of Results from Comprehensive Explosive Tests

Munition	Sandbag Thickness (in) to Defeat Fragments	Max. Sandbag Throw Distance (ft)		Max Peak Overpressure (psi) @ 40 ft		Max Peak Overpressure (psi) @ 80 ft		Max Noise Level (dB) at 100 ft
		Side of Round	Nose/Tail of Round	Side of Round	Nose of Round	Side of Round	Nose of Round	
155-mm M107	36	200	130	0.06	0.12	0.04	0.05	114.7
4.2-in M329A2	24	110	70	0.12	0.14	0.04	0.06	115.8
105-mm M1	24	120	50	0.17	0.18	0.07	0.08	119.3
81-mm M374A1	20	110	30	0.14	0.08	0.05	0.03	118.3
60-mm M49A3	12	20	20	0.06	0.08	0.02	0.03	117.3

Obviously, the five munition types do not cover all of the munitions that may be encountered. To determine the minimum wall and roof thickness for a particular shell other than those found in Table 5, the approach is as follows:

(1) Determine the initial fragment velocity (V_F) in ft/s, the maximum fragment weight (W_F) in pounds, and the kinetic energy ($W_F V_F^2/2$) in lb-ft^2/s^2 for the particular munition.

(2) Identify the munition with the next largest kinetic energy, from Table 6.

(3) Use the sandbag wall and roof thickness from Table 5 for the munition with the next largest kinetic energy shown in Table 6.

Table 6 provides the maximum fragment weight, the initial fragment velocity, and the resulting kinetic energy for the 5 munition types. The maximum fragment weight and the initial fragment velocity values were determined with the Mott and Gurney equations, as presented in TM 5-1300 [1] and detailed in HNC-ED-CS-S-98-1 [2].

Table 5 - Required Wall and Roof Thicknesses for Sandbag Enclosures, with Expected Sandbag Throw Distances and Pressures, for Five Tested Munitions

Munition	Charge Weight, Comp B, lb	Required Wall and Roof Sandbag Thickness, in	Expected Maximum Sandbag Throw Distance, ft	Expected Peak Pressure @ 40 feet, psi	Expected Peak Pressure @ 80 feet, psi	Expected Sound Level @ 100 feet, dB
155-mm M107	15.4	36	220	0.18	0.09	115
4.2-in M329A2	8.17 (TNT)	24	125	0.16	0.06	116
105-mm M1	5.08	24	135	0.18	0.08	120
81-mm M374A2	2.1	20	125	0.14	0.05	119
60-mm M49A3	0.43	12	25	0.05	0.03	118

Table 6 - Maximum Fragment Weight, Initial Fragment Velocity and Kinetic Energy for Five Tested Munitions

Munition	W_F, Maximum Fragment Weight, lb	V_F, Initial Fragment Velocity, ft/s	Kinetic Energy, 10^6 lb-ft^2/s^2
155-mm M107	0.467	4667	5.085
4.2-in M329A2	0.079	6391	1.613
105-mm M1	0.155	4870	1.868
81-mm M374A2	0.031	6721	0.700
60-mm M49A3	0.033	3605	0.214

As an example, for a shell such as the 3-in Stokes Mortar Round, the maximum fragment weight and initial fragment velocity are 0.0436 lb and 6189 ft/s, respectively. The resulting kinetic energy is 0.835 x 10^6 lb-ft^2/s^2. The next largest fragment kinetic energy in Table 6 is the 4.2-in M329A2 round. Therefore, a sandbag enclosure with a roof and wall thicknesses of 24 inches should be used to contain the fragments and suppress the blast overpressures. The maximum sandbag throw distance is 125 ft. Therefore, the withdrawal distance is 200 ft.

Based on this procedure, a more complete list of typical munitions is given in Table 7. This table includes the required sandbag wall and roof thicknesses and maximum expected sandbag throw distances to be used for each munition. For other munitions not listed in Table 7, the procedure given above can be used. The procedure should not be used to extrapolate sandbag thicknesses or sandbag throw distances for munitions larger than the 155-mm M107.

3.2 Enclosure Construction Method

The enclosure construction method follows the procedure that was used to build the test enclosures, with a few modifications. Figure 4 illustrates a typical enclosure. Figure 5 shows a photograph of a sandbag enclosure for an 81 mm mortar.

The sandbag fabric should be woven polypropylene. Each bag should have a nominal volume of 0.5 ft^3 and an approximate weight when full of 50 lb. The bags should be filled with washed sand, either dry or in saturated surface dry (that is, slightly moist) condition. Wet sand should not be used. Prefilled sandbags should be protected from the rain by storage on pallets, off the ground surface, and by covering them with a plastic tarpaulin or similar cover to prevent them from becoming saturated with water. The gradations and physical composition of the sand are not critical but it should be at least typical of local construction practice for sand used in foundations and backfill. Minor inclusions of clay or soils materials can be permitted. However, no rocks or stones should be placed in the sandbags. Typically, the sand used for the tests had a density of about 100 pounds per cubic foot and a moisture content of 6-7%.

Four walls of identical thickness should surround the munition. The minimum wall thickness should be the thickness determined using the procedure in Section 3.1 above. The sandbag walls should be stacked to maintain a clear standoff distance of 6 inches between the shell and the inside face of each wall. The interior face of each wall should be vertical but the exterior face can be built with a 1:6 slope (2" horizontal to 12" vertical). If a sloped outer face is used, the thickness of the wall, at the nominal “top” of the wall, 6 inches above the top of the munition, must be no less than the specified required thickness

The sandbags should be placed tightly against each other. All vertical joints should be staggered, so there is no clear line of sight from the munition to the exterior. As the wall is built, each new layer of sandbags should run in opposite direction to the layer below, so that the layers are interlocked (see Figure 6).

At a minimum, a double layer of sandbags shall be used. For example, when a 12” thickness is required, the sandbags should be oriented so that two sandbags are necessary to achieve this thickness (see Figure 7).

After the walls are constructed to a height of 6" above the upper surface of the munition, the shaped charge or other initiator should be placed on the shell. Ideally, the use of shaped charges, such as oil well perforators, is recommended. These add very little to the total charge weight for each detonation, given the highly directional nature of the effects of the shaped charge. Also, the use of shaped charges for initiation parallels test procedures. The shaped charge should be located either on top of the munition or on its side. If it is located on the side of the round, the charge should be tilted downward sufficiently to ensure that the shaped charge jet penetrates the round and is directed into the ground, rather than into the opposite sandbag wall. Generally, a small mound of sand next to the round can be used to establish this orientation.

A sheet of 3/4-inch thick Douglas Fir (or equivalent) plywood should be cut to the dimensions of the cavity between the walls, plus 12 inches in each direction. The plywood sheet is then centered on the walls so that it bears on 6" of each wall. The additional sandbags that make up the roof of the enclosure are then placed on top. As with the side walls, the roof sandbags should be stacked with staggered horizontal joints and alternating directions in each layer. The exterior sides of the roof may also be vertical or have a 1:6 slope. The thickness of the sandbag roof, above the plywood panel, must be the same as the required wall thickness.

After the sandbag layers of the roof have been placed to the correct height, the enclosure is complete and the munition may be detonated.

Table 7 - Required Wall and Roof Thicknesses for Sandbag Enclosures, with Expected Sandbag Throw Distances and Pressures, for Tested and Non-Tested Munitions

Munition	Charge Weight (lb)	W_F, Maximum Fragment Weight, lb	V_F, Initial Fragment Velocity, ft/s	Kinetic Energy, 10^6 lb-ft^2/s^2	Required Wall and Roof Sandbag Thickness, in	Expected Maximum Sandbag Throw Distance, ft	With-drawal Distance, ft
155mm M107*	15.48	0.467	4667	5.086	36	220	220
4.7-in Mark I	6.07	0.591	3566	3.761	36	220	220
105mm M1*	5.08	0.155	4870	1.840	24	135	200
4.2-in M329A2*	8.165	0.079	6391	1.607	24	125	200
4-in Stokes	7.92	0.078	6336	1.570	24	125	200
75mm M48	1.47	0.153	3471	0.922	24	125	200
3-in Stokes	2.1	0.044	6189	0.835	24	125	200
2.75-in M229 Rocket	4.8	0.050	5569	0.777	24	125	200
81mm M374*	2.1	0.031	6721	0.696	20	125	200
37mm MK II	0.53	0.030	5758	0.490	20	125	200
60mm M49A3*	0.42	0.024	5114	0.310	12	25	200
FMU 54A/B	0.357	0.006	9031	0.263	12	25	200
40mm MK2 Mod 0	0.187	0.033	3605	0.215	12	25	200
MK II Grenade	0.125	0.014	3425	0.083	12	25	200
25mm M792	0.096	0.005	5736	0.081	12	25	200
M67 Grenade	0.40625	0.001	7006	0.029	12	25	200
20mm M56A4	0.0264	0.0000011	4941	0.004	12	25	200

* = tested munitions

3.3 Withdrawal Zone

A withdrawal zone is necessary for any detonation. This withdrawal zone applies to everyone, both public and operational personnel. The withdrawal zone is the maximum of the sandbag throw distance, the distance to a sound level of 140 db, or 200 ft. For all munitions tested, the sound level at 100 ft was substantially less than 140 db. At 200 ft. the sound level will be even lower. The withdrawal zones are also listed in Table 7.

4.0 Summary and Conclusions

A test program has been performed to determine the effects of sandbag enclosures for mitigating fragments and blast effects due to an intentional detonation of a munition. A total of eighteen tests on five different munitions were performed. A summary of the test procedures and results are presented in this document.

The results of these tests have been used to develop guidelines for the use of sandbag enclosures to mitigate the fragments and blast effects due to an intentional detonation of a munition. Methods for determining the required sandbag thickness and the resulting sandbag throw distance are detailed in Section 3.0. Figures 4, 5, 6 and 7 show the resulting sandbag enclosures.

5.0 References

1. TM5-1300, “Structures to Resist the Effects of Accidental Explosions”, Departments of the Army, the Navy, and the Air Force, November 1990.

2. HNC-ED-CS-S-98-1, “Methods for Predicting Primary Fragmentation Characteristics of Cased Explosives”, M. Crull, U.S. Army Engineering and Support Center, Huntsville, January 1998.

3. “Evaluation of Sandbags for Fragment and Blast Mitigation”, D. Stevens, Southwest Research Institute, San Antonio, TX, January 1998.

4. “User’s Guide for Microcomputer Programs CONWEP and FUNPRO Applications of TM 5-855-1. “Fundamentals of Protective Design For Conventional Weapons””, Revision 2, D. Hyde, US Army Corps of Engineers Waterways Experiment Station, February 1989.

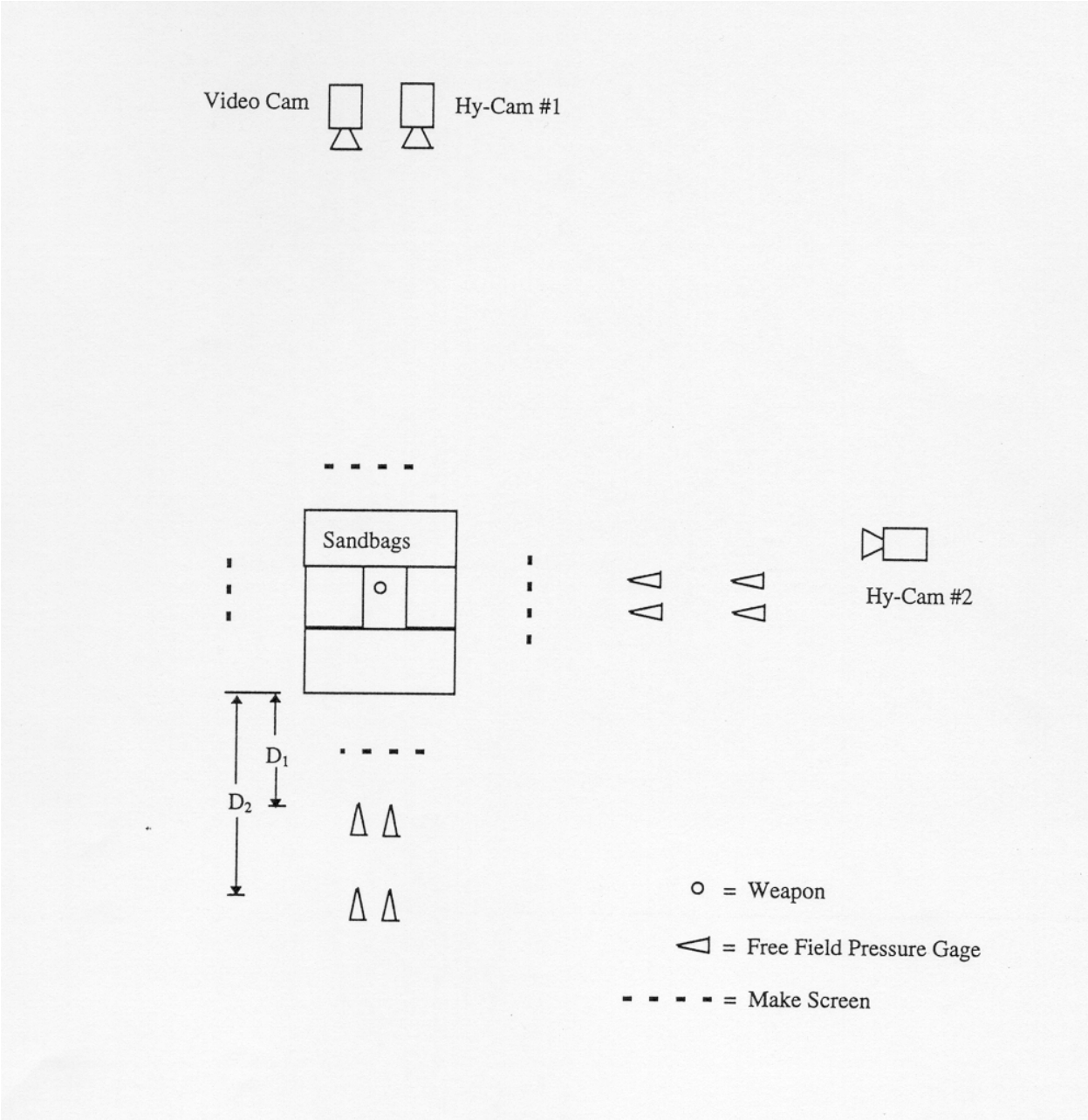

Figure 1 – Site Layout for Tests of Sandbag Enclosures

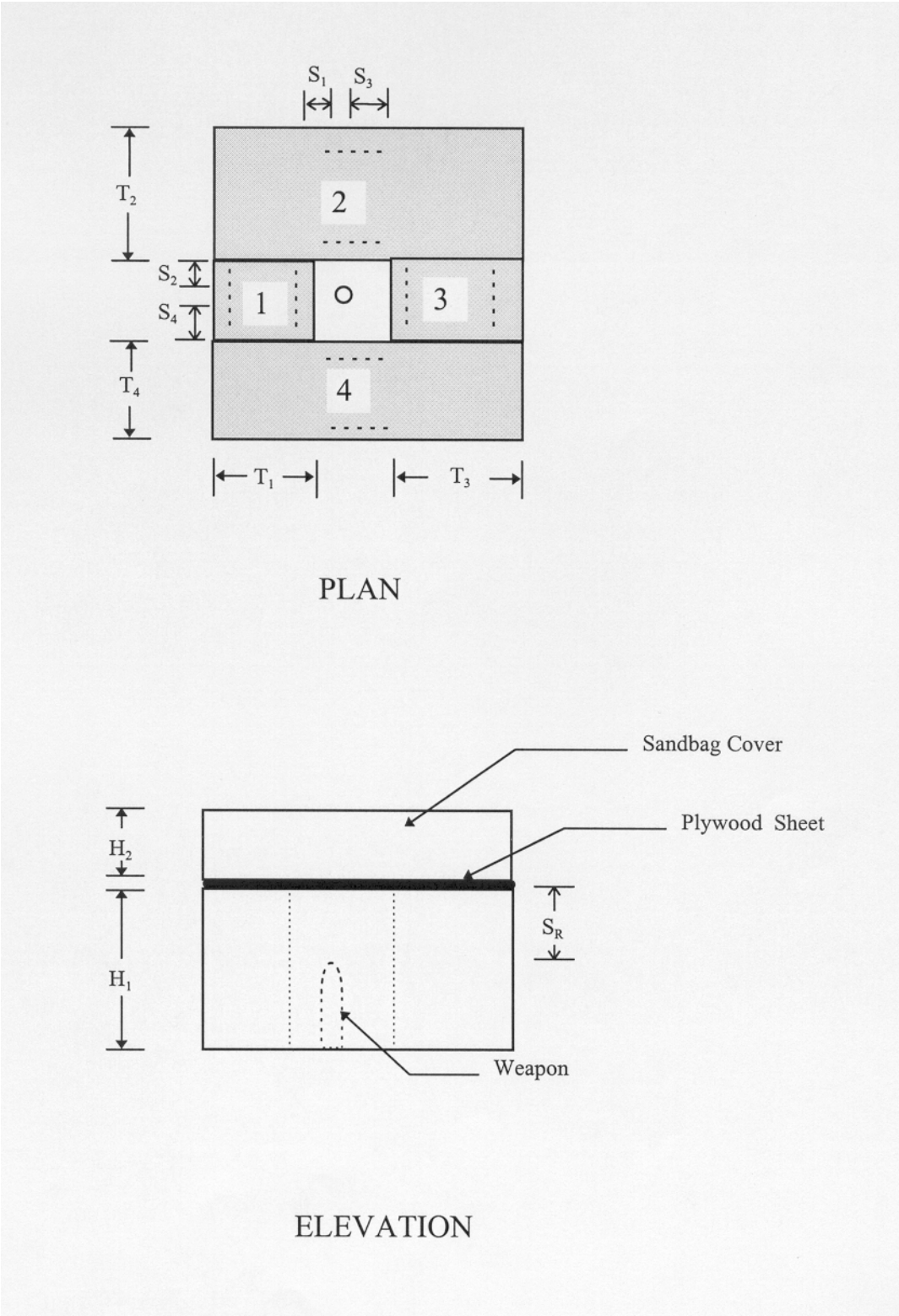

Figure 2 – Sandbag Enclosure Configuration for Vertical Weapon Tests

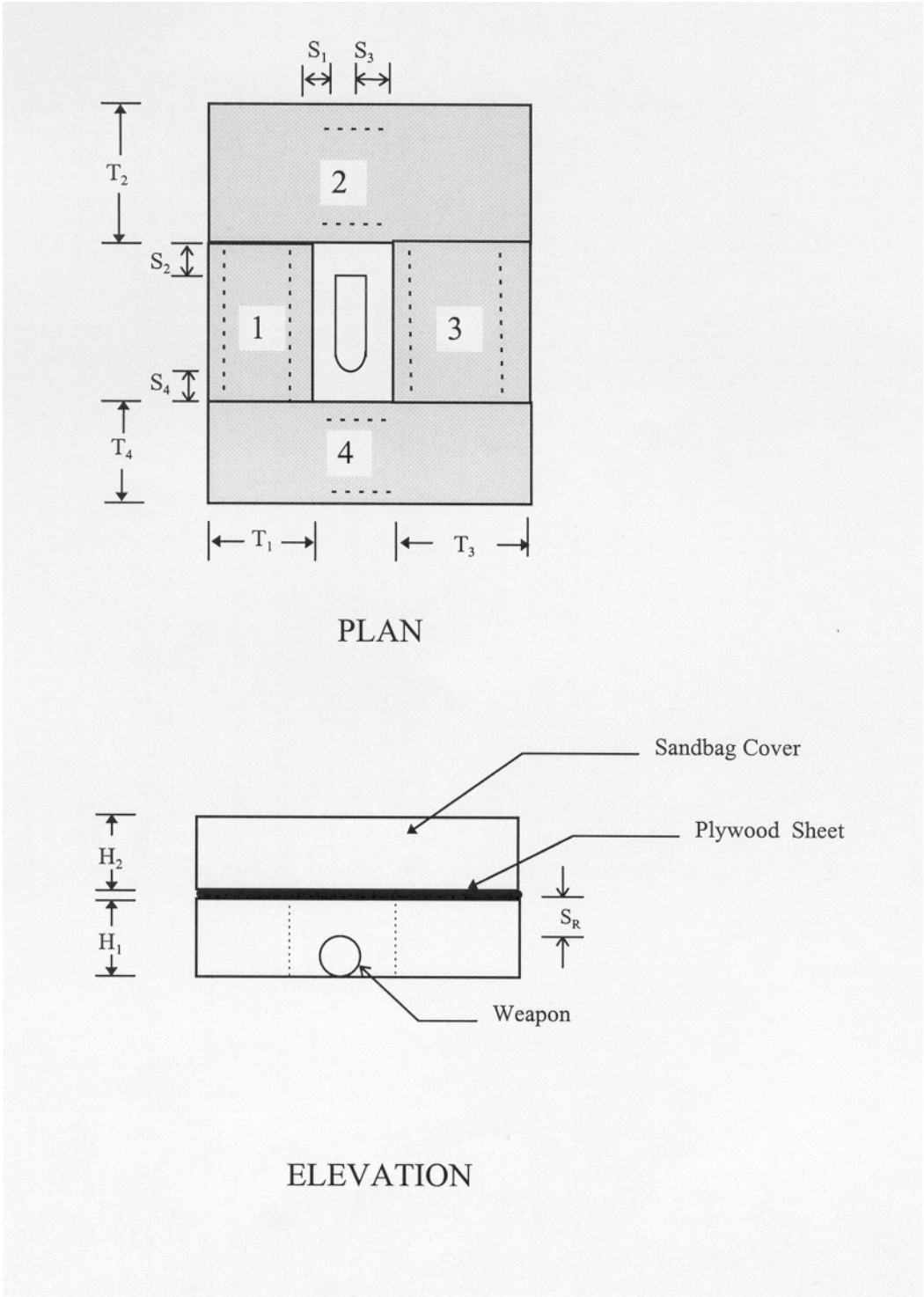

Figure 3 – Sandbag Enclosure Configuration for Horizontal Weapon Tests

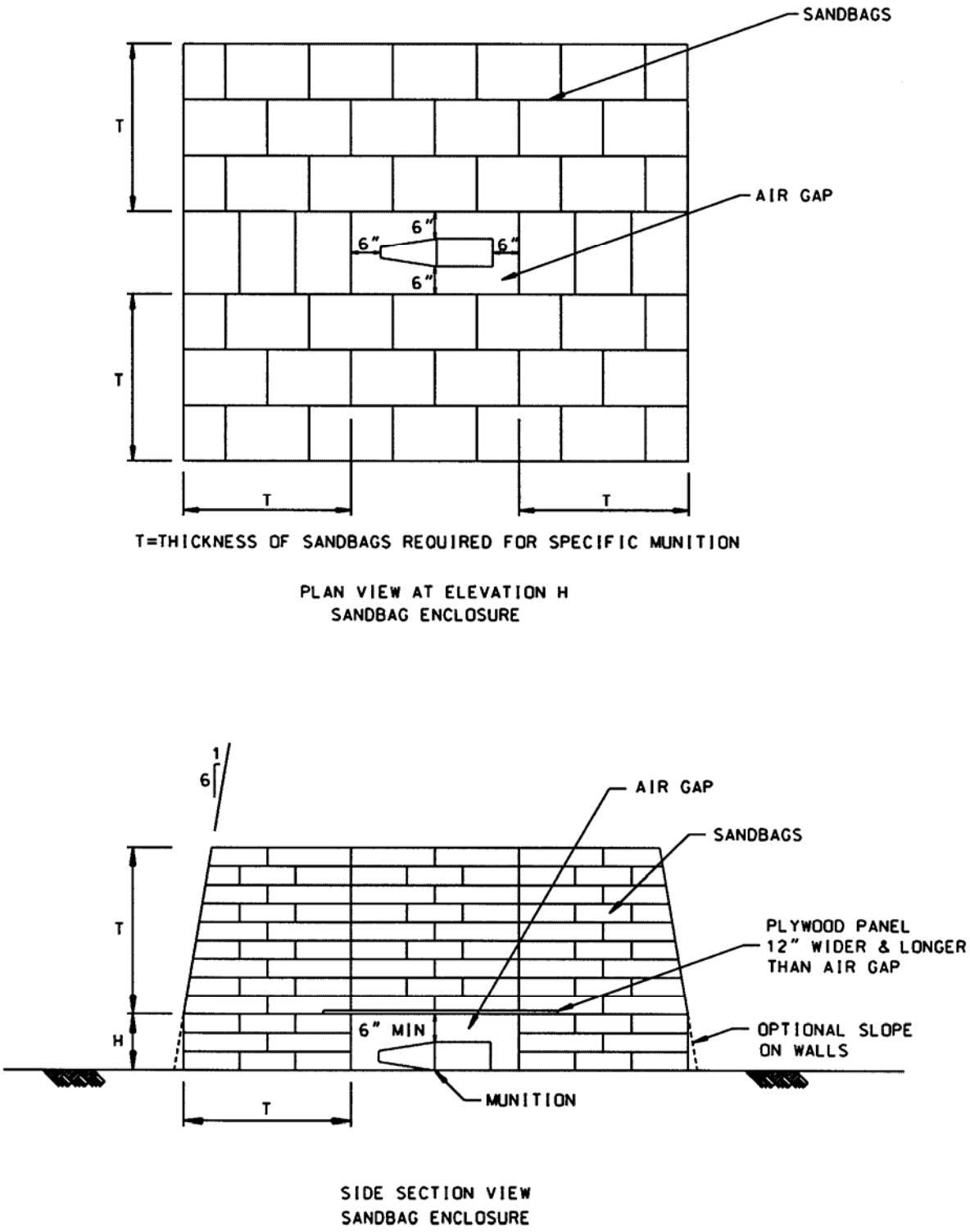

Figure 4 - Typical Sandbag Enclosure

Figure 5 – Sandbag Enclosure for an 81 mm M374A2 mortar.

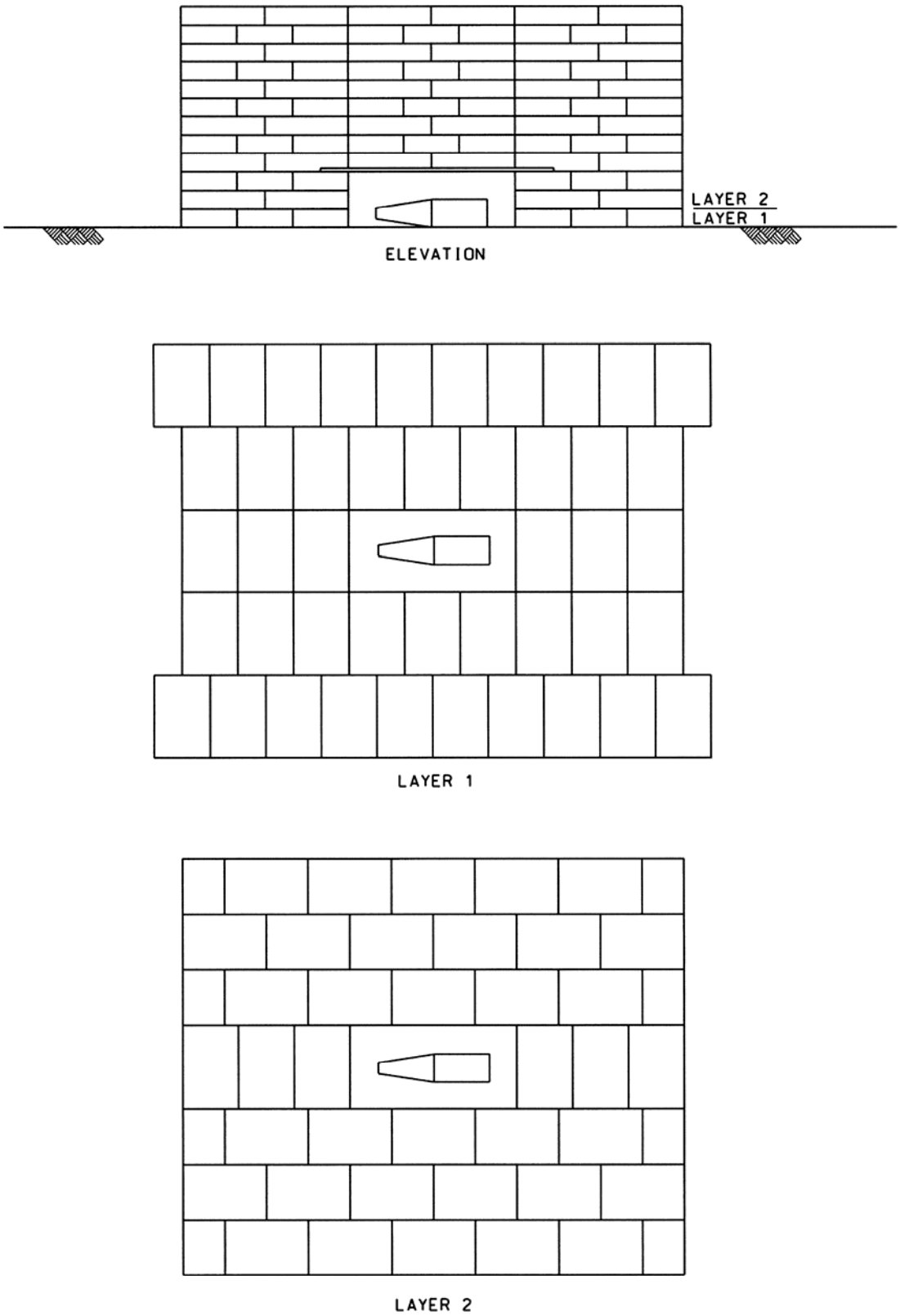

Figure 6 - Interlocking Alternate Layers of Sandbags

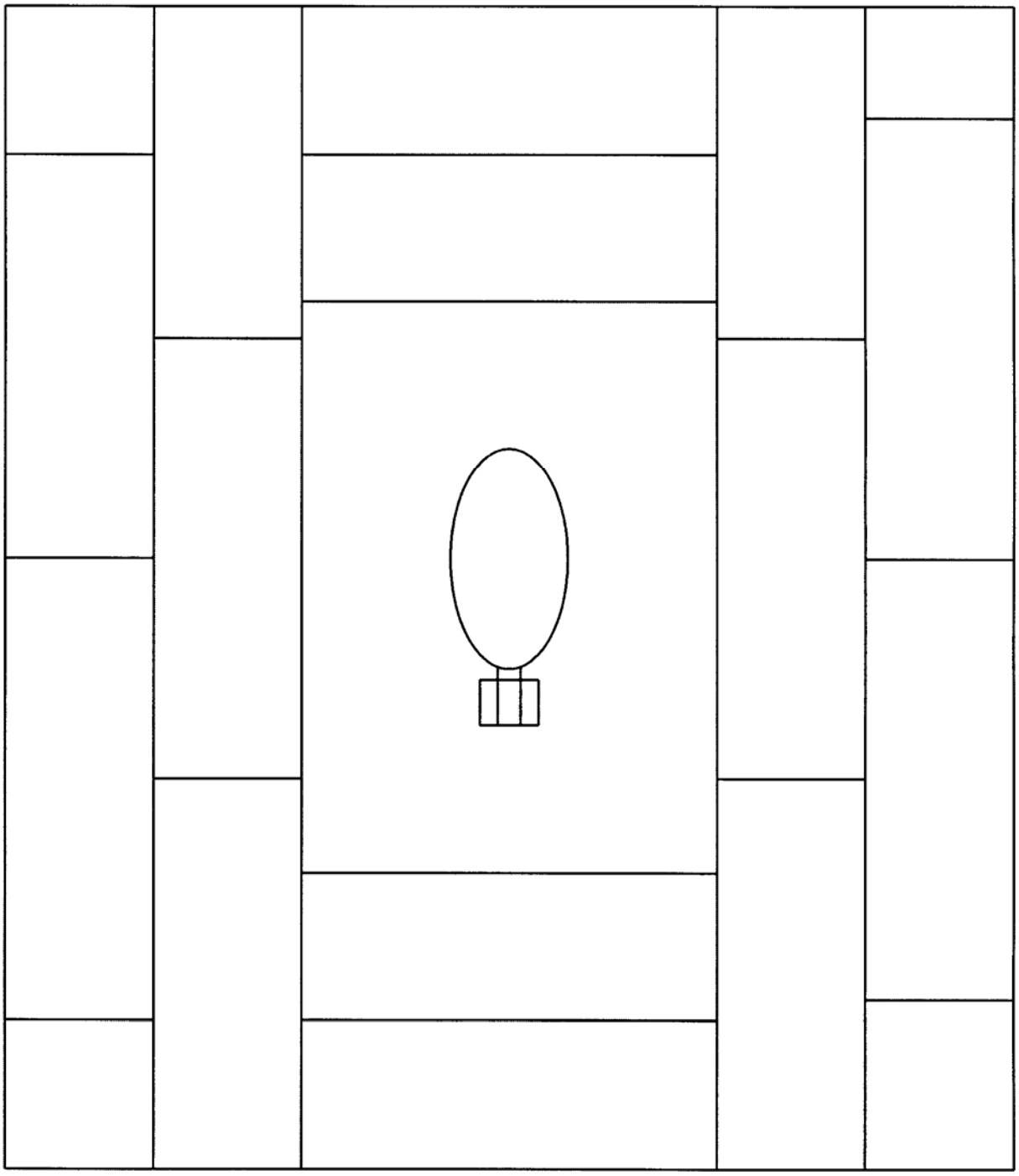

Figure 7 - Configuration for 12” Wall Enclosures

US Army Corps of Engineers
Engineering and Support Center, Huntsville

USE OF WATER FOR MITIGATION OF FRAGMENTATION AND BLAST EFFECTS DUE TO INTENTIONAL DETONATION OF MUNITIONS

HNC-ED-CS-S-00-3
SEPTEMBER 2000

DEPARTMENT OF DEFENSE EXPLOSIVES SAFETY BOARD
2461 EISENHOWER AVENUE
ALEXANDRIA, VIRGINIA 22331-0600

27 FEB 2001

DDESB-KT

MEMORANDUM FOR US ARMY DEFENSE AMMUNITION CENTER
(ATTENTION: SMAAC-ESL)

SUBJECT: Use of Water for Mitigation of Fragmentation and Blast Effects Due to Intentional Detonations of Munitions, Report HNC-ED-S-00-3 (December 2000)

Reference: SMAAC-ESL (CESO-E/19 Dec 00) (385[A]) 1st End dated 21 December 2000, Subject: Explosives Safety Submission (ESS) for Use of Water for Mitigation of Fragmentation and Blast Effects Due to Intentional Detonations of Munitions, HNC-ED-S-00-3, September 2000

The Department of Defense Explosives Safety Board (DDESB) Secretariat has reviewed the mitigation technology described in the subject report as requested by the reference. Based on the information furnished in the report the water mitigation techniques for intentional detonations defined in Section 3.0 of the report are approved for field use in Ordnance Explosives (OE) removal action projects.

A copy of this memorandum of approval must be included with a DDESB approved site plan, and be available at OE sites where intentional detonations are conducted that use the approved water mitigation technique.

The DDESB point of contact for this action is Dr. Jerry M. Ward, Director, Technical Programs Division, DSN: 221-2525, Commercial phone: (703) 325-2525; Fax: (DSN) 221-6227 and E-mail: Jerry.Ward@hqda.army.mil.

DANIEL T. TOMPKINS
Colonel, USAF
Chairman

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USE OF WATER FOR MITIGATION OF FRAGMENTATION AND BLAST EFFECTS DUE TO INTENTIONAL DETONATION OF MUNITIONS

HNC-ED-CS-S-00-2

FEBRUARY 2000

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EXECUTIVE SUMMARY

The U.S. Army Engineering and Support Center, Huntsville (USAESCH) is currently engaged in projects which require the disposal of uncovered/discarded ordnance and explosives (OE) on public and private lands. The uncovered OE item is often detonated in place if it is too dangerous to move. In some cases, covering and tamping with loose earth is used to contain the blast and fragments. Another method to mitigate the fragmentation and blast effects is to cover the item with sandbags. However, both of these methods result in secondary fragments (earth clumps or sandbags) being thrown some distance from the blast. Preliminary tests show that water can be used to mitigate the fragmentation and blast effects and, depending on the method used to contain the water, there may be no hazardous secondary fragments. In addition, the water quenches the fireball and there is no fire hazard associated with the detonation. This last observation is especially important when working in a high fire hazard area.

The Structural Branch, USAESCH, sponsored a test program in 1999 to evaluate the use of water for fragment and blast mitigation, for intentional detonations at Ordnance and Explosives (OE) sites. The U.S. Army Engineer Research and Development Center (USAERDC), with USAESCH performed a two-phase test program of water mitigation of blast and fragmentation. In phase one, tests were conducted using four different munitions to determine the depth of water required to defeat the fragments. In phase two, different water containment systems were tested for these munitions.

For phase one, the munitions were suspended vertically in an aboveground pool in an off-center position. Thus the fragments were dispersed through varying thicknesses of water. Witness panels of 0.032” aluminum were used to record any fragments that might exit the pool. Witness screens were placed in the pool at various distances from the munition to determine if the fragments had penetrated that far.

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These tests showed that water is a feasible means of mitigating fragments and blast effects from an intentional detonation. The containers that are made of heavy plastic produce secondary fragments that may be thrown some distance from the blast. The inflatable swimming pools did not produce any significant secondary fragments. Some small pieces of these pools were found around the site but, since the pool was made of thin flexible plastic, these pieces were very

lightweight and not hazardous. High-speed photography of the tests shows that there is no fireball. Therefore, there is no fire hazard associated with the detonation.

The results of these tests have been used to develop guidelines for the use of water to mitigate fragments and blast effects due to an intentional detonation of a munition. Methods for determining the required water containment system and the resulting minimum separation distance are detailed in this report. Figures are provided to show the resulting munition/initiator configuration and water containment systems.

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1.0 INTRODUCTION

The U.S. Army Engineering and Support Center, Huntsville (USAESCH) is currently engaged in projects which require the disposal of uncovered/discarded ordnance and explosives (OE) on public and private lands. The uncovered OE item is often detonated in place if it is too dangerous to move. In some cases, covering and tamping with loose earth is used to contain the blast and fragments. Another method to mitigate the fragmentation and blast effects is to cover the item with sandbags. However, both of these methods result in secondary fragments (earth clumps or sandbags) being thrown some distance from the blast. Preliminary tests show that water can be used to mitigate the fragmentation and blast effects and, depending on the method used to contain the water, there may be no hazardous secondary fragments. In addition, the water quenches the fireball and there is no fire hazard associated with the detonation. This last observation is especially important when working in a high fire hazard area.

The Structural Branch, USAESCH, sponsored a test program in 1999 to evaluate the use of water for fragment and blast mitigation, for intentional detonations at Ordnance and Explosives (OE) sites. The U.S. Army Engineer Research and Development Center (USAERDC), with USAESCH performed a two-phase test program of water mitigation of blast and fragmentation. In phase one, tests were conducted using four different munitions to determine the depth of water required to defeat the fragments. In phase two, different water containment systems were tested for these munitions.

For phase one, the munitions were suspended vertically in an aboveground pool in an off-center position. Thus the fragments were dispersed through varying thicknesses of water. Witness panels of 0.032” aluminum were used to record any fragments that might exit the pool. Witness screens were placed in the pool at various distances from the munition to determine if the fragments had penetrated that far.

Once a required water thickness was determined for each of the four munitions in phase one, containers were selected to test for use in actual disposal situations. The points considered in this selection were adaptability to munition size, transportability (empty or pre-filled with water), debris producing potential, adaptability to uneven terrain, and cost. The water containment systems tested were 55-gallon plastic drums, 1100-gallon plastic agricultural chemical tanks, 5-gallon stackable plastic carboys, and inflatable plastic wading pools.

These tests showed that water is a feasible means of mitigating fragments and blast effects from an intentional detonation. The containers that are made of heavy plastic produce secondary fragments which may be thrown some distance from the blast. The inflatable swimming pools did not produce any significant secondary fragments. Some small pieces of these pools were found around the

site but, since the pool was made of thin flexible plastic, these pieces were very lightweight and not hazardous. High-speed photography of the tests shows that there is no fireball. Therefore, there is no fire hazard associated with the detonation.

2.0 TEST PROGRAM

The munitions used in both phases of the tests are the 60 mm M49A4 mortar, the 81 mm M362A1 mortar, the 105 mm M1 projectile and the 155 mm M107 projectile.

2.1 Phase One Tests

Commercially available aboveground swimming pools were used to contain the water in the phase one tests because they were easily obtainable and relatively inexpensive. Different size pools were used for different munitions. In the phase one tests the munitions were suspended vertically in the pool at a specified distance from the edge of the munition to one edge of the pool (off-center). Window screens were suspended from 2”x2” wood beams 180 degrees from the nearest edge of the pool at specified distances from the munition. These were used as witness panels in the pool. Witness panels of 0.032” aluminum were placed around the outside of the pool to record any fragments that might leave the pool. The test layout is shown in Figure 1 and the dimensions of the pool and placement of the munition and witness screens are shown in Table 1. The detonations were initiated using C-4 packed in the fuze well.

TABLE 1 – Phase One Test Parameters

Munition	Pool Diameter	Distance, R1 Edge of Pool	Expected Penetration	Pool Depth	Munition Distance from		Munition to Screen Distance			
					Bottom	Surface	S1	S2	S3	S4
60mm	90"	6"	8"	18"	2"		5"	10"	15"	20"
81mm	90"	12"	18"	24"	2"		10"	15"	20"	25"
105mm	12'	24"	30"	24"	3.5"	3"	30"	30"	40"	50"
155mm	18'	36"	48"	46"	4"	15"	40"	50"	60"	70"

2.1.1 155 mm M107 Projectile

The 155 mm M107 projectile contains 15.4 lbs of Comp B. For the phase one test, the booster was removed and the fuze well was packed with C-4. An 18 ft diameter, 4 ft deep pool was used for this test. The projectile was placed base down to make sure the base plate did not become airborn. Fragments were found all around the pool. One section of the metal pool wall from the near blast region was wrapped in a witness panel and thrown over 200 feet from ground zero.

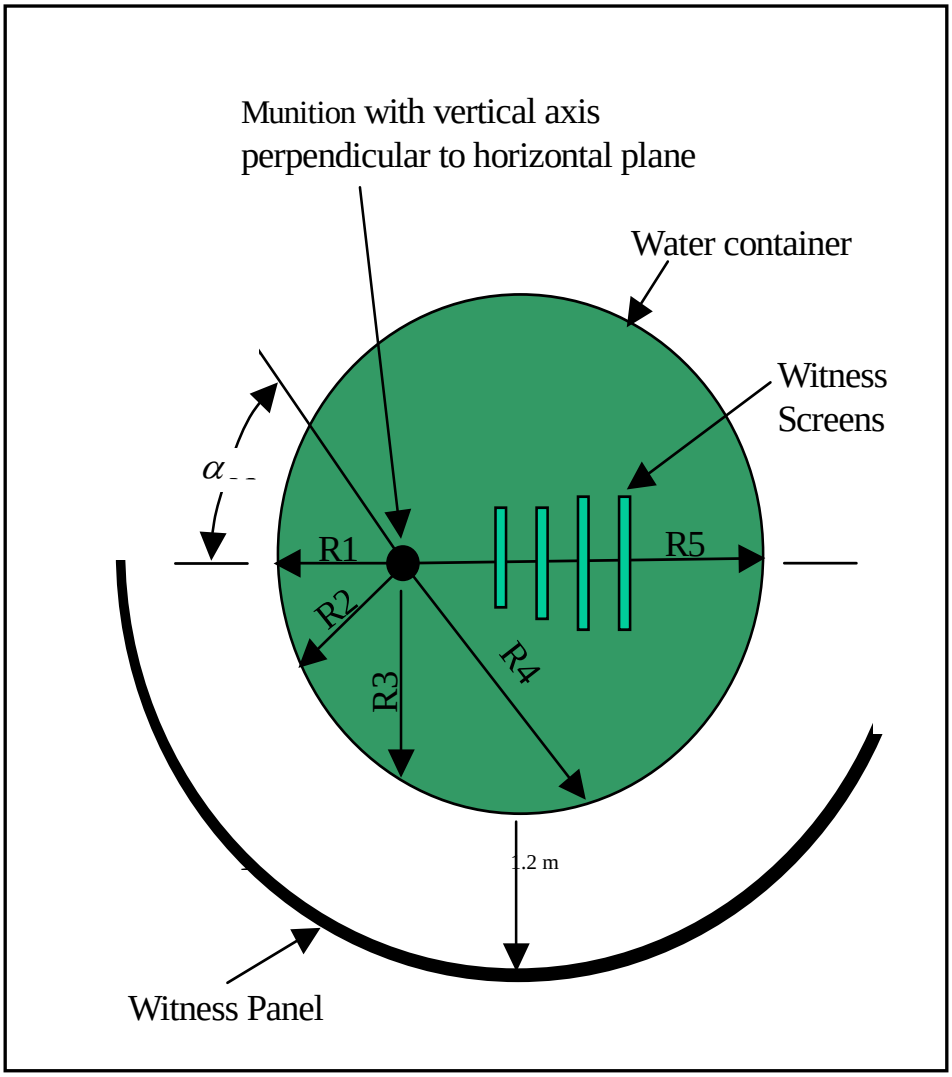


FIGURE 1 – Test Layout for Phase One Tests

TABLE 2 – 155 mm M107 Phase One Results

Perforation of Pool			Fragment Size		Comments	Witness Screens	
Angle A, degrees	Distance D, in.	Height, in.	Length, in.	Width, in		Screen No.	Distance, in.
40.54	70.31		2	1.5		1	24
59.93	96.46		4	2		2	30
66.45	104.96		1	0.125		3	40
						4	50
						5	60
						6	70

Note: Fragment penetrated 5th screen but not 6th.

2.1.2 105 mm M1 Projectile

The 105 mm M1 projectile contains 5.07 lbs of Comp B. For the phase one test the fuze well was packed with C-4. A 12 ft diameter, 2 ft deep pool was used for this test. The projectile was placed base down to make sure the base plate did not become airborn. Fragments were recovered out to a distance of approximately 75 feet from the pool. There were no penetrations in the side or rear of the pool or witness panels, so the explosive mass apparently lofted these fragments along with the water.

TABLE 3 – 105 mm M1 Phase One Results

Perforation of Pool			Fragment Size		Comments	Witness Screens	
Angle A, degrees	Distance D, in.	Height, in.	Length, in.	Width, in		Screen No.	Distance, in.
25.97	38.87	28	5	1		1	30
47.96	53.83	12	6	1	Tear?	2	42
						3	54
						4	66
						5	80

Note: Fragment penetrated 1st screen only.

2.1.3 81 mm M362A Mortar

The 81 mm M362A mortar contains 2.1 lbs of Comp B. For the phase one test the fuze well was packed with 113 grams of C-4. A 90 inch diameter, 24 inch deep pool was used for this test. The mortar was placed nose down in the pool with the nose 2 inches off the bottom. No fragments penetrated the rear side of the pool. The tail fin was recovered 42 feet from the pool. One fragment was recovered 130 feet from the pool.

TABLE 4 – 81 mm M362A Phase One Results

Perforation of Pool			Fragment Size		Comments	Witness Screens	
Angle A, degrees	Distance D, in.	Height, in.	Length, in.	Width, in		Screen No.	Distance, in.
2.56	12.12	17	2.5	0.25		1	10
2.56	12.12	17	1.5	0.125	Dent	2	15
1.79	12.06	36	0.25	2		3	20
7.62	13.05	7	4	2		4	25
7.34	12.97	5	1	0.25	Dent		
7.62	13.05	9	0.75	0.5			
8.46	13.28	12	1	0.5	3 together		
9.61	13.63	14	0.25	0.25	Frag imbedded		
7.62	13.05	22	0.5	0.25			
7.34	12.97	33	2	1			
7.89	13.12	36	1	0.5			
10.50	13.92	9	3	1			
10.80	14.02	37	0.75	0.75			

Note: Fragment penetrated 3rd screen but not 4th.

2.1.4 60 mm M49A4 Mortar

The 60 mm M49A4 mortar contains 0.42 lbs of Comp B. For the phase one test the fuze well was packed with 65.2 grams of C-4. A 90 inch diameter, 18 inch deep pool was used for this test. The mortar was placed nose down in the pool with the nose 2 inches off the bottom. The pool was filled to the top (22 inch depth) but no effort was made to level the ground under the pool. As a result the low side of the pool began to sag before the test. Sandbags were used to prop up this side. No fragments penetrated the rear of the pool, but were found in the bottom of the pool. Fragment holes were found in the lower portion of the witness panel. Several fragments were found 30 to 40 feet from the pool, but the fragment field extended only 30 degrees off a line running through the center of the munition to the nearest point on the side of the pool. No fragments were found in the same region behind the witness panel side, although several fragments penetrated the witness panel.

TABLE 5 – 60 mm M49A4 Phase One Results

Perforation of Pool			Fragment Size		Comments	Witness Screens	
Angle A, degrees	Distance D, in.	Height, in.	Length, in.	Width, in		Screen No.	Distance, in.
2.97	7.32	10	1.75	1.25		1	5
6.07	8.26	4	2.25	0.25		2	10
6.07	8.26	12	0.5	0.125		3	15
6.67	8.49	4	1	0.125	dent	4	20

Note: Fragment penetrated 1st screen but not 2nd.

2.1.5 Phase One Summary and Conclusions

Open front barricade tests using the 60 mm and 81 mm mortars and the 105 mm projectile were also conducted at this test range during this time. The

detonations were all initiated by packing the fuze wells with C-4. It was observed that the fragments from the water tests were significantly larger than those from the barricade tests. This is most likely due to the confinement of the water. Compared to the number of fragment impacts observed in the barricade tests, a very small number of fragments penetrated the witness panels in the water tests. The water contained all but the most energetic fragments. A summary of the penetration distances is presented in Table 6. The screen distance is the distance of the first screen that was not penetrated by fragments. The panel distance is the longest travel distance through water of a fragment impacting the witness panel.

Because these fragments were larger than would be expected from the detonation of a munition not submerged in water, they probably penetrated a greater thickness of water than would be expected in an intentional detonation of a munition in the field. Consequently, in actual field conditions, the thickness of water required to contain munition fragments can be expected to be less than those shown here.

TABLE 6 – Water Penetration Distance, Phase One

Munition	Fragment Penetration, in.	
	Screen	Panel
60 mm M49A4	< 10	8.5
81 mm M362A	< 25	14
105 mm M1	< 42	53
155 mm M107	< 70	105

2.2 Phase Two Tests

Phase Two tests were set up in a manner simulating actual field conditions. For each test the munition was placed in a horizontal orientation in a hole with the top of the munition six inches below the ground surface. A piece of plywood was placed over the hole to keep the water containers from resting on the munition. The detonation was initiated using a GOEX oil well perforator charge containing 26 grams of RDX. The perforator was placed on the side of the munition so that the shaped charge was directed slightly downward. Pressure gages and sound meters were used to measure the blast effects. Video cameras and a high speed digital camera were used to record each test. The test setup is shown in Figure 2.

2.2.1 155 mm M107 Projectile

Two water containment systems were tested with the 155 mm M107 projectile. The first system was two layers of 55 gallon drums and the second system was a single 1100 gallon agricultural tank.

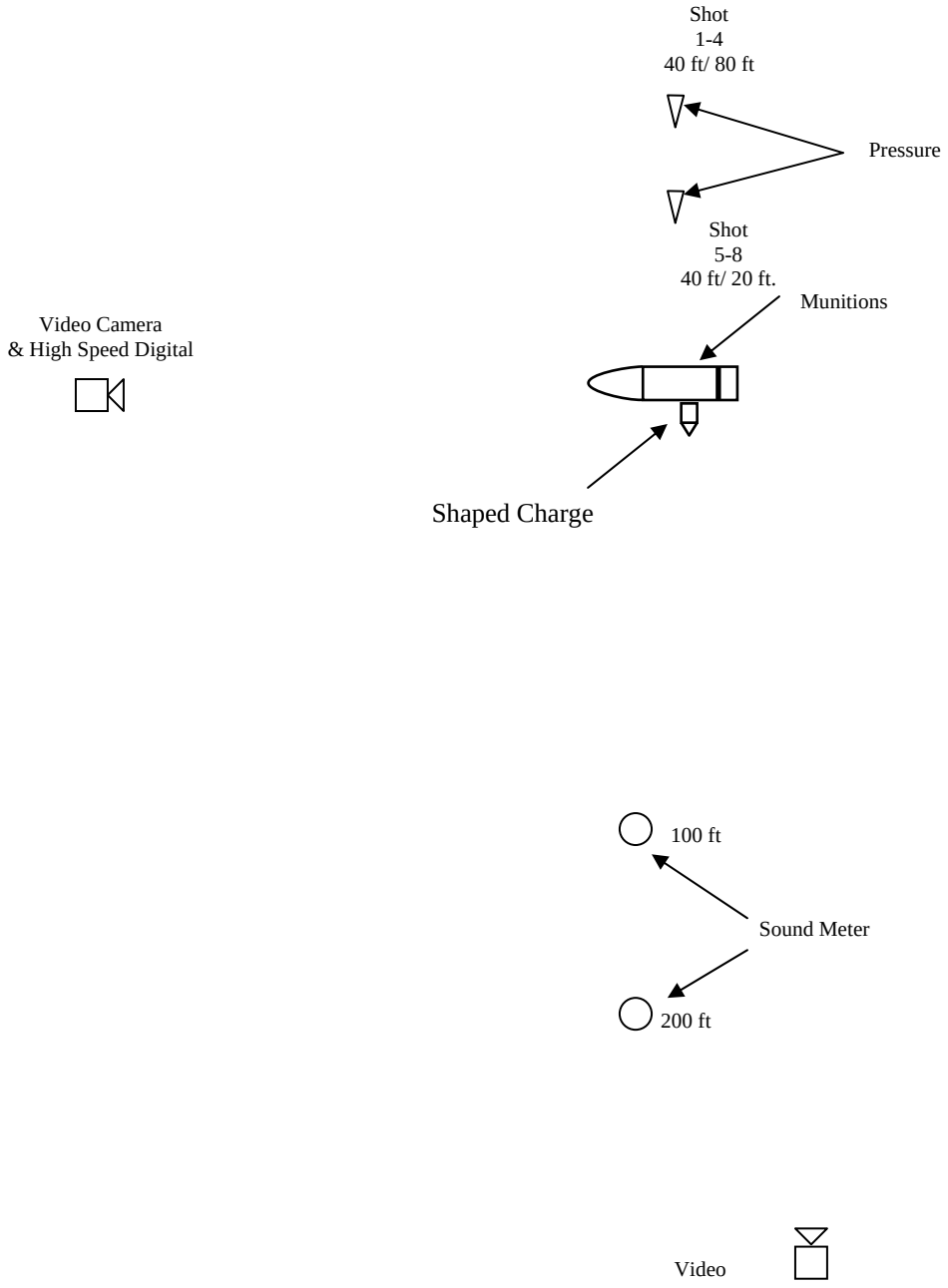


FIGURE 2 – Instrument and Camera Layout for Phase Two Tests

2.2.1.1 Water Contained in 55 Gallon Drums

After placing the 155 mm M107 with the initiator in the hole (see Figure 3), a sheet of ¾ inch plywood was placed over the hole and two layers of 55 gallon drums were placed over the projectile. A total of 28 drums were used with a witness panel placed between the layers and around the outside of the drums. This layout is shown in Figure 4.

The barrels were thrown seventy feet into the air. One barrel, mostly intact, was recovered about 300 feet from ground zero. It had apparently rolled part of this distance. The rest of the barrels were recovered within 100 feet of the crater.

A partially destroyed barrel was recovered approximately 55 feet from the crater with a 3 inch long fragment embedded in the inside surface. Beside this barrel was another fragment about 2 inches long, which may have fallen out of the barrel as it rolled. A small fragment was found inside one of the barrels from the top layer. Several fragments were found between 30 and 40 feet from the crater.

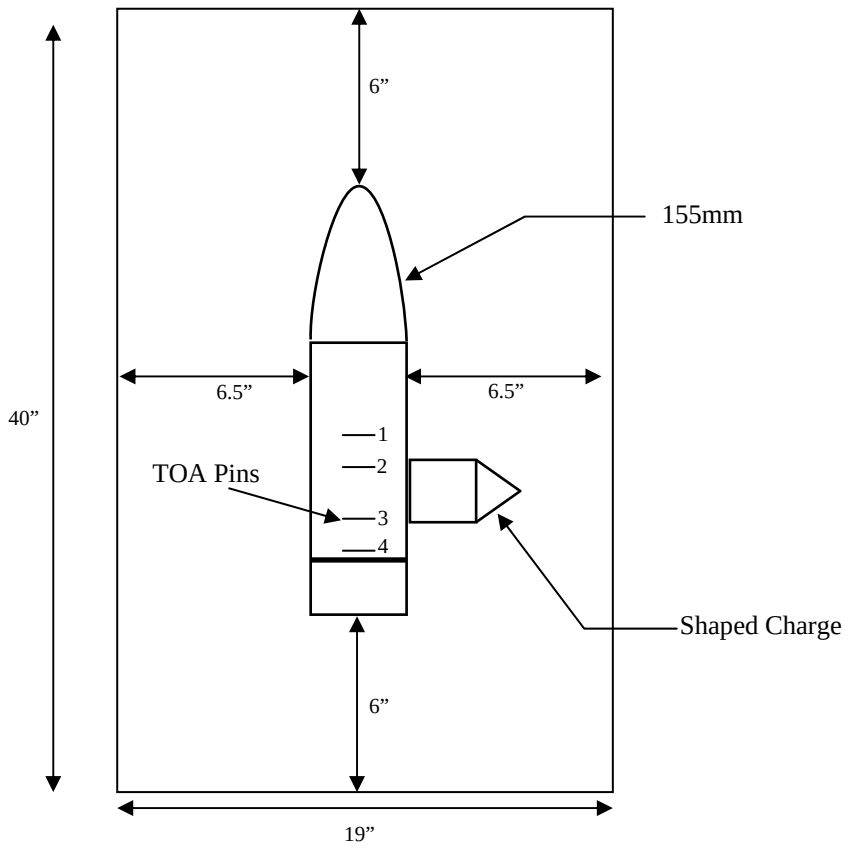
A small fragment hole (about ¼ inch in diameter) was found in the witness plate that was between the layers of barrels. The penetration appeared in the gap between barrels indicating that at least part the fragments path was through air and not water. The top barrel directly over the charge was perforated on the bottom and a circular section over the charge was dented by fragments but not perforated at the top.

Airblast and sound pressure measurements (converted from decibels to psi) are plotted against open-air blast pressure curves for a 155 mm M107 projectile in Figure 5.

Fragments from the 155 mm M107 projectile can penetrate more water than the 3 ft height of the barrels. Because there are significant gaps between the barrels when they are stacked (even more so on uneven ground), a greater area must be covered with barrels to insure that fragments do not escape. This method is very time consuming. Several hours were required to stack and fill all the barrels with water.

2.2.1.2 Water Contained in 1100 Gallon Agricultural Tank

An 1100 gallon agricultural tank was placed over the munition and filled with water. The cylindrical tank was 7 feet in diameter and 58 inches tall. The opaque plastic was approximately 1/8 inch thick. The test layout is shown in Figure 6. The detonation tore the tank into large pieces. One piece was recovered approximately 250 feet from ground zero. One fragment was embedded in the inner side of a piece of the tank but no fragments penetrated the tank.



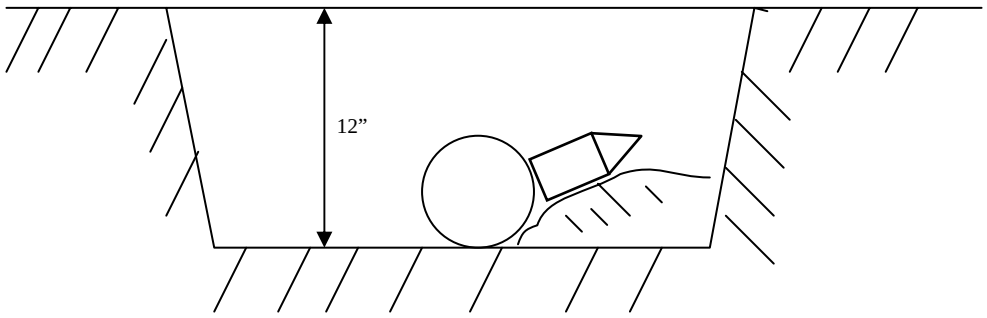


FIGURE 3 – Munition and Initiator Placement for 155 mm M107 Projectiles

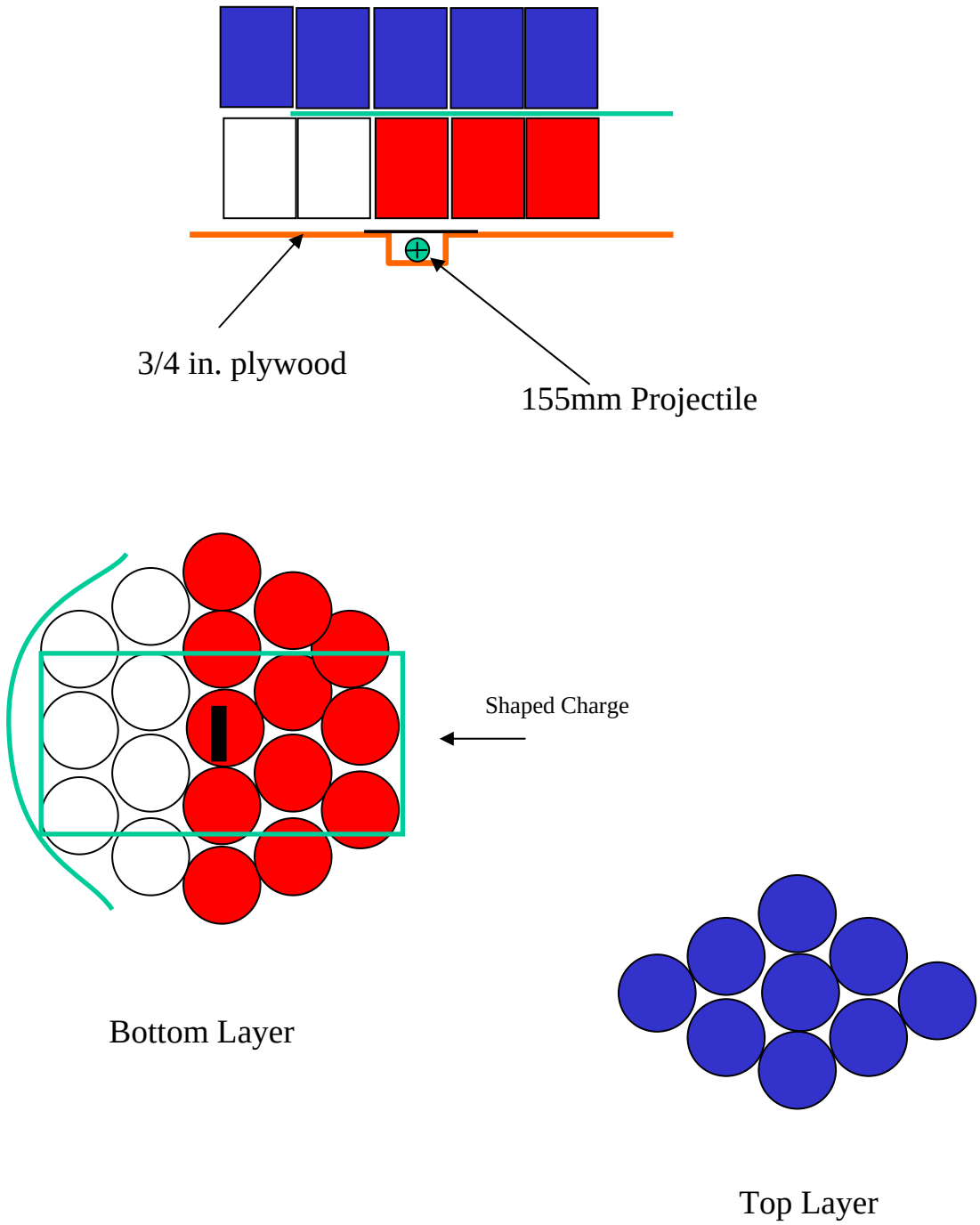


FIGURE 4 – Test Layout for 155 mm M107 Under 55 Gallon Drums

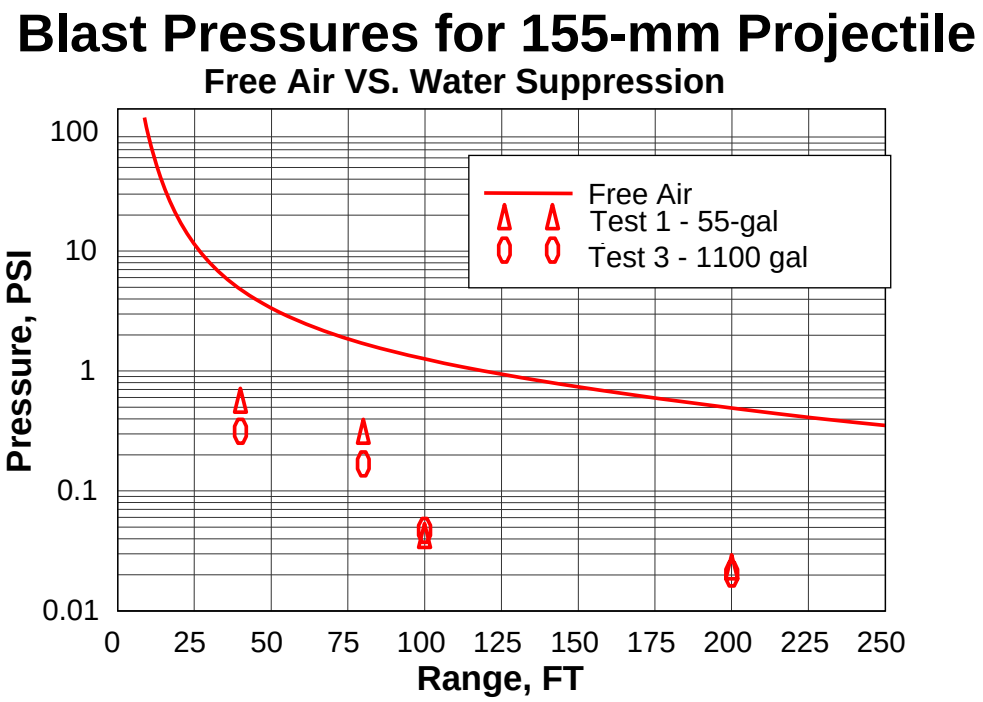


FIGURE 5 – 155 mm M107 Blast Pressures

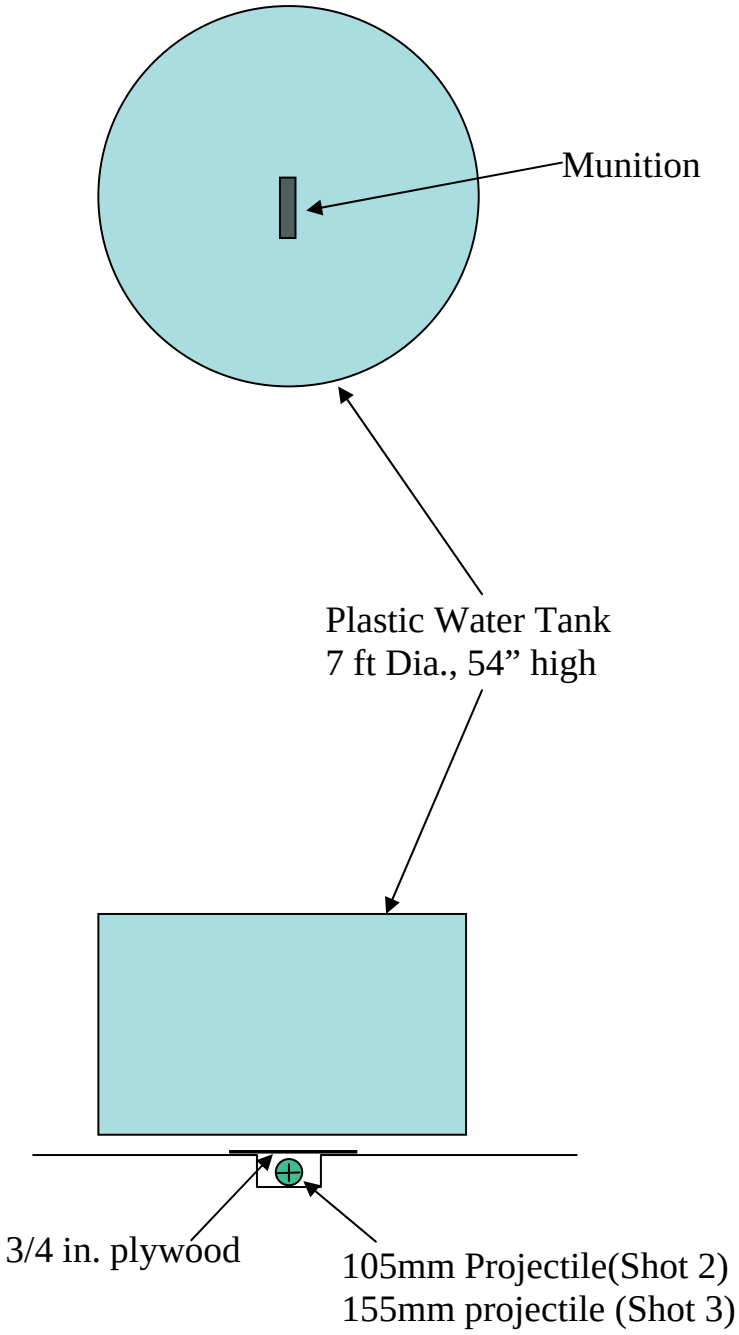


FIGURE 6 – Layout for Tests Using 1100 Gallon Agricultural Tank

2.2.2 105 mm M1 Projectile

Two water containment systems were tested with the 105 mm M1 projectile. The first system was two layers of 55 gallon drums and the second system was a single 1100 gallon agricultural tank.

2.2.2.1 Water Contained in 55 Gallon Drums

After placing the 105 mm M1 with the initiator in the hole (see Figure 7), a sheet of ¾ inch plywood was placed over the hole and two layers of 55 gallon drums were placed over the projectile. A total of 22 drums were used with a witness panel placed between the layers and around the outside of the drums. This layout is shown in Figure 8.

Several fragments penetrated the witness panel between the layers of drums and there were a few dents where the panel was impacted but the fragments did not penetrate. As in the 155 mm M107 test, the fragments penetrating the witness panel were in the gaps between barrels.

The furthest drum was recovered 70 feet from ground zero. Most of the top layer of drums seemed to come straight back down and land in or near the crater. Two of the drums in the crater were undamaged and full of water.

Airblast and sound pressure measurements (converted from decibels to psi) are plotted against open-air blast pressure curves for a 105 mm M1 projectile in Figure 9.

2.2.1.2 Water Contained in 1100 Gallon Agricultural Tank

The test layout is shown in Figure 6. Most debris was within 35 feet of the crater. A number of fragments were found within 50 feet of ground zero, including a piece of the base plate at 50 feet off the base end of the munition. A large piece of the tank was found at 180 feet. A 6 inch long fragment was stuck in the plastic with the bulk of the fragment on the inside of the tank. There were several dents in the witness panels, but only one complete penetration and the fragment causing this penetration was found within a few feet of the panel. Only one obvious exit hole was found in the side of the tank.

The tank is light, easy to place and, because of a large filler hole, can be filled with water in just a few minutes. This container defeated essentially all of the fragments. The one or two that did penetrate the container had been slowed enough that they did not travel any distance. The container pieces traveled further than these primary fragments.

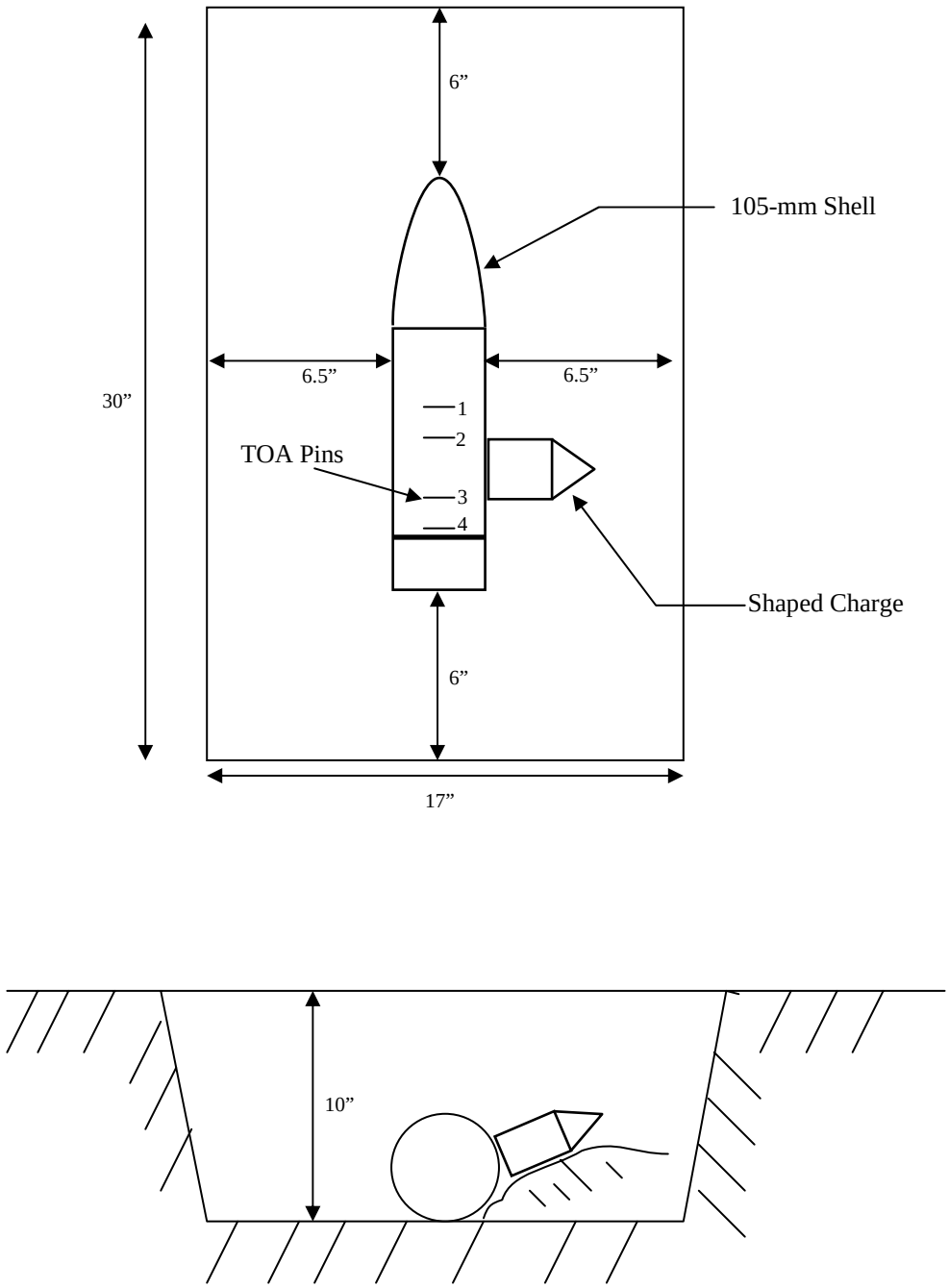


FIGURE 7 – Munition and Initiator Placement for 105 mm M1 Projectiles

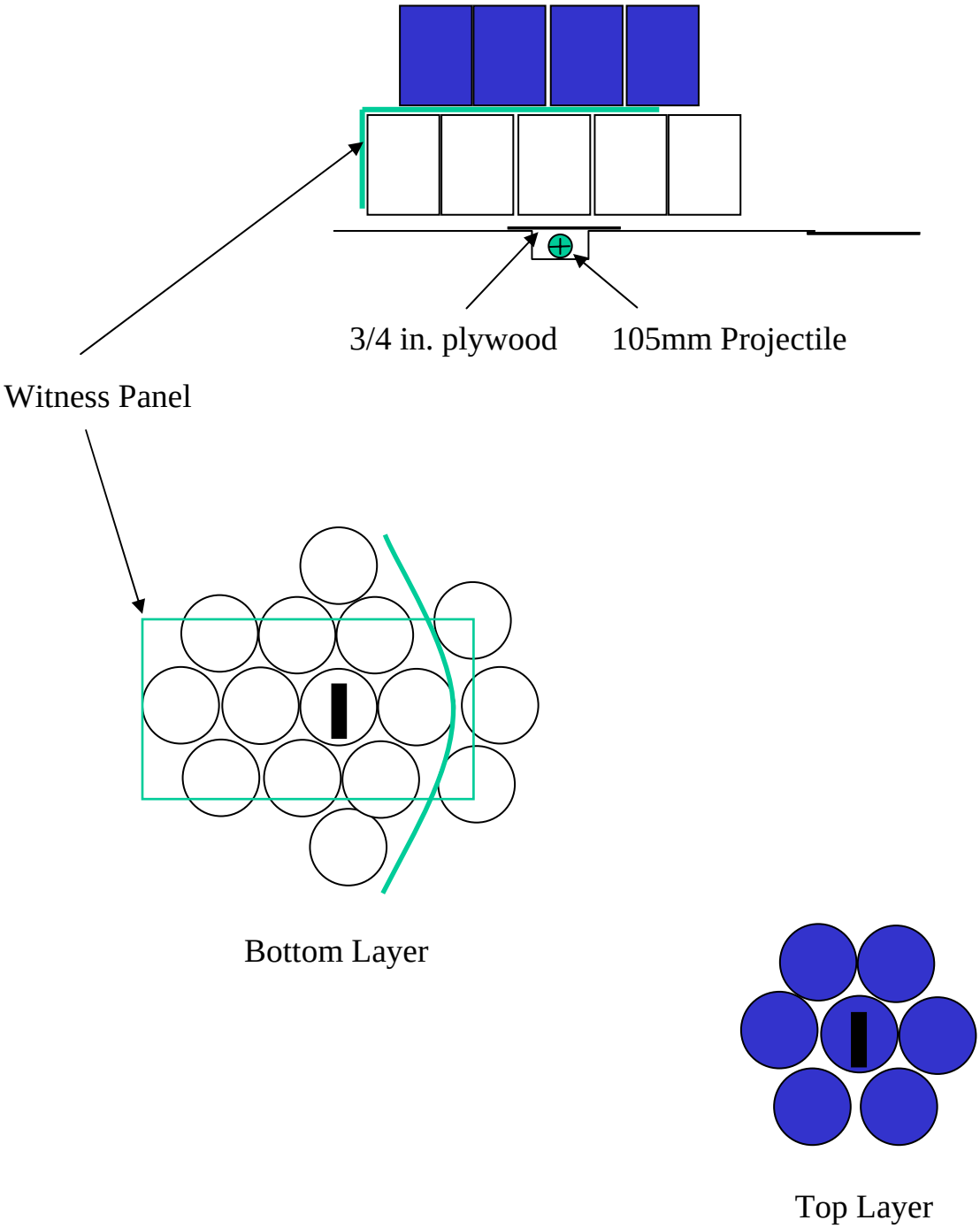


FIGURE 8 - Test Layout for 105 mm M1 Under 55 Gallon Drums

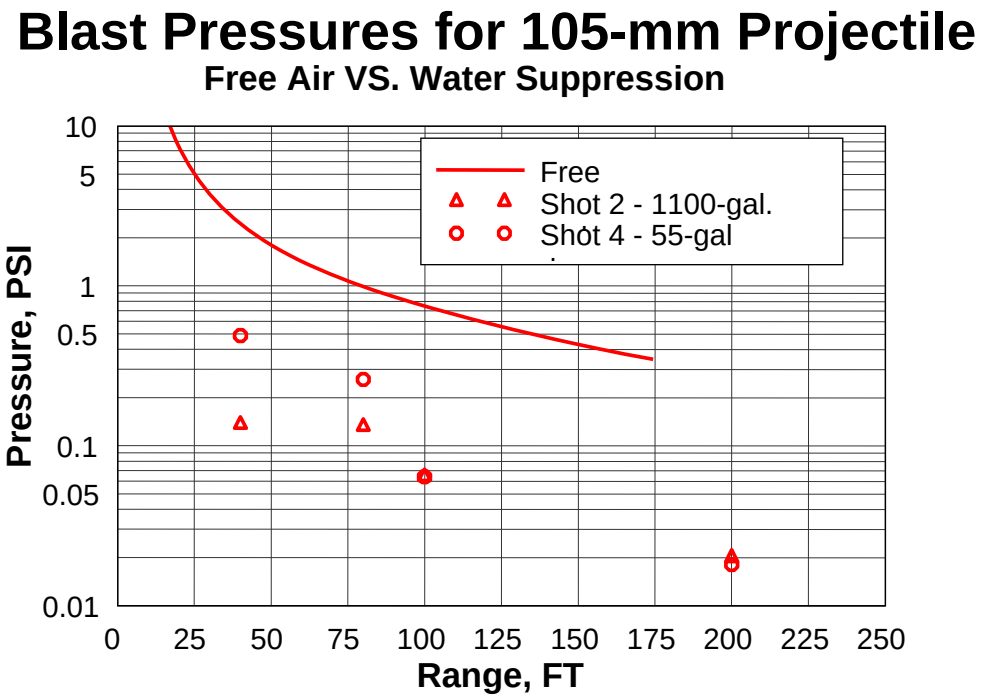


FIGURE 9 - 105 mm M1 Blast Pressures

2.2.3 81 mm M362A Mortar

Two water containment systems were tested with the 81 mm M362A mortar. The first system was two layers of 5 gallon plastic carboys and the second system was a 90 inch diameter inflatable wading pool.

2.2.3.1 Water Contained in 5 Gallon Carboys

After placing the 81 mm M362A with the initiator in the hole (see Figure 10), a half sheet of ¾ inch plywood was placed over the hole and two layers of 5 gallon carboys were placed over the mortar. A total of 31 carboys were used with a witness panel placed between the layers and around the outside of the carboys. This layout is shown in Figure 11.

There was one small fragment hole in the witness panel over the bottom layer of containers and a larger hole about 3 inches long and an inch wide right behind the rear of the munition, probably made by the tail fin. One carboy was found off the side of the stack in the woods at 223 feet and another in a pond about 240 feet off the nose end of the munition. Several were found at distances near 100 feet. Many were still full of water. The tail fin of the mortar was recovered intact directly to the rear of the munition at a distance of 107 feet. Blast pressures from the 81 mm tests are shown in Figure 12.

2.2.3.2 Water Contained in 90 inch Inflatable Wading Pool

After placing the 81 mm M362A with the initiator in the hole, a half sheet of ¾ inch plywood was placed over the hole and a 90 inch diameter inflatable wading pool was placed over the mortar (see Figure 16). The water depth was 18 inches. A witness panel was placed over the pool.

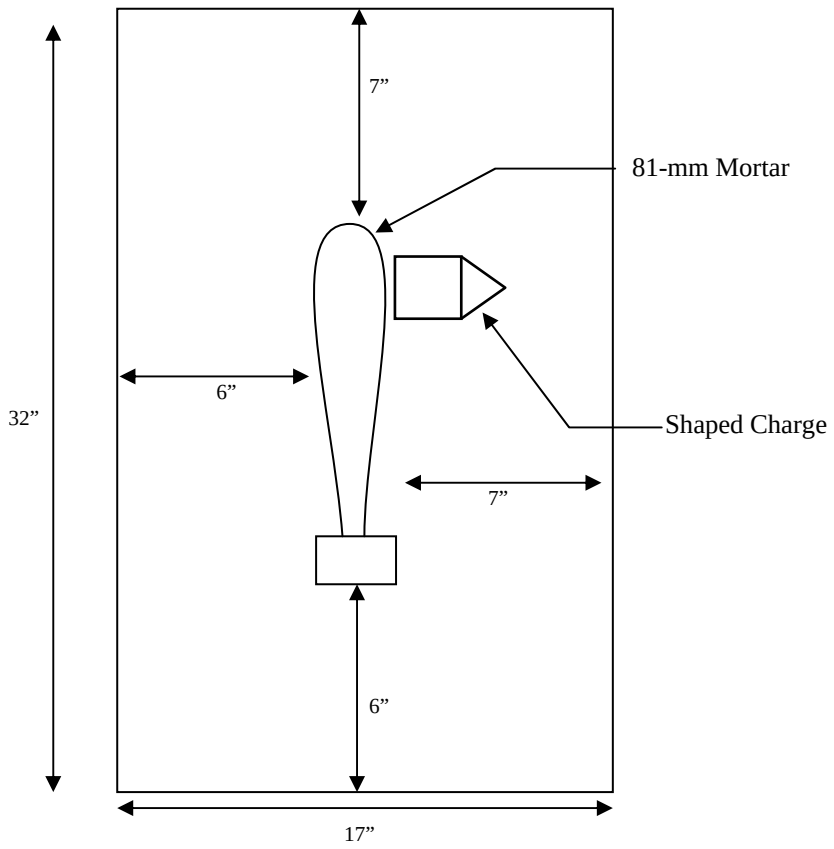
The witness panel was thrown several feet into the air. A hole was blown in the bottom of the pool but the inflated perimeter of the pool was essentially intact. The side of the pool had a small puncture on the inside that caused it to slowly deflate. The witness panel was not perforated.

2.2.4 60 mm M49A4 Mortar

Two water containment systems were tested with the 60 mm M49A4 mortar. The first system was two layers of 5 gallon plastic carboys and the second system was a 90 inch diameter inflatable wading pool.

2.2.4.1 Water Contained in 5 Gallon Carboys

After placing the 60 mm M49A4 with the initiator in the hole (see Figure 13), a half sheet of ¾ inch plywood was placed over the hole and two layers of 5 gallon carboys were placed over the mortar. A total of 11 carboys were used with a



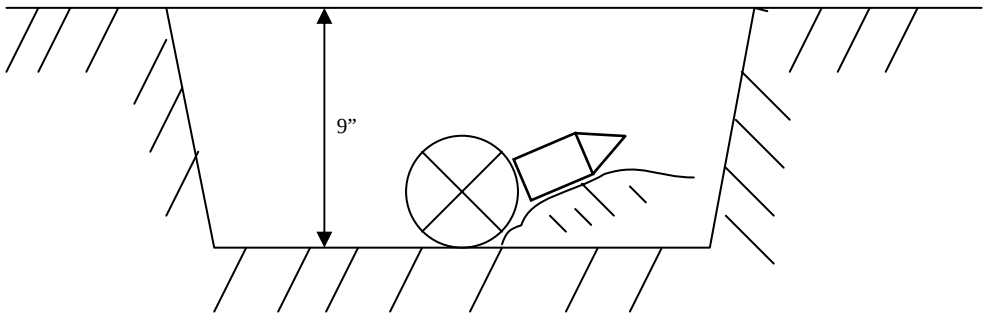


FIGURE 10 – Munition and Initiator Placement for 81 mm M362A Mortars

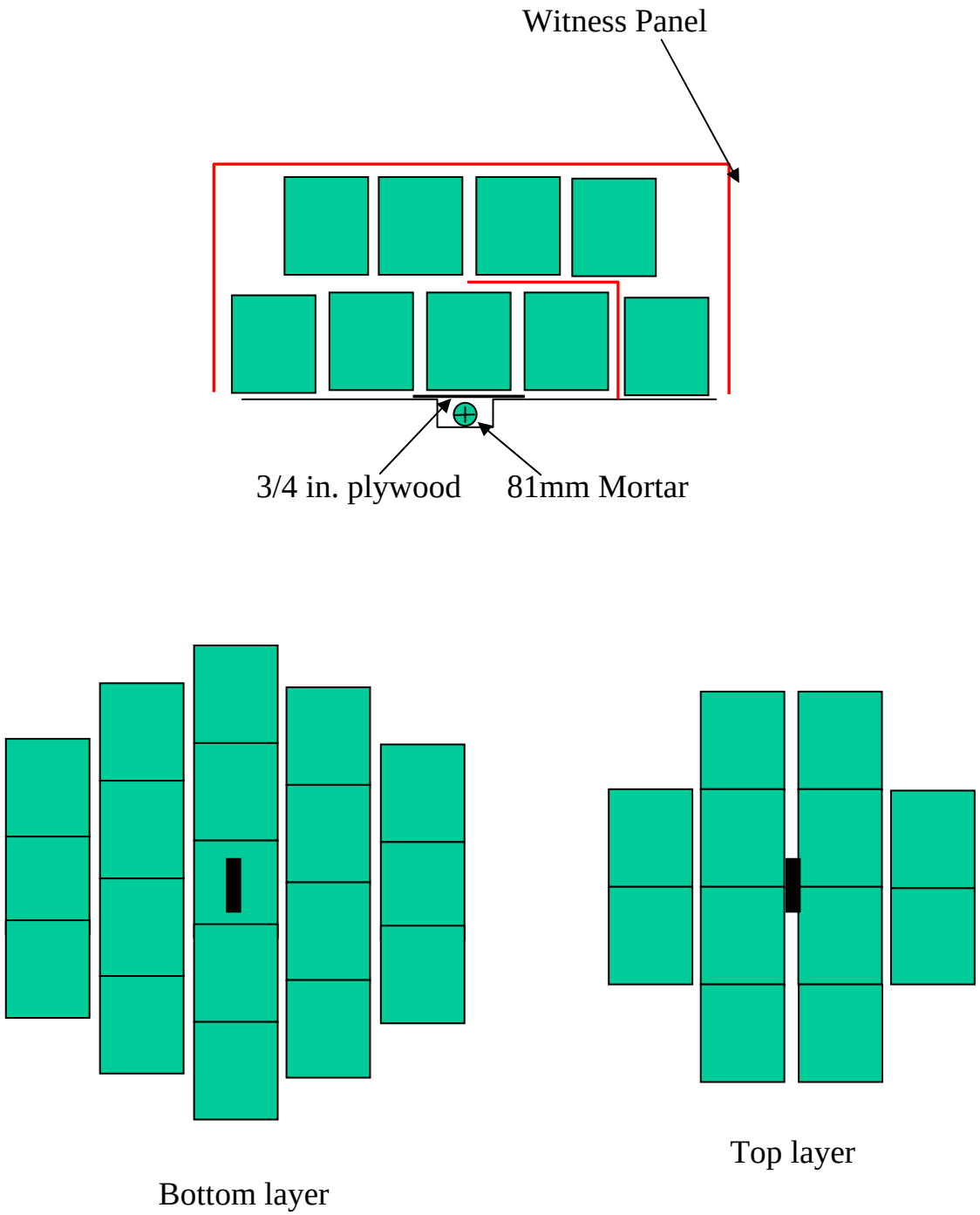


FIGURE 11 - Test Layout for 81 mm M362A Under 5 Gallon Carboys

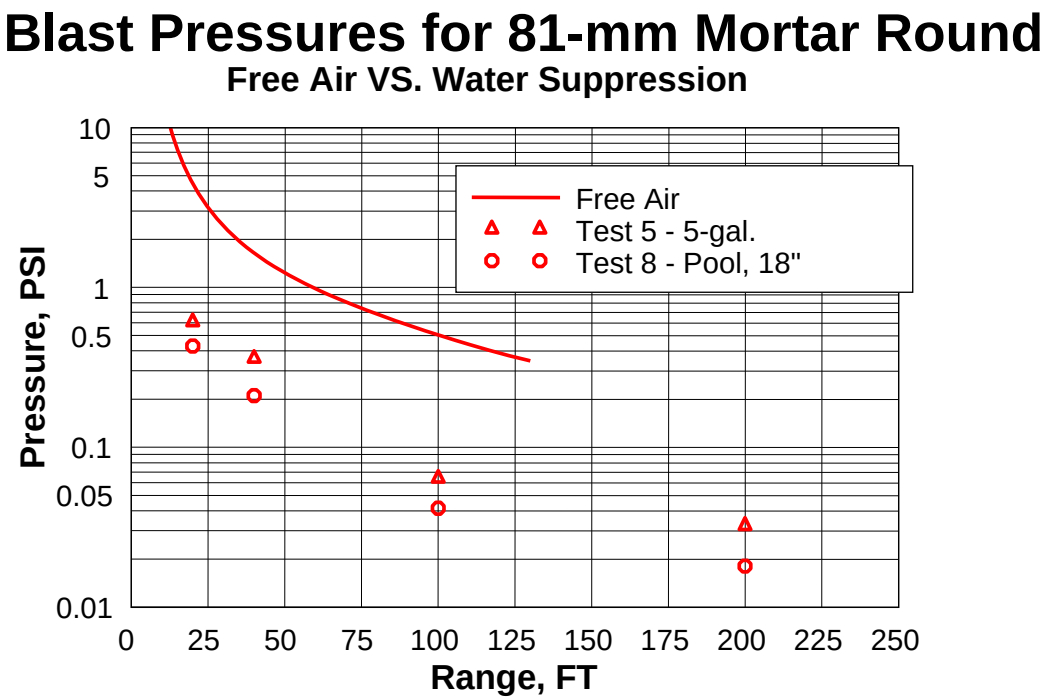


FIGURE 12 - 81 mm M362A Blast Pressures

witness panel placed between the layers and around the outside of the carboys. This layout is shown in Figure 14.

The carboys were thrown more than 100 feet into the air. Those on top landed within 10 feet of the crater. It was observed that the containers on the outer layers are the ones thrown the furthest. The most distant carboy on this test was recovered 44 feet from the nose of the munition. There were no holes in the witness panels. The blast pressures for the 60 mm tests are shown in Figure 15.

2.2.4.2 Water Contained in 90 inch Inflatable Wading Pool

After placing the 60 mm M49A4 with the initiator in the hole, a half sheet of ¾ inch plywood was placed over the hole and a 90 inch diameter inflatable wading pool was placed over the mortar (see Figure 16). The water depth was 18 inches. A witness panel was placed over the pool.

The witness panel was thrown off of the pool. A hole was blown in the bottom of the pool but the inflated perimeter of the pool was not punctured. There were no perforations or even dents in the witness panel.

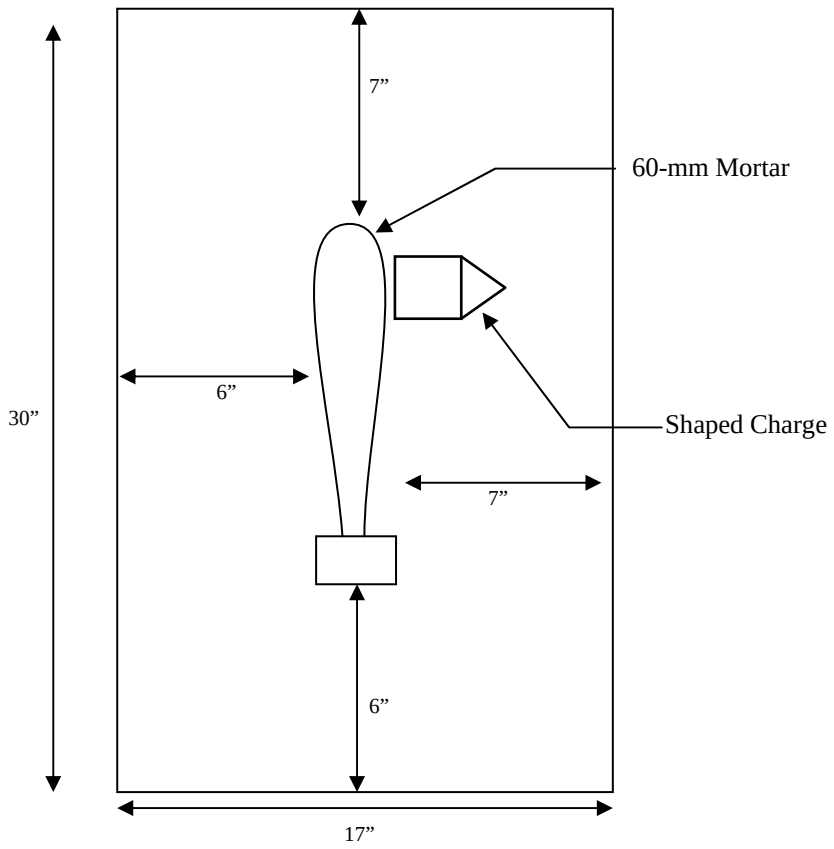
2.2.5 Phase Two Summary and Conclusions

Water is an excellent medium for mitigating blast and fragmentation due to the intentional detonation of unexploded ordnance. Test results show that noise due to detonation is reduced by the water and the fragments from the munitions can be defeated by water.

The best results were obtained using single containers for the water. When multiple containers are used fragments can travel through gaps between containers and the containers are thrown some distance by the blast. Also, containers that are not rigid seem to be a better option than rigid containers because the pieces of the non-rigid containers are smaller, lighter (non-hazardous) and don't travel as far. Non-rigid containers require a more level ground surface but the sides could be supported by soil or sandbags.

As the required thickness of water increases, rigid sides are necessary to contain the large volumes of water and the rigid sides may contribute to the secondary fragment distances. The small pools are readily available at local stores during the spring and early summer but may be difficult to obtain at other times. The agricultural tanks are available any time but may need to be ordered requiring advance planning.

Whenever possible a half sheet (4 ft x 4 ft) of plywood rather than a full sheet (8 ft x 8 ft) should be used under the charge. All of the plywood should be covered by the water container(s) to minimize debris from the plywood.



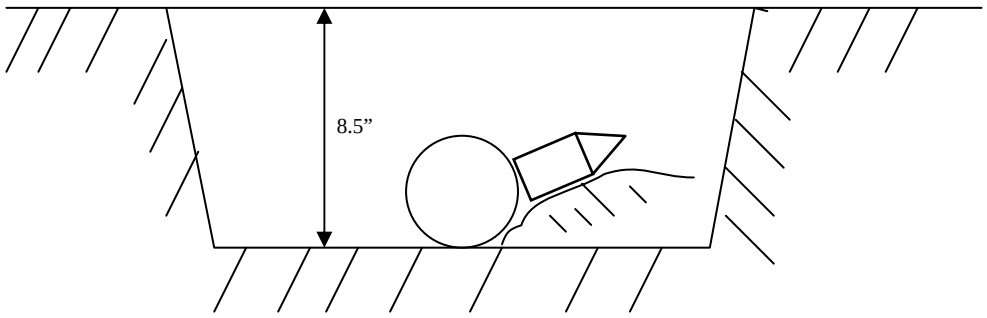


FIGURE 13 – Munition and Initiator Placement for 60 mm M49A4 Mortars

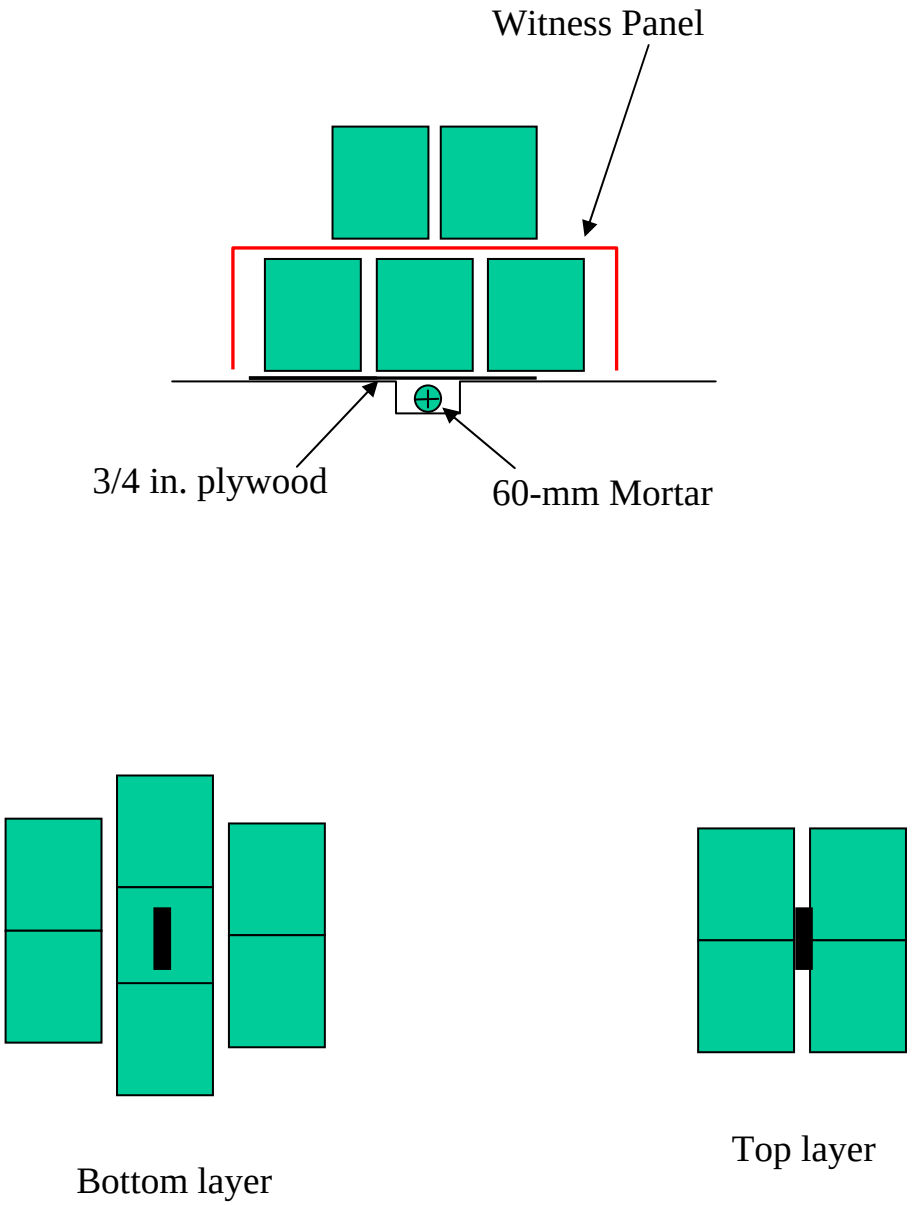


FIGURE 14 - Test Layout for 60 mm M49A4 Under 5 Gallon Carboys

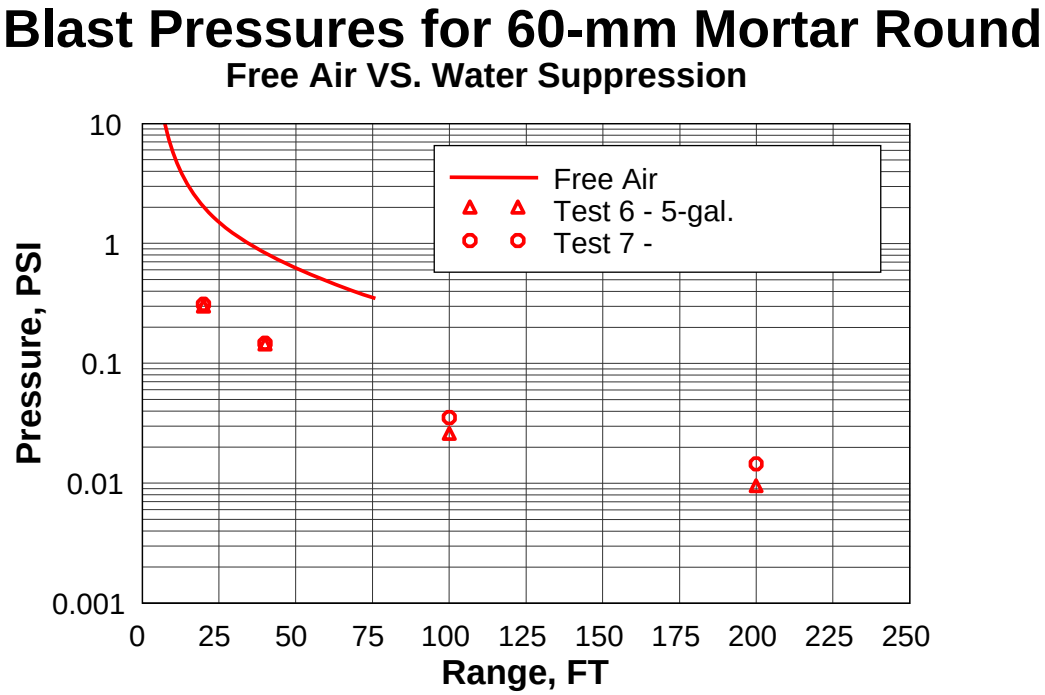


FIGURE 15 - 60 mm M49A4 Blast Pressures

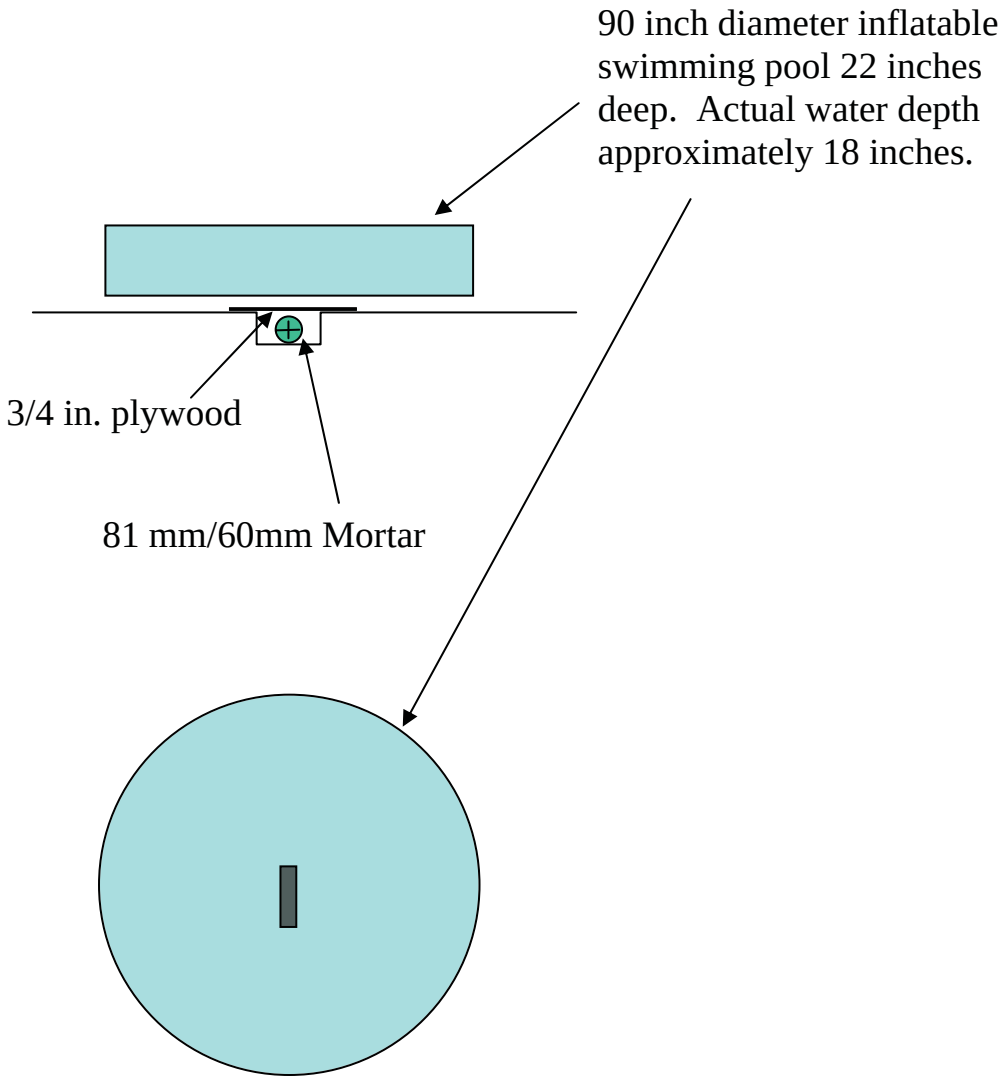


FIGURE 16 - Test Layout for 81 mm M362A and 60 mm M49A4 Under Inflatable Pool

Care should be taken to insure that there are no water spills of sufficient volume to the hole in which the munition is located. This could lead to a misfire. Also, as observed in phase one, the water may cause sufficient confinement to increase fragment size and penetration capabilities.

3.0 Water Mitigation for Intentional Detonations

3.1 Water Containment System

Based on the results from the Phase Two tests, the fragments from an intentional detonation of a 155 mm M107 or a 105 mm M1 projectile are defeated using an 1100 gallon agricultural tank filled with water. The 55 gallon drums are not a viable system for defeating fragments from an intentional detonation because of the gaps between the cylindrical barrels. The fragments from an intentional detonation of an 81 mm M362A or a 60 mm M49A4 mortar are defeated using either a system of 5 gallon plastic carboys or a 90 inch diameter, 18 inch deep wading pool. The results of the Phase Two tests are summarized in Table 7. To be conservative, the maximum secondary debris throw distance shown in Table 7 is 10% greater than the measured maximum secondary debris throw distance. Due to the small values, the overpressures have not been increased from the measured values.

TABLE 7 – Summary of Results From Phase Two Tests

Munition	Water Containment System	Max. Secondary Debris Throw Distance (ft)	Max Peak Overpressure (psi)				
			@ 20 ft	@ 40 ft	@ 80 ft	@ 100 ft[A]	@ 200 ft[A]
155 mm M107	1100 gal. Tank	275		0.28	0.15	0.0415	0.018
105 mm M1	1100 gal. Tank	198		0.136	0.132	0.064	0.02
81 mm M362A	5 gal. Carboys	264	0.61	0.36		0.064	0.0325
81 mm M362A	Inflatable Pool	See note	0.43	0.21		0.0415	0.018
60 mm M49A4	5 gal. Carboys	48	0.29	0.14		0.0251	0.0092
60 mm M49A4	Inflatable Pool	See note	0.31	0.147		0.0352	0.0145

[A]Pressure calculated from measured sound level.
Note: Inflatable pool did not produce any hazardous secondary debris.

The four munition types tested do not cover all of the munitions that may be encountered. To determine the water containment system required for a particular munition other than those tested, the approach is as follows:

(1) Determine the initial fragment velocity (v_f) in ft/s, the maximum fragment weight (W_f) in pounds, and the equivalent weight kinetic energy ($W_f v_f^2/2$) in lb-ft^2/s^2 for the particular munition.

(2) Identify the munition with the next largest kinetic energy from the four tested munitions.

(3) Use the water containment system from Table 7 for the tested munition with the next largest kinetic energy shown.

The maximum fragment weight, the initial fragment velocity, and the resulting kinetic energy for a variety of munitions are provided in Table 8. Table 8 also shows the suitable water containment system for these munitions. The munition/initiator placements and water containment systems are detailed in Figures 3, 6, 7, 10, 11, 13, 14, and 16. The maximum fragment weight and the initial fragment velocity values have been determined with the Mott and Gurney equations, as presented in TM 5-1300 [1] and detailed in HNC-ED-CS-S-98-1 [2]. This procedure should not be used to extrapolate water containment systems for munitions larger than the 155 mm M107 projectile.

3.2 Minimum Separation Distance

A minimum separation distance is required for any detonation. This minimum separation distance applies to everyone, both public and operational personnel. The minimum separation distance is the maximum of the debris throw distance, the distance to an overpressure of 0.065 psi (corresponds to $K328 = 328W^{1/3}$, where W is the net explosive weight), or 200 ft. For all munitions tested the overpressure at 200 ft was substantially less than 0.065 psi. In some cases, the debris throw distance exceeds 200 ft. The minimum separation distances are listed in Table 8.

4.0 Summary and Conclusions

A test program has been performed to determine the effects of water for mitigating fragments and blast effects due to an intentional detonation of a munition. Tests were performed using four different munitions and two water containment systems for each munition.

The results of these tests have been used to develop guidelines for the use of water to mitigate fragments and blast effects due to an intentional detonation of a munition. Methods for determining the required water containment system and the resulting minimum separation distance are detailed in Section 3.0. Figures 3, 6, 7, 10, 11, 13, 14, and 16 show the resulting munition/initiator configuration and water containment systems.

In addition to mitigating the fragments and the overpressure, water quenches the fireball due to an explosion. Therefore, this system insures that there in no fire hazard from an intentional detonation.

5.0 References

1. TM 5-1300, “Structures to Resist the Effects of Accidental Explosions”, Departments of the Army, the Navy, and the Air Force, November 1990.

2. HNC-ED-CS-S-98-1, “Methods for Predicting Primary Fragmentation Characteristics of Cased Explosives”, M. Crull, U.S. Army Engineering and Support Center, Huntsville, January 1998.

TABLE 8 – Water Containment System and Minimum Separation Distance

Munition	Max Fragment Weight (lb)	Critical Fragment Velocity (fps)	Equivalent Weight Kinetic Energy 10^6 (lb-ft^2/s^2)	Water Containment System	Minimum Separation Distance (ft)
20 mm M56A4	0.00058	3183	0.0029503	5 gal carboys/ inflatable pool	200
25 mm M792	0.00820	4256	0.0742528	5 gal carboys/ inflatable pool	200
M31 Rifle Grenade[A]	0.000361	11642	0.0244643	5 gal carboys/ inflatable pool	200
VB Rifle Grenade Mark I	0.0078	3660	0.0522428	5 gal carboys/ inflatable pool	200
37 mm Mk I, LE Practice	0.034207	1368	0.0320079	5 gal carboys/ inflatable pool	200
37 mm MK II	0.02953	5758	0.4894774	5 gal carboys	264
				inflatable pool	200
40 mm M406	0.00036	4508	0.0036986	5 gal carboys/ inflatable pool	200
GP Grenade M42 (submunition)[A]	0.00035	5805	0.0058803	5 gal carboys/ inflatable pool	200
40 mm MK2 Mod 0	0.03306	3605	0.2148275	5 gal carboys/ inflatable pool	200
40 mm HEDP M433	0.00023	11313	0.0147821	5 gal carboys/ inflatable pool	200
M73 Submunition	0.00200	8059	0.0649475	5 gal carboys/ inflatable pool	200
57 mm Chinese	0.01940	5500	0.2933645	5 gal carboys/ inflatable pool	200
57 mm M306	0.01291	3495	0.0788236	5 gal carboys/ inflatable pool	200
MK II Grenade	0.014217	3425	0.0833871	5 gal carboys/ inflatable pool	200
M39 Submunition	0.00011	2338	0.0003006	5 gal carboys/ inflatable pool	200
2.36 " Rocket (Case Only)	0.001035	8888	0.0408807	5 gal carboys/ inflatable pool	200
60 mm M49A3	0.02367	5114	0.3095835	5 gal carboys/ inflatable pool	200
60 mm M49A5	0.01660	6290	0.328382	5 gal carboys/ inflatable pool	200
M15 WP Grenade	0.00340	2685	0.0122557	5 gal carboys/ inflatable pool	200
BLU-59, BLU-26, BLU-36 Submunition	0.00152	6278	0.0299541	5 gal carboys/ inflatable pool	200

TABLE 8 (cont) - Water Containment System and Minimum Separation Distance

Munition	Max Fragment Weight (lb)	Critical Fragment Velocity (fps)	Equivalent Weight Kinetic Energy 10^6 (lb-ft^2/s^2)	Water Containment System	Minimum Separation Distance (ft)
Fragmentation Grenade, M67 (approx)	0.0011828	7006	0.0290283	5 gal carboys/ inflatable pool	200
2.75" M229 Rocket	0.005217	5569	0.0808994	5 gal carboys/ inflatable pool	200
6 lb Incendiary Bomb	0.0021	9431	0.0933909	5 gal carboys/ inflatable pool	200
FMU 54A/B Fuze	0.0064491	9031	0.2629909	5 gal carboys/ inflatable pool	200
75 mm M48	0.15303	3471	0.921814	1100 gal tank	200
3"/50 AP Mk 29	0.42992	1058	0.240619	5 gal carboys/ inflatable pool	200
3 in Stokes Mortar	0.04360	6189	0.835023	1100 gal tank	200
M1A1 Anti-Tank Mine	0.0138139	9891	0.6757199	5 gal carboys	264
				inflatable pool	200
4 lb Frag Bomb M83	0.076176	3266	0.4062754	5 gal carboys	264
				inflatable pool	200
81 mm M374	0.03083	6721	0.6963488	5 gal carboys	264
				inflatable pool	200
81 mm M56	0.03270	5724	0.5356943	5 gal carboys	264
				inflatable pool	200
3.5" M28A2 Rocket Case	0.05242	6126	0.9836056	1100 gal tank	200
90 mm M71	0.3426	2335	0.9339661	1100 gal tank	200
90 mm HEAT M371	0.124	3075	0.5862488	5 gal carboys	264
				inflatable pool	200
20 lb Frag Bomb M41	0.33321	3303	1.8176287	1100 gal tank	275
4 in Stokes Mortar	0.07820	6336	1.5696915	1100 gal tank	200
105 mm M1	0.20573	4055	1.6914479	1100 gal tank	200
105 mm HEAT M456	0.07010	6326	1.4026406	1100 gal tank	200
106 mm M344 (Case)	0.0630543	6238	1.2268048	1100 gal tank	200
4.2 in M3A1	0.07869	6391	1.6069785	1100 gal tank	200
British Naval 4.5"	0.408519	2461	1.237102	1100 gal tank	200
4.5 inch rocket M8	0.1485	5352	2.1268099	1100 gal tank	275
4.7 in Mark I	0.59147	3566	3.7606709	1100 gal tank	275
120mm M356	0.32909	3493	2.0076278	1100 gal tank	275
5 in 38 Caliber Mk 35	0.36485	3563	2.3158861	1100 gal tank	275
6" Trench Mortar	0.11418	3939	0.8857615	1100 gal tank	200
155 mm M107	0.64821	3426	3.8041893	1100 gal tank	275

[A]These rounds contain a shaped charge. Care must be taken that the destruction method does not allow formation of a jet and fragment slug.

STANDARD OPERATING PROCEDURE
MRP SOP 08
UXO DOCUMENTATION

1.0 SCOPE AND APPLICABILITY

This document is designed to set a standard operating procedure (SOP) for the documentation of unexploded ordnance (UXO) related field operations during activities performed under the Munitions Response Program (MRP). The purpose of this SOP is to identify and designate the field data record forms, logs, and reports generally initiated and maintained for documenting munitions related projects performed by Tetra Tech. This SOP is not site-specific, but rather is intended as a general guidance document for a variety of sites and conditions. Documents presented within this SOP (or equivalents) shall be used for all Tetra Tech munitions related field activities, as applicable. Other or additional documents may be required by specific client contracts or project planning documents.

2.0 PERSONNEL QUALIFICATIONS

UXO personnel shall be graduates of a military Explosive Ordnance Disposal (EOD) School of the United States, Canada, Great Britain, Germany, or Australia or a graduate of a formal training course of instruction or EOD assistant course as stated in DDESB TP-18.

Project Manager (PM)

The Project Manager is responsible for placing all field documentation used in site activities (i.e., records, field reports, sample data sheets, field notebooks, and the site logbook) in the project's central file upon the completion of fieldwork.

Senior UXO Supervisor (SUXOS)/ Field Operations Leader (FOL)

The SUXOS will have a minimum of 10 years experience in all aspects of munitions response actions or range clearance activities. A minimum of 5 years of the experience shall be in supervisory positions.

The SUXOS/FOL is responsible for ensuring that the site logbook, notebooks, and all appropriate and current forms and field reports included in this SOP (and any additional forms required by the contract) are correctly used, accurately filled out, and completed in the required time frame.

UXO Team Leader (UXO Technician III)

The UXO Team Leader will have a minimum of 8 years of EOD/UXO experience including prior military EOD and/or commercial UXO experience in munitions response actions, and/or range clearance activities. The UXO Team Leader may supervise up to six UXO technicians. The UXO Team Leader will conduct UXO activities as directed by the project manager (PM) and

UXO Manager. The UXO Team Leader will be under the direct supervision of the UXO Manager.

UXO Quality Control Specialist (UXOQCS)

The UXOQCS shall have a minimum of 8 years experience in all phases of munitions response actions and/or range clearance activities. The UXOQCS shall have completed corporate quality assurance and UXO quality control training.

UXO Safety Officer (UXOSO)

The UXOSO shall have a minimum of 8 years experience in all phases of munitions response actions and/or range clearance activities. The UXOSO shall have completed 30-hour Construction Safety course or other approved specialized safety training.

3.0 FIELD FORMS

All Tetra Tech MRP related field forms (see list in Table 1 of this SOP) can be found on the MRP Website. (http://www.ttnus.com/MRPRepository/). This website serves as a centralized portal to facilitate data exchange for field personnel, GIS staff, and Tetra Tech Project Managers. The website contains a "Reference" page that will contain the latest version of this SOP and other valuable documentation. For general questions about the use of the MRP website, please contact Doug Schloer (douglas.schloer@tetratech.com).

Forms may be altered or revised for project-specific needs, subject to UXO Program Manager and Tetra Tech Project Manager approval. Care must be taken to ensure that all essential information can be documented. This SOP does not include field forms required by other agencies such as Naval Ordnance Safety and Security Activity (NOSSA), Department of Defense Explosives Safety Board (DDESB), or Bureau of Alcohol Tobacco, and Firearms (ATF).

3.1 FIELD FORM TYPES

Four types of field forms are associated with the MRP SOPs. All forms are listed in Table 1 and include Daily Activities Documentation, Quality Control (QC), Health and Safety (H&S), and Miscellaneous Forms.

The Daily Activities Documentation Forms (MRP FF.1 through MRP FF.14) are maintained by the SUXOS and should be used to document daily site activities related to Definable Features of Work and activities associated with specific MRP SOPs such as performing UXO detector-aided surface surveys, digital geophysical mapping (DGM), UXO Intrusive investigations, or munitions and explosives of Concern (MEC) management and treatment.

The QC forms (MRP FF.15 through MRP FF.20) are maintained by the UXOQCS and document daily and periodic quality control activities associated with Definable features of Work and MRP SOPs such as vegetation management, blind seeding, global positioning system (GPS) accuracy, and field documentation.

The MRP H&S Forms (MRP FF.21 through MRP FF.22) are maintained by the UXOSO and document daily and periodic issues related to health and safety. Examples include site-specific training, daily tailgate safety briefings, injuries, and accidents. The UXOSO should review the project site-specific health and safety plan/Accident Prevention Plan (HASP/APP) for additional forms, which are required for each project by the Tetra Tech Corporate H&S Department.

Miscellaneous Forms (MRP FF.23 through MRP FF.24) are maintained by either the UXO Program Manger or SUXOS. The Field Change Request Form is initiated by the either the SUXOS/FOL or UXO Program Manager to document deviations from the project planning documents. A copy of all Field Change Request Form will be emailed to the SUXOS and a copy placed in the Field Files. The Equipment Maintenance-Repair Form is initiated by the SUXOS for any piece of equipment which is in need of maintenance or repair.

4.0 PROCEDURES

4.1 SITE LOGBOOK/DAILY MEC ACTIVITY LOG/DAILY QC LOG/DAILY SAFETY LOG

The site logbook is a hard-bound, paginated, controlled-distribution record book in which all major on-site activities are documented. The Daily MEC Activity Log and Daily Safety Log are methods of tracking the progress of field activities by daily transferring field activity information gathered in the logbook to the UXO Program Manager and Tetra Tech Project Manager.

At a minimum, record or reference the following activities/events (daily) in the site logbook, Daily MEC Activity Log, Daily QC Log, and/or Daily Safety Log:

- All field personnel present
- Arrival/departure times and names of site visitors
- Times and dates of health and safety training
- Arrival/departure times of equipment
- Times and dates of equipment calibration and maintenance
- Daily on-site activities referencing the Definable Features of Work as described in the SAP (Worksheet 12)
- All munitions-related or environmentally significant non-munitions-related finds (e.g., drums, staining, construction debris, trash) and their location
- Quality control (QC) Issues
- Health and safety issues (level of protection, personal protective equipment [PPE], etc.)
- Weather conditions

Maintain a site logbook for each project and initiate it at the start of the first on-site activity (e.g., site visit or initial reconnaissance survey). Make entries every day that on-site activities take place involving Tetra Tech or subcontractor personnel. Upon completion of the fieldwork,

provide the site logbook to the PM or designee for inclusion in the project's central file. On a daily basis, email the Daily MEC Activity Log to the UXO Program Manager and Tetra Tech PM for review.
Record the following information on the cover of each site logbook:

- Project name
- TtNUS project number
- Sequential book number
- Start date
- End date

Information recorded daily in the site logbook/Daily MEC Activity Log need not be duplicated in the Daily QC Log, Daily Safety Log, or other field forms but must summarize the contents of these other notebooks/Logs and reference the specific dates in these notebooks/Field Forms for detailed information (where applicable).

Key field team personnel (UXOSO/UXOQCS) will maintain a separate dedicated field notebook to document the pertinent field activities conducted directly under their supervision. The Daily QC Log and Daily Safety Log may be combined in one field notebook if one person is filling both roles on the project team.

On large projects with multiple investigative sites and varying operating conditions, a Field Team Leader may maintain a separate field notebook to document the pertinent field activities conducted directly under their supervision. However, the SUXOS must include all information related to munitions-related items in the Daily MEC Activity Log.

Make all logbook, notebook, and log sheet entries in indelible ink (black pen is preferred). No erasures are permitted. If an incorrect entry is made, cross out the entry with a single strike mark, initial, and date it. At the completion of entries by any individual, the logbook pages used must be signed and dated by the person making the entries. The site logbook must also be signed by the SUXOS/FOL at the end of each day. An example of a typical site logbook entry and Daily MEC Activity Log is shown in Attachment A.

4.2 PHOTOGRAPHS

Sequentially number movies, slides, or photographs taken of a site or any munition-related item to correspond to logbook/notebook entries. Complete an entry in the Daily Photographic Log (MRP FF.6) by entering the photograph number, date, time, initials of the photographer, item/subject description, anomaly identifier, and any additional remarks or comments as the photographs are taken. A series entry may be used for rapid-sequence photographs. The photographer is not required to record the aperture settings and shutter speeds for photographs taken within the normal automatic exposure range. However, for munitions items, treatment locations, or other unique photograph subjects collect a geographical position system (GPS) measurement and record it

Download all photographs onto the SUXOS' project computer daily. Photographs may be emailed directly to the UXO Program Manager or uploaded to the MRP Website (Section 5.3).

At a minimum the following items should be photographed:

- Generally site photographs showing site features (buildings, berms, craters, targets, etc)
- Any munitions-related item such as MEC or munitions potentially presenting an explosive hazard (MPPEH) which require management or treatment
- A representative photograph of the various types of material documented as safe (MDAS) such as scrap material, small arms ammunitions, casings, etc.
- MEC/MPPEH treatment setups (pre and post detonation)
- Documentation of Definable Features of Work such as vegetation management, surveying activities, trenching, performance of manual or mechanical intrusive activities.
- Environmentally significant finds such as drums, staining, construction debris, landfilling material

4.3 Equipment Calibration and Maintenance Forms

The calibration or standardization of monitoring, measuring, or test equipment is necessary to ensure the proper operation and response of the equipment, to document the accuracy, precision, or sensitivity of the measurements, and determine if correction should be applied to the readings. Some items of equipment require frequent calibration, others infrequent. The manufacturer calibrates some equipment; the user calibrates others.

Daily Equipment Checklist

Each instrument requiring calibration has its own Daily Equipment Checklist (MRP FF.3), which documents that the manufacturer's instructions were followed for calibration of the equipment, including frequency and type of standard or calibration device. Maintain an Daily Equipment Checklist for each device (weed eater, mower, brush hog, GPS, Schonstedt GA-52Cx, White's Spectrum XLT, Vallon NMH 3, or digital geophysical equipment) used in the field; make entries for each day the equipment is used noting the time the equipment was checked out and in, the daily conditions, any malfunctions or repairs needed.

Instrument Verification Strip (IVS) Installation Checklist/Daily IVS Checklist

The Instrument Verification Strip (IVS) Installation Checklist (MRP FF.6) is maintained by the UXOQCS and documents the installation of the IVS and the initial testing of all UXO Technicians who will be performing UXO detector-aided surveys on the first day of the surveying activities. An abbreviated Daily IVS Checklist (MRP FF.7) will be completed for all subsequent days noting the test will be completed twice daily, once prior to beginning surveying and again later in the day (e.g. after lunch or battery change). Note: The DGM Instrument Verification Strip (IVS) Installation Checklist (MRP FF.14.2) and DGM Daily IVS Checklist (MRP FF.14.3) contain specific information required during DGMs and should be completed by the site geophysicist.

Table 1

Field Forms

Form Type	Form Number	Frequency	Form Title
Daily Activities Documentation	MRP FF.1	Once	Sap Worksheet No 4-Project Sign-Off
	MRP FF.2	Once	Daily MEC Activity Log
	MRP FF.3	Daily	Daily Equipment Checklist
	MRP FF.4	Daily	Daily Visitors Log
	MRP FF.5	Daily	Daily Photographic Log
	MRP FF.6	Daily	IVS Installation Checklist
	MRP FF.7	Daily	Daily IVS Report
	MRP FF.8	Daily	Daily MEC_MPPEH Log For UXO Avoidance Activities
	MRP FF.9	Daily	MEC Cumulative Summary Log
	MRP FF.10	Daily	MEC Accountability Form
	MRP FF.11	Daily	Dig Sheet - Manual Target Excavation Results
	MRP FF.12	Daily	Dig Sheet - Mechanical Target Excavation Results
	MRP FF.13	Daily	MDAS Container Form
	MRP FF.14	Daily	Geophysical Survey Field Forms (1 - 6)
	MRP FF.14.1	*Daily*	*Daily DGM Quality Control Report*
	MRP FF.14.2	*Daily*	*DGM Instrument Verification Strip (IVS) Installation Checklist*
	MRP FF.14.3	*Daily*	*DGM Daily IVS Checklist*
	MRP FF.14.4	*Daily*	*DGM Initial Instrument Checklist*
	MRP FF.14.5	*Daily*	*DGM Daily Instrument Checklist*
	MRP FF.14.6	*As Needed*	*DGM Field Editing Checklist*
QC	MRP FF.15	Daily	Daily QC Report
	MRP FF.16	Once per Definable Feature	Preparatory Phase Inspection Report
	MRP FF.17	Once per Definable Feature	Initial Phase Inspection Report
	MRP FF.18	Periodic	Follow Up Phase Inspection Report
	MRP FF.19	As Needed	Non Conformance Report
	MRP FF.20	As Needed	Lessons Learned
H&S	MRP FF.21	Daily	Daily Safety Log
	MRP FF.22	Daily	Daily Tailgate Safety Briefing-Training Record Form
Miscellaneous	MRP FF.23	As Needed	Field Change Request
	MRP FF.24	As Needed	Equipment Maintenance-Repair Form

STANDARD OPERATING PROCEDURE
MRP SOP 09
MPPEH MANAGEMENT AND CERTIFICATION

1.0 SCOPE AND APPLICABILITY

This document is designed to set forth a standard operating procedure (SOP) for the management and inspection processes and documentation of Material Potentially Presenting an Explosive Hazard (MPPEH), MPPEH certified as Material documented as safe (MDAS) and Material Documented as an Explosive Hazard (MDEH) during activities performed under the Munitions Response Program (MRP). This Document is not applicable to the treatment of Munitions and Explosives of Concern (MEC). For standard operating procedures involving the treatment of MEC refer to SOP 2 and SOP 7.

2.0 BACKGROUND

MPPEH is material that is not known with certainty to present an explosive hazard, but may contain explosive material. MPPEH must be assumed to present an explosive hazard until it is 100% inspected, processed, and certified as Safe. Ordnance that has functioned as designed and unexploded ordnance detonated during clearance or cleanup operations results in a variety of MPPEH. MPPEH examples include but are not limited to, expended base ejecting artillery projectiles, cluster munition dispensers, flare and signal casings, smoke grenades, Jet Assisted Take Off (JATO) motors, rocket tubes, Rocket Assisted Take Off (RATO) motors, practice munitions, small arms cartridge cases, kinetic penetrators, and shrapnel. MPPEH can also be generated off-range, for example: expended munitions and components used for testing which are no longer needed, and explosive contaminated equipment. It is also important to note that Munitions containers and packaging material presumed to be empty could present an explosive hazard through human error. Although MPPEH is often metal but can be plastic, wood, paper, or other material (refer to NAVSEA OP 5 Chapter 13 paragraph 13-15 for a more information).

MPPEH management and certification activities will be performed in accordance with all local, State, and federal regulations and will include all applicable Department of Defense (DOD) requirements. Generally, MPPEH will be encountered during the performance of Unexploded Ordnance (UXO) detector-aided surface Survey operations, subsurface anomaly investigations, geophysics investigations and UXO Escort operations. UXO detector-aided surface Survey operations may be used as a stand-alone method for site survey and assessment or in preparation for geophysical survey and other operations. UXO escort operations may be required during site visits (initial site assessments, planning, and stakeholders meetings), geophysical operations, construction support during subsurface activities, and MC sampling operations.

3.0 DEFINITIONS

a) Certification of MPPEH – Signed documentation by authorized personnel that declares the explosives safety status of MPPEH.

b) Demilitarization - The act of destroying, mutilation, cutting, crushing, scrapping, melting, burning, or alteration to prevent the further use of this equipment and material for its originally intended military or lethal purpose.

c) Material Documented as Safe (MDAS) – MDAS is MPPEH that has been assessed and documented as not presenting an explosive hazard and for which the chain of custody has been established and maintained. This material is no longer considered to be MPPEH.

d) Material Documented as an Explosive Hazard (MDEH) – MDEH is MPPEH that cannot be documented as MDAS, that has been assessed and documented as to the maximum explosive

hazards the material is known or suspected to present, and for which the chain of custody has been established and maintained. This material is no longer considered to be MPPEH. MDEH is considered not likely or likely to contain and explosive hazard. This is not to be confused with Munitions and Explosives of Concern (MEC) which are documented to possess an explosive hazard.

e) Explosive Safety Status of MPPEH – "Safe" means certified as not presenting an explosion hazard, and consequently safe for unrestricted transfer or release pending any further demilitarization requirements. (Safe is also known as 5X or MDAS). Munitions that have been certified "Safe" are no longer considered MPPEH provided the chain of custody remains intact. "Hazardous" means certified as known or suspected to present an explosive hazard. (Hazardous is also known as 3X, 1X, or MDEH).

f) Material Potentially Presenting an Explosive Hazard (MPPEH) – Material that, prior to determination of its explosives safety status, potentially contains explosives or munitions (for example, munitions containers and packaging material; munitions debris remaining after munitions use, demilitarization, or disposal; and range related debris) or potentially contains a high enough concentration of explosives that the material presents an explosive hazard. Excluded from MPPEH are other hazardous items that may present explosion hazards such as gasoline cans, compressed gas cylinders that are not munitions or munitions related and are not intended for use as munitions.

g) Qualified Receiver of MPPEH – Activities that have personnel or individuals who are, trained and qualified in the identification and safe handling of used and unused military munitions, and any known or potential explosive hazards that may be associated with MPPEH they receive; and are licensed and permitted or otherwise qualified to receive, manage, and process MPPEH.

h) Small Arms Ammunition – Ammunition, without projectiles that contain explosives (other than tracers), that is .50 caliber or smaller, or for shotguns.

4.0. PERSONNEL QUALIFICATIONS

UXO personnel shall be graduates of a military Explosive Ordnance Disposal (EOD) School of the United States, Canada, Great Britain, Germany, or Australia or a graduate of a formal training course of instruction or EOD assistant course as stated in DDESB TP-18.

4.1. Responsibilities

- **SUXOS**
  - Ensure site specific Work Plans specify the procedures and responsibilities for processing MPPEH for final disposition for all munitions debris.
  - Ensure a requisition and turn-in document, DD Form 1348-1(series) (attachment 1) is completed for all munitions debris certified to be transferred for final disposition.
  - Perform random checks to satisfy that the munitions debris is free from explosive hazards necessary to complete the form, DD 1348-1(series)
  - Certify all munitions debris as free of explosive hazards, engine fluids, illuminating dials, and other visible liquid Hazardous, Toxic, or Radiological Waste (HTRW) materials.
  - Be responsible for ensuring that inspected debris is secured in a closed, labeled and sealed container with a unique identification number.
    - The container will be closed in such a manner that the seal must be broken in order to open the container.

- If a lock is used as additional security the SUXOS will be the sole possessor of the containers key.

- **UXOSO**
  - Ensure the specific procedures and responsibilities for processing MPPEH for certification as munitions debris as specified in the Work Plan are being followed.

  - All procedures for processing MPPEH are being performed safely and consistent with applicable regulations.

- **UXOQC**
  - Conduct daily audits of the procedures used by the UXO teams and individuals for processing MPPEH.

  - Perform and document random sampling of MPPEH collected from the UXO team to ensure no items with explosive hazards, engine fluids, illuminating dials or other HTRW materials are identified as munitions debris.

- **UXO Technician III**
  - Perform a 100% re-inspection of all recovered items to determine if free of explosives hazards, engine fluids, illuminating dials, and other visible liquid HTRW materials.
  - Supervise the consolidation of MPPEH for containerization and sealing.

- **UXO Technician II**
  - Perform a 100% inspection of each item as it is recovered and determine the following:
    1. Is the item MDEH or MDAS?
    2. Does the item contain explosives hazards or other dangerous fillers?
    3. Does the item require detonation?
    4. Does the item require demilitarization or venting to expose dangerous fillers?
    5. Does the item require draining of visible liquid HTRW material?
    6. Does the item require additional demilitarization in order to verify 100% of surfaces are free of explosives hazards or other dangerous fillers?

- **UXO Technician I**
  - Perform a tentative inspection to identify an item as MPPEH, followed by a required confirmation by a UXO Tech II or III.

5.0. MPPEH MANAGEMENT

5.1. MPPEH Degrees of Explosion Hazard

- MPPEH explosive contamination falls into one of four categories: 5X (MDAS), 3X (MDEH), 1X (MDEH), and 0X (Not Applicable). These categories are meant to be used in correspondence and documentation in a general sense to indicate degree of explosion hazard.

- **Category 5X - MDAS**

  - MDAS is MPPEH that has been inspected, certified and documented as 100% free of any explosive hazard and for which the chain of custody has been established and maintained.

- Category 5X: The item is completely decontaminated and free of any explosive hazard and may be released for general use provided that:

a) All demilitarization requirements for the item are met. Certification of the material may be contingent upon further demilitarization of the decontaminated items.
b) Items are only classified 5X (MDAS) through visual inspection in which all surfaces are visible and capable of being inspected. Visual inspection is only applicable to pieces of metal that have no cavities, holes, blind spaces, rivets, cracks, or other obscured features.
c) Probes are NOT used to inspect any blind cavities. Probes may NOT be used to satisfy visual inspection requirements for purposes of documentation as MDAS.
d) The material is fully documented and certified as having an explosives safety status of MDAS.
e) Documentation as safe by visual inspection requires 100% inspection by one qualified individual, followed by an independent 100% re-inspection by another qualified individual.

- **Category 3X - MDEH**

  - MDEH is MPPEH that cannot be documented as MDAS, that has been inspected and documented as to the maximum explosive hazards the material is known or suspected to present, and for which the chain of custody has been established and maintained.

    - Category 3X: The item has been inspected and no contamination can be visually noted on accessible surfaces but explosives may be present in concealed or hidden areas. The following requirements apply to 3X materials:

a) 3X material is material that is expected to be free of explosive hazard, but not enough information is available to certify it as safe. This may be due to the potential for internal cavities or devices to contain explosives because the material is not 100% inspected, or because the certification process has not been completed to the point of documentation with dual signatures.
b) Prior to performing operations involving 3X material a site specific Explosive Safety Submission (ESS) or ESS Determination must be in place.
c) Though it is suspected UNLIKELY that an explosive hazard exists, it is still possible.
d) 3X material is MPPEH and must be documented as to the explosive hazard the item is known or suspected to present before transfer from one area of the activity to another, stored, or placed in standby status.
e) 3X material that cannot be been inspected and documented MDAS must be assessed and documented MDEH.

- **Category 1X - MDEH**

  - MDEH is MPPEH that cannot be documented as MDAS, that has been inspected and documented as to the maximum explosive hazards the material is known or suspected to present, and for which the chain of custody has been established and maintained.

a) Category 1X: The Item is contaminated or partially decontaminated and is likely to present an explosive hazard.
b) Prior to performing operations involving 1X material a site specific Explosive Safety Submission (ESS) or ESS Determination must be in place.
c) 1X material is thought LIKELY to present an explosive hazard.

d) 1X material is MPPEH and must be documented as to the explosive hazard the item is known or suspected to present before transfer from one area of the activity to another, stored, or placed in standby status.
e) 1X material that cannot be inspected and documented MDAS must be assessed and documented MDEH.

- **Category 0 (Zero, 0X)**
  - Articles Equipment or buildings that were never contaminated and do not pose an explosive hazard. 0X material is not MPPEH.

5.2 MPPEH Processes

Processing includes any action or operation involving MPPEH, MDAS, and MDEH including but not limited to:

1. Collection
2. Consolidation, sorting, Segregating
3. Inspecting
4. Storing
5. Transferring, Certifying, Releasing
6. Demilitarizing, Venting
7. Transporting Materials

a) **Collecting** – All handling and processing of items regardless of classification will be performed with care. At no time will rough handling of an item be considered acceptable. Proper precautions will be taken when involving the handling of an item including but not limited to:

- Proper PPE will be worn at all times.
- Situational Awareness of who and what make up the current surroundings.
- Validation of all inspection processes. Check and Re-Check.

The collection process will consist of first identifying the item and determining if it is MPPEH, MDAS, MDEH, or cultural debris.

- An attempt will be made to identify all MPPEH items.
- MPPEH items original location will be recorded by GPS equipment, a photo will be taken, basic information of the item will be recorded in the team leader's logbook or on a dig sheet, and the information on the item will be reported to the SUXOS for inclusion in the daily report.

b) **Consolidation, Sorting, and Segregating**
The performance of consolidation, sorting and segregating ensures the inspection process remains as safe and thorough as possible by:

- Grouping similar items and materials allowing separation of known MPPEH from MDAS or scrap.
- Uses a centralized location providing the necessary personnel, tools, and documentation to maintain the chain of custody.
  - Intended to prevent the commingling of items.
- Allows a more effective and efficient inspection process.

c) **Inspecting**
When MPPEH is encountered, a UXO Technician II or higher will perform 100% inspection of each item as it is recovered. A UXO Technician I may assist in the performance of MPPEH inspection under direct supervision and required confirmation of a UXO technician II or III. A UXO Technician II or higher and the UXO Team Leader will inspect the MPPEH to determine:

1. Is the item MDEH or MDAS?

2. Does the item contain explosives hazards or other dangerous fillers?
3. Does the item require detonation?
4. Does the item require demilitarization or venting to expose voids that may contain dangerous fillers?
5. Does the item require draining of visible liquid HTRW material?
6. Does the item require additional demilitarization in order to verify 100% of surfaces are free of explosives hazards or other dangerous fillers?

Using the same logic (1-6) above and table 5-1 below, two technicians designated in writing to certify MPPEH status will each perform a separate 100% inspection of each item to determine wither it is MDAS or MDEH. All certification of MPPEH, MDEH, and MDAS will be performed by a qualified technician authorized to perform inspection and certification procedures as stated in this SOP. (See sub-text (e) transferring and certifying).

After each inspection an item will be placed in one of the following categories:

MPPEH – The item is awaiting inspection, re-inspection, demil or venting, and or certification of its explosive safety status.

MDAS – The item has been 100% inspected and all surfaces are deemed free of any explosive hazard by the SUXOS (or designated technician). The item has been 100% independently re-inspected and all surfaces are deemed free of any explosive hazard by the UXOQCS (or designated technician). The item has been documented and certified MDAS. The item is no longer MPPEH.

MDEH – The item CANNOT be certified MDAS due to the inability to verify that 100% of all surfaces are free of any explosive hazard. The item has been documented and certified MDEH. The item is no longer MPPEH. An item need not be independently re-inspected once it has been initially inspected and documented MDEH.

Empty Containers – All empty containers that previously were used for ammunition and explosives to be transferred or released are considered MPPEH and must be managed as such.

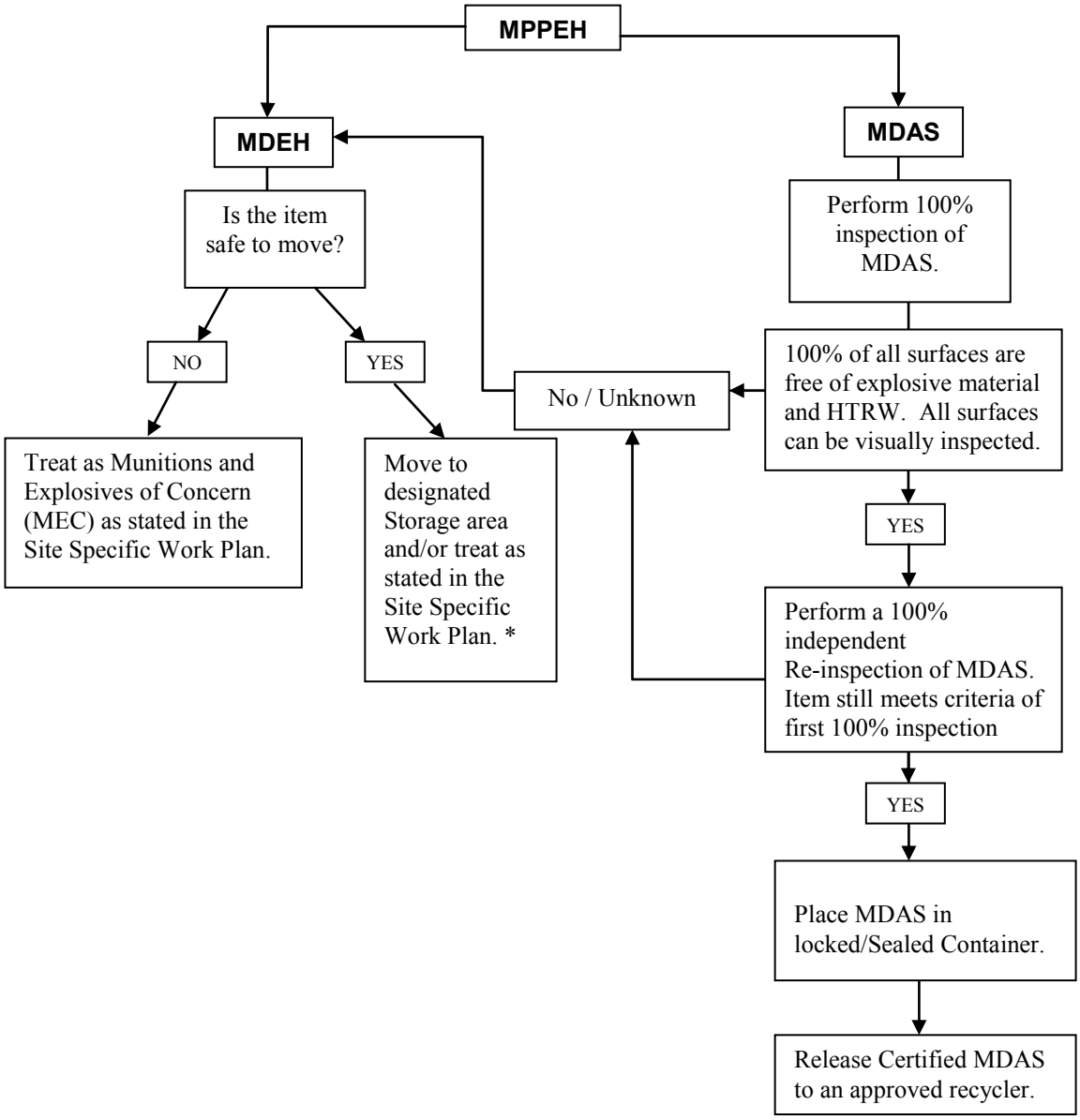
- All previous markings on empty containers must be removed or obliterated.
- Approved cardboard and plywood containers and packing material for C/D 1.4S materials may be discarded as solid waste (general trash) provided the following criteria are met.
    1. The items are 100% visually screened or the presence of munitions by two different individuals per approved written operating procedures.
    2. The items are broken down or otherwise deformed so that they may not be used for their original purpose.

<u>If the MDEH item cannot be identified by type as a conventional munition, and/or if in the unlikely event that the MDEH is suspected to be potential Chemical Warfare Material (CWM),</u> personnel will withdraw upwind from the area, assemble at a pre-designated rally point, secure the site, and immediately request assistance from the point of contact at the facility and notify the Tetra Tech UXO Manager. If so directed, UXO personnel will take emergency non-invasive actions such as covering the item with plastic sheeting and securing the area until the appropriate exclusion and safety zones have been determined.

<u>If Hazardous, Toxic, or Radiological Waste (HTRW) is encountered on-site</u>, the work site will be evacuated until the Tetra Tech Project Health and Safety Officer, with concurrence of the client point of contact at the facility, identifies and implements appropriate protective measures.

For any of the scenarios, upon receiving notification from the Tetra Tech UXO Team Leader, the Tetra Tech UXO Manager will then immediately inform the Tetra Tech Project Manager, who will then immediately inform the client Project Manager. Tetra Tech Program Management personnel will then be notified. The client Project Manager will then make all other necessary notifications within the client's organization.

Table 5-1 MPPEH INSPECTION PROCESS



*In most cases MDEH will be treated/stored as MEC. See Site Specific Work Plan for MDEH treatment and storage procedures..

d) **Storage**

- Recovered MPPEH shall be managed as hazard C/D 1.1, Storage Compatibility Group (SCG) L unless assigned differently by NOSSA (N82) until it is inspected and certified.

- In order to maintain the chain of custody, do not commingle different categories of materials (MPPEH, MDAS, MDEH). Should commingling occur, MDAS and/or MDEH shall lose its documented explosives safety status and become MPPEH.
- To prevent commingling, use a suitable combination of controls such as separate storage locations within the storage area, moveable signs, barriers, gates, locked containers, waterproof certification documents attached to containers (1. MDAS Addition Form, 2. MPPEH Certification Letter), container seals traceable to the transfer documentation, or other methods included in approved written operating procedures.
- MDAS must be segregated in a location with controlled access, preferably a locked container or facility.
- Minimize the quantity and time MPPEH is accumulated and retained at any location.
- When possible, MPPEH shall be covered or stored in closed containers to prevent exposure to or the collection of precipitation.

e) **Transferring and Certifying**

- Personnel who are qualified and authorized to certify MPPEH and Document its explosives safety status as MDAS or MDEH, will be designated in writing by the project manager for the site in letter format (MPPEH Certification Appointment Letter) and approved by the Commanding Officer of the cognizant Facilities Engineering Command (FEC) who must endorse the MPPEH Certification Appointment Letter to the appropriate Defense Reutilization Marketing Office (DRMO) or Qualified Recycling Program (QRP). The MPPEH Certification Appointment Letter will include sample signatures. A current list of personnel along with their sample signatures, who are qualified and authorized to inspect MPPEH and document its explosives safety status, shall be provided to any DRMO or QRP receiving MDAS.

MDAS

- Certification as MDAS requires dual signatures on the transfer document (DD document 1348-1). The SUXOS (or designated technician) will certify that the MDAS has been 100% inspected properly inspected, and to the best of his/her knowledge and belief, is free of explosive hazards. The UXOQCS (or designated technician) will verify that the MPPEH inspection process has been followed in accordance with this SOP, the site specific work plan, and to the best of his/her knowledge and belief, is free of explosive hazards. All certification/verification documentation will clearly show the printed names of the SUXOS and UXOQCS (or qualified individual), organization, signature, and phone numbers of the persons certifying and verifying the material as free of explosive hazards.

  The following certification/verification will be entered on each form (DD Document 1348-1) for turn over of MDAS and will be signed by the SUXOS and UXOQCS (or designated technicians):

  > "This certifies that the material potentially presenting an explosive hazard listed has been 100% properly inspected and, to the best of our knowledge and belief, is inert and/or free of explosives or related materials."

MDEH

- Any MDEH found during MPPEH processing will be treated as MEC. If MDEH is transferred to another activity or organization for final deposition, certification as MDEH will be provided using a Disposal Turn-in Document DD Form 1348-1 and a DD Form 2271 (Decontamination Tag). The certification document must provide information about:

  a) Type of explosive hazard or contamination.
  b) Presence of un-vented cavities.
  c) Estimated maximum credible Net Explosive Weight (N.E.W.)

  Hazardous certifications shall include the following statement:

  > "This certifies that the material documented as an explosive hazard listed has been 100% properly inspected and to the best of my knowledge and belief presents an explosive hazard"

  The hazardous certification statement may be modified as required.

Documentation of the material's explosives safety status must accompany MDAS and MDEH through final disposition.

MPPEH

- No MPPEH shall be transferred or released unless it is inspected and certified to be MDAS or inspected and certified to be MDEH. MDEH may only be transferred or released to EOD or a qualified receiver as stated below.

f) **Releasing**

MDAS

- The certified and verified MDAS will be release with applicable transferring documentation (DD document 1348-1) to the certified subcontractor who will:
  Upon receiving the unopened labeled containers each with its unique identified and unbroken seal, ensuring a continued chain of custody and after reviewing and concurring with all provided supporting documentation, sign for having received and agreeing with the provided documentation that the sealed containers contained no explosives when received.

  Perform Shredding/cutting process capable of demilitarizing MDAS resembling military munitions.

  Perform 100% inspection of the shredded/cut scrap to ensure no resemblance to military munitions. Once this has been determined, the scrap will be transported to a qualified recycler and recycled.

  Provide an "END USE" certification confirming that the material has been recycled. End Use certifications will be included in the After Action Report.

If any organization breaks the MPPEH chain of custody, the affected items status will be changed to MPPEH until they undergo a second 100% inspection, a second 100% re-inspection, and have be documented to verify its explosive safety status.

MDEH

Ensure that MDEH are transferred or released only to those DOD components and personnel or non-DOD entities or individuals that:

1. Have the licenses and permits required to receive, manage, and process the materials.
2. Have technical expertise about the known or suspected explosive hazards associated with the MDEH being received.
3. Are qualified to receive, manage, and process MDEH in accordance with this Instruction and any implementing guidance.
4. Have personnel who are:
    a. Experienced in the management and processing of materials with explosive hazards equivalent to the MPPEH or MDEH being received.
    b. Trained and experienced in the identification and safe handling of used and unused military munitions and any potential explosive hazards that may be associated with the specific MDEH being received.
    c. Require an explosive risk evaluation before allowing the DOD components or non-DOD entities or individuals to receive, manage, or process MDEH. This explosives risk evaluation process will evaluate the adequacy of the receiver's management controls (e.g., training, oversight, record keeping) and operations (e.g., processing methods, equipment, storage facilities).

If any organization breaks the MPPEH chain of custody, the affected items status will be changed to MPPEH until they undergo a second 100% inspection, a second 100% re-inspection, and have be documented to verify its explosive safety status.

g) **Demilitarizing, and Venting**

- Performed in order to Vent or expose any internal cavities of MPPEH, to include training or practice munitions, to:
    1. Confirm that explosive filler is not present.
    2. Procedures used to achieve venting include use of shaped charges, crushers, drills, saws, etc. Attended, with an engineering design, based on a Mishap Risk Assessment (MRA).

    3. Mishap Risk Analysis. A MRA of risks shall be performed on all new or modified industrial operations and facilities other than previously-approved standard designs that involve ammunition and explosives. Based on this analysis, engineering design criteria shall be developed for selecting equipment, shielding, engineering controls, and protective clothing for personnel appropriate for the facility or operation. The MRA should be prepared in accordance with Appendix A of MIL-STD-882 (Series).

- Expended small arms ammunition cartridge cases may be processed as a non-explosive operation prior to being assessed and determined safe, provided that they are screened before processing. Screening is intended to ensure that only .50 caliber and smaller are processed, and to remove unused cartridges. Screening will be done by locally determined methods included in approved written operating procedures.

- Demilitarization is often a separate requirement from documenting the explosive safety status of the material. MPPEH is often determined to be MDAS before demilitarization. In some cases, a demilitarization requirement (such as venting or burning) may be part of the safe certification requirement. (For more information refer to SOP 7 Demolition Disposal Operations).

i) Transporting Materials

All UXO personnel approved to transport MPPEH/MEDH by means of motor vehicle are required to possess the applicable OSHA Explosive Drivers certification as well as to be listed on the Tetra Tech NUS BATF explosive possessor license 1-GA-089-33-3K-00431. Per the BATF all individuals submitted as an addition to said license will be considered authorized to transport, ship, receive, or possess explosive material until the BATF clearance has been determined.

Neither MPPEH nor MDEH will be transported over public transportation routes (PTR) unless determined safe for transport by the responsible authority. All approved transportation of MPPEH or MDEH over public transportation routes will include a signed “Safe to Transport” certification to accompany the shipment. Hazard classification assignments are also required to accompany the shipment. Personnel and vehicles transporting MPPEH or MDEH over PTR will comply with the safety and transport requirements of NAVSEA SWO2-AF-HBK-010

TABLE 1
Contact Information

Position	Name	Organization	Direct Dial Phone	Cell Phone
Project Manager				
UXO Manager				
Environmental Site Manager				
Navy BRAC Project Manager				

TABLE 2
Related Field Forms

Form Number	Frequency	Form Name
MRP FF.1	Once	SAP Worksheet No 4-Project Sign-Off
MRP FF.2	Daily	Daily MEC Activity Log
MRP FF.3	Daily	Daily Equipment Checklist
MRP FF.5	Daily	Daily Photographic Log
MRP FF.8	Daily	Daily MEC / MPPEH Accountability Log for UXO Avoidance
MRP FF.9	Daily	MEC Cumulative Summary Log
MRP FF.10	Daily	MEC Accountability Form
MRP FF.13	Daily	MDAS Addition Form
MRP FF.15	Daily	Daily QC Report
MRP FF.16	Once per Definable Feature	Preparatory Phase Inspection Report
MRP FF.17	Once per Definable Feature	Initial Phase Inspection Report
MRP FF.18	Periodic	Follow Up Phase Inspection Report
MRP FF.21	Daily	Daily Safety Log
MRP FF.22	Daily	Daily Tailgate Safety Briefing-Training Record Form
Memorandum	Once	MPPEH Certification Letter

References

1. NOSSAINST 8023.11A (Series), Standard Operating Procedures Development, Implementation, and Maintenance for Ammunition and Explosives.

2. NAVSEA OP-5 Volume 1, 7th Rev., Change 8

3. COMNAVREGNWINST 8023.3 Munitions Rule Implementation

4. COMNAVREGNWINST 5090.6A Regional Hazardous Material Control and Management Program

ATTACHMENT 1

STANDARD OPERATING PROCEDURE
MRP SOP 10
UXO INTRUSIVE INVESTIGATION

1.0 SCOPE AND APPLICABILITY

This document is designed to set a standard operating procedure (SOP) for Unexploded Ordnance (UXO) intrusive investigation operations during activities performed under the Munitions Response Program (MRP). This SOP is not site-specific, but rather is intended as a general guidance document for a variety of sites and conditions.

2.0 BACKGROUND

UXO intrusive investigation activities will be performed in accordance with all local, state, and federal regulations and will include all applicable DoD requirements. The scope of the UXO intrusive investigation activities for a specific site will be defined in the project-specific work plans and the Explosive Safety Submission (ESS). Generally, all areas identified as suspect for munitions and explosives of concern (MEC) will receive a UXO detector-aided survey prior to the start of any intrusive investigation activities. Intrusive activities will stop if nonessential personnel enter a UXO intrusive investigation area. Nonessential personnel include those conducting site visits (initial site assessments, planning, and stakeholders meetings), Digital Geophysical Mapping (DGM) operations, munitions constituents (MC) sampling operations and others who are non-UXO trained personnel and not required on site for the purpose of the UXO intrusive investigation. Essential personnel may include mechanical equipment operators, cultural scientist, archeologist, or others required on site for the purpose of the UXO intrusive investigation. Essential personnel will be identified by the Senior UXO Supervisor (SUXOS), receive site specific training and a risk hazard analysis by the UXO Safety Officer (UXOSO), and be approved by the Project Manager (PM).

3.0 PERSONNEL QUALIFICATIONS

UXO personnel conducting UXO intrusive investigation activities shall be graduates of a military Explosive Ordnance Disposal (EOD) School of the United States, Canada, Great Britain, Germany, or Australia or a graduate of a formal training course of instruction or EOD assistant course as stated in DDESB TP-18.

A. Senior UXO Supervisor (SUXOS)

The SUXOS will have a minimum of 10 years experience in all aspects of munitions response actions or range clearance activities. A minimum of 5 years of the experience shall be in supervisory positions. Additionally, the SUXOS shall have received OSHA-mandated supervisory training.

B. UXO Team Leader (UXO Technician III)

The UXO Team Leader will have a minimum of 8 years of EOD/UXO experience including prior military EOD and/or commercial UXO experience in munitions response actions, and/or range clearance activities. The UXO Team Leader may supervise up to six UXO technicians. The UXO Team Leader will conduct UXO intrusive investigation activities as directed by the SUXOS or the UXO Manager if a SUXOS is not on site. The UXO Team Leader will be under the direct supervision of the UXO Manager.

C. UXO Quality Control Specialist (UXOQCS)

The UXOQCS shall have a minimum of 8 years experience in all phases of munitions response actions and/or range clearance activities. The UXOQCS shall have completed corporate quality assurance and quality control training.

D. UXO Safety Officer (UXOSO)

The UXOSO shall have a minimum of 8 years experience in all phases of munitions response actions and/or range clearance activities. The UXOSO shall have received specialized safety training.

E. UXO Technicians II

The UXO Technicians II will have prior military EOD experience or a minimum of 3 years of experience in munitions response actions and/or range clearance activities. The UXO technician will conduct UXO intrusive investigation activities as directed by the UXO Team Leader.

F. UXO Technician I

The UXO Technician I will have training as specified in DDESB TP-18. The UXO technician I will be directly supervised by a UXO Technician III or higher when conducting UXO activities.

4.0 UXO INTRUSIVE INVESTIGATION OPERATIONS

A. Equipment

A magnetic locator such as the Schonstedt, GA-52Cx instrument or equivalent and/or an all-metal detector such as the White's XLT or equivalent will be used for UXO intrusive investigation operations. The detection depth of the instrument is limited by size and orientation of a target and soil characteristics of the work area. The locators provide an audio signal for response, but do not store data. The magnetic locator does not need to be calibrated. The all-metal detector has field calibration. Calibration settings are specific to the make and model of the all metals detector. Table 1 lists the calibration settings for the White's spectrum XLT.

To ensure each detector is operating properly, the operator turns on the instrument and slowly moves the locator towards metal. As the probe advances toward the target, the audio signal will increase. Failure to detect the object is reason to reject the instrument.

The detector will be checked daily before starting UXO intrusive investigation activities and after any battery change. The daily check for UXO intrusive investigation operations will be identified in the Work Plan. A couple of examples of an instrument daily check are the use of the Instruments Verification Strip (IVS) and the blanket test. To conduct the blanket test, an area near the work site and free of anomalies will be identified. The senior UXO Technician or UXOQCS will position several inert munitions, or surrogate munitions items on the surface and cover the items with a tarpaulin or similar cover so the items are not visible to the UXO technician. Each UXO technician will conduct a detector-aided survey of the blanket test area and locate the test items. The IVS information and is included in MRP SOP 03. The senior UXO technician or UXOQCS will compare the results of the test to the actual placement of the items and make corrections as necessary. UXO Technicians will also conduct random checks during daily operations.

The normal setting for the Schonstedt instrument is 2; setting the instrument to 3 or 4 will make it more sensitive and setting the instrument to 1 will make it less sensitive. The instrument will not detect copper, brass, or aluminum munitions. The normal setting for the White's all-metal detector will vary according to site conditions.

B. UXO Intrusive Investigation

The objective of the UXO intrusive investigation is to locate suspect MEC, and materials potentially presenting an explosive hazard (MPPEH) at the UXO intrusive investigation site. Early in the planning for the field activities, usually during the DQO process with the regulators and the client, the level of effort is determined for each munitions response site (MRS) within a munitions response area, (MRA). The level of effort can vary from a UXO mag and dig intrusive investigation where each anomaly within the entire foot print of the MRS receives a UXO intrusive investigation, to select anomalies where the PM identifies which anomalies will receive a UXO intrusive investigation depending on target signature, DGM Mapping, investigation goals, etc., to mechanical UXO intrusive investigation using heavy equipment such as screens, excavators, etc.

C. General Safety Concerns and Procedures

(1). As a general rule, all UXO and discarded military munitions (DMM) will be detonated in the original position found. This is the safest method to effect final disposition of munitions. Engineering controls may be required based on site-specific conditions and will be in accordance with the approved ESS. If authorized by the approved ESS and Work Plan, UXO and DMM may be moved to a consolidated area for demolition.

(2). All UXO will be destroyed daily unless circumstances beyond the UXO team's control (e.g., unexpected weather storms, unavailability of donor explosives, etc.) preclude their destruction. If a UXO cannot be destroyed on the day of discovery,

then the item will be secured and guarded until destruction can be accomplished. Under no circumstances will UXO be left unsecured overnight. Responsibility for security of UXO can be transferred to the installation (Base Security/POC) on a case by case basis. This transfer will be documented in the Daily Report with name, time, and phone number/email address of person accepting responsibility for security of the UXO item.

(3). UXO intrusive investigation operations will not be conducted until all applicable plans for the project in question are prepared and approved. These plans will be based upon the concept of limiting exposure to the minimum number of personnel, for the minimum amount of time, to the minimum amount of military munitions consistent with safe and efficient operations.

(4). Only UXO-qualified personnel Tech II or higher will perform UXO intrusive investigation procedures. As an exception, a UXO Technician I may assist in the performance of UXO intrusive investigation activities when under the supervision of a UXO Technician III or higher. Non-UXO-qualified personnel who have been determined to be essential for the operations being performed may be utilized to perform UXO intrusive investigation related procedures when supervised by a UXO Technician III or higher. All personnel engaged in field operations will be thoroughly trained and capable of recognizing the specific hazards of the procedures being performed. To ensure that these procedures are performed to standards, all field personnel will be under the direct supervision of a UXO Technician III or higher.

(5). Personnel who will be handling military munitions will not wear outer or inner garments having static-electricity-generating characteristics. For example, materials made of 100-percent polyester, nylon, silk, and wool are highly static producing.

(6). Prior to any action being performed on an ordnance item, all fuzing will be definitively identified if it is possible to safely do so without disturbing the ordnance item. This identification will consist of fuse type by function and condition (armed or unarmed) and the physical state/condition of the fuse, i.e., burned, broken, parts exposed/sheared, etc. This information will be recorded in accordance with the MEC Management and Accountability SOP and MPPEH Management and Certification SOP.

(7). MEC operations will be conducted only during daylight hours.

(8). UXO-qualified personnel involved in performing UXO intrusive investigation procedures will be limited to a 40-hour work week, either four 10-hour days or five eight-hour days. Two consecutive work weeks will be separated by 48 hours of rest. A waiver to the 40-hour work week requirement may be granted for conventional munitions response to MEC projects using the following protocols:

(a). The PM, taking into account a wide array of factors (e.g., fatigue, health, environment, type of work, etc.) may approve a longer work schedule. The work schedule will be reviewed during the Preparatory, Initial, and Follow-up phase inspections and adjustments made if warranted.

(b). The PM may approve a 10 day work schedule which should be followed by a 4 day rest schedule. Work schedules should not exceed 60 hours

per week, except under extreme circumstances and require both the PM and UXO Program Managers approval.

(c). The SUXO, UXOSO and or UXOQCS can initiate a stop work at any time that the schedule is determined to be extreme for the conditions on the site.

D. MEC Procedures Safety Precautions

(1). Every effort will be made to identify a suspect military munition. Under no circumstances will any MEC be moved in an attempt to make a definitive identification. The military munition will be visually examined for markings and other external features such as shape, size, and external fittings. If an unknown military munition is encountered, the UXO Program Manager will be notified immediately. The PM will be notified as soon as possible. If research of documentation is required, it will be initiated by the UXO Program Manager with assistance from military EOD. Following is additional guidance for the safe handling of military munitions:

(a). Projectiles containing base-detonating fuses are to be considered armed if the round has been fired.

(b). Arming wires and pop out pins on unarmed fuses should be secured prior to moving military munitions.

(c). Do not depress plungers, turn vanes, or rotate spindles, levers, setting rings, or other external fittings on military munitions. Such actions may arm or activate the items.

(d). Do not attempt to remove any fuse(s) from military munitions. Do not dismantle or strip components from any military munitions.

(e). UXO personnel are not authorized to render inert any military munitions found onsite.

(f). Military munitions will not be taken from the project property as souvenirs/training aids.

(g). Civil War era ordnance will be treated in the same manner as any other military munition.

(2). Prior to entering a MRS that contains Improved Conventional Munitions (ICMs) or submunitions, a waiver will be obtained by the affected installation or RPM for the properties. If an ICM or submunition is found at a project property not previously known to contain ICMs or submunitions, work will cease. If the item is found as a result of a munitions response to MEC project, then the team that discovered the item will perform the disposal. The discovered item will be identified, then properly disposed of (including guarding the item if disposition is to be delayed). Work will resume only when an ICM waiver has been obtained. For guidance on the preparation of waiver requests, contact the MM CX.

(3). Any time munitions with unknown fillers are encountered during conventional munitions response to MEC project activities, all work will immediately cease. Project personnel will withdraw along cleared paths upwind from the discovery. A team consisting of a minimum of two personnel will secure the area in accordance with the provisions identified in the approved Work Plan to prevent unauthorized access. Personnel should position themselves as far upwind as possible while still maintaining security of the area. Personnel who could have been exposed to the unknown filler will not be released from the site until the presence of contamination has been verified by the U.S. Army Technical Escort Unit (TEU).

The UXO team will notify the local Point of Contact (POC), UXO Program Manager, and PM as designated in the Work Plan. Refer to EP 75-1-3 for more detailed instructions on the procedures to take in the event munitions with unknown fillers are encountered on FUDS properties.

(4). Avoid inhalation and skin contact with smoke, fumes, and vapors of explosives and related hazardous materials.

(5). UXO are the most dangerous military munitions that may be encountered. All military munitions, regardless of their appearance or condition, will be considered dangerous and managed as UXO until assessed otherwise by an UXO-qualified individual. Military munitions that have experienced abnormal environments, such as demilitarization by open burning, open detonation, accidents, fires or where components have been armed or affected by certain tests (e.g., fuse arming tests, jolt and jumble tests), are very unstable.

(6). Do not rely on the color coding of military munitions for definitive identification. Military munitions having incomplete or improper color codes have been encountered.

(7). Avoid approaching the forward area of a military munition until it can be determined whether or not the item contains a shaped charge. The explosive jet, which is formed during detonation, can be lethal at great distances. Assume that all shaped-charge munitions contain a piezoelectric (PZ) fuzing system until investigation proves otherwise. PZ fuzing systems are extremely sensitive, can function at the slightest physical change, and can remain hazardous for an indefinite period of time. In some cases, merely casting a shadow across a PZ fuse can cause it to detonate.

(8). Approach an unfired rocket motor at a 45-degree angle from the rear. Accidental ignition can cause a missile hazard and hot exhaust.

(9). Do not expose unfired rocket motors to any electromagnetic radiation (EMR) sources.

(10). Consider an emplaced landmine to be armed until proven otherwise. Many training mines contain spotting charges capable of inflicting serious injury.

(11). Assume that a practice military munition contains a live charge until investigation proves otherwise. Expended pyrotechnic and practice devices can contain

red or white phosphorus (WP) residue. Due to incomplete combustion, this residue may re-ignite spontaneously if the crust is broken and exposed to air.

(12). Do not approach a smoking WP munition. Burning WP may detonate the explosive burster charge at any time.

(13). Foreign ordnance was shipped to the United States for exploitation and subsequent disposal. Every effort will be made to research all applicable documentation prior to commencement of a project involving foreign ordnance.

E. Exclusion Zone Operations

On munitions response to MEC projects, it is the responsibility of the UXOSO to establish the exclusion zone (EZ) for each MRS.

(1). The purpose of the EZ is to protect nonessential personnel from blast overpressure and fragmentation hazards. Calculating EZs with respect to intentional and unintentional detonations is discussed below. Approved engineering controls may be used to reduce the EZ for either intentional or unintentional detonations.

(a). Intentional Detonations. Establish the EZ as stated in the approved Work Plan, ESS and SOP 07. The EZ will normally be established at the greater of K328 or MFD for the MGFD. If the K328 or MFD of the MGFD is less than 200 feet, then 200 feet (the Minimum Safe Distance) will be used as the EZ during intentional detonations.

(b). Unintentional Detonations. Establish the EZ as stated in the approved Work Plan, and ESS. The EZ will normally be established at the greater of K40 or HFD for the MGFD.

(2). When multiple teams are working onsite, a Team Separation Distance (TSD) will be established. The minimum TSD will be K40 of the MGFD.

(3). While MEC procedures are being conducted, only personnel essential for the operation and authorized visitors will be allowed to enter a MRS EZ. When nonessential personnel enter the EZ, all MEC procedures will cease. In addition to this work stoppage, the following actions will be taken:

(a). The individual(s) will receive a safety briefing and sign the visitors log prior to entering the EZ.

(b). The individual(s) will be escorted by a UXO-qualified individual.

(4). All personnel working within the EZ will comply with the following:

(a). There will be no smoking within the EZ, except in areas designated by the UXOSO.

(b). There will be no open fires for heating or cooking (gas stoves, grills, etc.) within the EZ, except where authorized by the UXOSO.

(c). During geophysical detection operations, personnel will not wear any metal (e.g., rings, watches, keys, etc.) that would interfere with the instrument's operation.

(5). On RCWM project properties, EZs will be established in accordance with EP 75-1-3.

F. Munitions Response Excavation Operations

(1). By their nature, MEC procedures/anomaly excavations are hazardous and certain calculated risks will be taken. Ingenuity, judgment, common sense, and above all, the mastery of UXO techniques and observance of UXO principles will determine success or failure. UXO-qualified technicians will be alert at all times and be in observance of UXO safety precautions. UXO-qualified personnel are the most experienced and best qualified to perform these operations.

(2). Hand excavation is the most reliable method for uncovering a military munition. However, hand excavation exposes personnel to the hazard of detonation. Only UXO-qualified personnel are to perform these operations.

(3). Specific Procedures for Anomaly Excavation.

(a). Start all excavations from the side of the anomaly. Carefully dig from the side until identification of the anomaly is made. Excavation operations, whether by hand or Earth-Moving Machinery (EMM), will employ a step-down or offset access method. Under no circumstances will any excavation be made directly over suspected military munitions.

(b). Clear debris/dirt from the subsurface anomaly only enough to permit identification of the anomaly and to apply the necessary MEC procedure.

(c). All UXO will be blown in place, when possible.

(d). Move with slow, deliberate motions; avoid abrupt moves.

(e). Avoid impacting, jarring, or striking UXO.

(f). Do not subject UXO to shock, rough handling, heat, or any other force.

(4). EMM may be used to excavate overburden from suspected military munitions. EMM will not be used to excavate within 12 inches of a suspected military munition. Once the EMM is within 12 inches of the suspected military munition, the excavation will be completed by hand excavation methods. Personnel who are not UXO-qualified may operate EMM only when supervised by a UXO Technician III or higher. Shielding of equipment to protect from fragmentation will not be required, when removing overburden.

(a). If more than one earth-moving machine is to be used onsite, the same minimum separation distances required for multiple work teams apply.

(b). EMM operations will be conducted within the guidelines of EM 385-1-1 EM 385-1-97, and 29 CFR 1926, subpart P.

G. Procedures for Assessing Munitions with Unknown Fillers

(1). Background.

(a). For explosives and chemical safety reasons, the complete identification of recovered munitions is required before destruction or disposal. This is particularly true with regard to munitions that can be filled with chemical warfare materiel (CWM) and could present a downwind chemical vapor hazard.

(b). Many munitions have sufficient physical properties (e.g., design characteristics, markings) that allow UXO personnel to positively identify the munition and the filler. However, the design or physical condition of some munitions may not allow their complete identification by visual inspection.

(c). Munitions whose external design does not always allow for positive identification of their filler include: 4.2-inch mortars (M1, M2, and the M2A1 models) and Livens projectiles (MK II (M1) and MKIIAI).

(2). Because the 4-inch Stokes mortar's physical dimensions clearly indicate whether or not it contains a suspect chemical filler, it is not included in this list.

(3). Because this list is not all inclusive, the UXO Program Manager should be contacted about other munitions when questions arise.

(4). The identification of the filler of some munitions is very difficult, if not impossible, through visual inspection when the munition has been used or otherwise impacted (e.g., disposed of after ineffective treatment) or exposed to the environment (e.g., buried as a means of disposal) for years.

(5). Only EOD or TEU will be allowed to determine the most likely filler of these munitions.

All MEC/MPPEH items discovered during the UXO intrusive investigation of the anomalies will be left in place. No MEC/MPPEH will be moved until determined safe to do so by the SUXOS). The facility POC will be notified of the presence of MEC so that arrangements may be made through the facility for proper disposition of the item(s). If the facility initiates an emergency response or disposal action, follow-up documentation must be obtained to detail the date and method of disposition. This is also needed to ascertain the actual type and condition of the item (live or inert filled) to aid in future classification of the site.

H. Quality Control

During the UXO intrusive investigation the UXOQCS, or Senior UXO technician if there is no UXOQCS, will recheck 25% of the first four units of work (grids or transects). If quality requirements are not met on any unit, that unit will be rejected and the UXO team will rework the entire unit. Once quality requirements are met for four units in a

row, the UXOQCS, or Senior UXO technician if there is no UXOQCS may reduce the level of rechecks to 10% of each unit (grids or transects). Blind seeding of the UXO intrusive investigation area may be done as an alternative to the 25% rechecks. The blind seeding plan if used will be included in the approved Work Plan. If at any time a unit fails the quality control check, that complete unit will be reworked and the rechecks will be increased until four units in a row pass the recheck. All QC failures will be recorder on the Non-Conformance Report.

TABLE 1

White's Spectrum XLT Settings		
Basic Adjustments:	**UXO 1**	
Target Volume	58	
Audio threshold	23	
Tone (audio frequency)	226	
Audio Disc.	on	
Silent Search	off	
Mixed-Mode	on	
A.C. Sensitivity	60	Adjust at a test Grid. Compare with another White's
D.C. Sensitivity	30	Adjust at a test Grid. Compare with another White's
Backlight	0	
Viewing Angle	25	
Pro Options:		
"Audio"		
Ratchet Pinpointing	on	
S.A.T. Speed	7	
Tone I.D.	on	
V.C.O.	on	
Absolute Value	off	
Modulation	on	
"G.E.B/Trac"		
Autotrac	on	
Trac View	off	
Autotrac Speed	14	
Autotrac Offset	+1	
Trac Inhibit	on	
Coarse B.E.B.	54	These numbers are variable and will change automatically.
Fine G.E.B.	160	These numbers are variable and will change automatically.
"Discrimination"		
Disc. Edit	+95 Accept	
Block Edit	+95 Accept	
Learn Accept	off	
Learn Reject	off	

White's Spectrum XLT Settings		
Basic Adjustments:	**UXO 1**	
Recovery Speed	20	
Bottlecap Reject	20	
"Display"		
Visual Disc.	off	
Icons	on or off	
V.D.I. Sensitivity	55	
D.C. Phase	9on	
Graph Averaging	on	
Graph Accumulating	on	
Fade Rate	u	
"Signal"		
Transmit Boost	off	
Transmit Frequency	1 to 7	
Preamp Gain	4	

TABLE 2

Related Field Forms

Form Number	Frequency	Form Name
MRP FF.1	Once	SAP Worksheet No 4-Project Sign-Off
MRP FF.2	Daily	Daily MEC Activity Log
MRP FF.3	Daily	Daily Equipment Checklist
MRP FF.5	Daily	Daily Photographic Log
MRP FF.6	Once	IVS Installation Checklist
MRP FF.7	Daily	Daily IVS Report
MRP FF.8	Daily	Daily MEC_MPPEH Log For UXO Avoidance Activities
MRP FF.10	Daily	MEC Accountability Form
MRP FF.15	Daily	Daily QC Report
MRP FF.16	Once per Definable Feature	Preparatory Phase Inspection Report
MRP FF.17	Once per Definable Feature	Initial Phase Inspection Report
MRP FF.18	Periodic	Follow Up Phase Inspection Report
MRP FF.21	Daily	Daily Safety Log
MRP FF.22	Daily	Daily Tailgate Safety Briefing-Training Record Form

Field Forms

FIELD FORMS

Field Forms

Form Type	Form Number	Frequency	Form Title
Daily Activities Documentation	MRP FF.1	Once	Sap Worksheet No 4-Project Sign-Off
	MRP FF.2	Once	Daily MEC Activity Log
	MRP FF.3	Daily	Daily Equipment Checklist
	MRP FF.4	Daily	Daily Visitors Log
	MRP FF.5	Daily	Daily Photographic Log
	MRP FF.6	Daily	IVS Installation Checklist
	MRP FF.7	Daily	Daily IVS Report
	MRP FF.8	Daily	Daily MEC_MPPEH Log For UXO Avoidance Activities
	MRP FF.9	Daily	MEC Cumulative Summary Log
	MRP FF.10	Daily	MEC Accountability Form
	MRP FF.11	Daily	Dig Sheet - Manual Target Excavation Results
	MRP FF.12	Daily	Dig Sheet - Mechanical Target Excavation Results
	MRP FF.13	Daily	MDAS Container Form
	MRP FF.14	Daily	Geophysical Survey Field Forms (1 - 6)
	MRP FF.14.1	Daily	Daily DGM Quality Control Report
	MRP FF.14.2	Daily	DGM Instrument Verification Strip (IVS) Installation Checklist
	MRP FF.14.3	Daily	DGM Daily IVS Checklist
	MRP FF.14.4	Daily	DGM Initial Instrument Checklist
	MRP FF.14.5	Daily	DGM Daily Instrument Checklist
	MRP FF.14.6	As Needed	DGM Field Editing Checklist
QC	MRP FF.15	Daily	Daily QC Report
	MRP FF.16	Once per Definable Feature	Preparatory Phase Inspection Report
	MRP FF.17	Once per Definable Feature	Initial Phase Inspection Report
	MRP FF.18	Periodic	Follow Up Phase Inspection Report
	MRP FF.19	As Needed	Non Conformance Report
	MRP FF.20	As Needed	Lessons Learned
H&S	MRP FF.21	Daily	Daily Safety Log
	MRP FF.22	Daily	Daily Tailgate Safety Briefing-Training Record Form
Miscellaneous	MRP FF.23	As Needed	Field Change Request
	MRP FF.24	As Needed	Equipment Maintenance-Repair Form

TETRA TECH

MRP FF.1

SAP Worksheet #4 (Field Personnel)

Project Personnel Sign-off Sheet

Facility/Location: _____

Site(s): _____

Date	Organization/Role	Name	Signature
	Tetra Tech/SUXOS		
	Tetra Tech/UXOQCS		
	Tetra Tech/UXOSO (if different than UXOQCS)		
	Tetra Tech/Technician		
	Tetra Tech/ Technician		
	Tetra Tech/ Technician		
	Tetra Tech/ Technician		
	Tetra Tech/ Technician		
	Tetra Tech/ Technician		
	Tetra Tech/ Technician		
	Tetra Tech/ Technician		
	Site Geophysicist		
	Staff Geophysicist		
	Staff Geophysicist		
	Staff Geophysicist		

I have read and understood the SAP relative to assigned roles, per SAP Worksheet No. 3.

TETRA TECH

MRP FF.2

DAILY MEC ACTIVITY LOG

Facility/Location: _____

Site(s): _____

FIELD ACTIVITY SUBJECT:	**Date:**
PROJECT NO:	**TASK CODES**:

SUMMARY OF DAILY PROGRESS: (Update Definable Feature of Work - Worksheet 12)

Mobilization/Set Preparation:

Site Survey:

Vegetation Management:

GPS Positional Data

Detector Aided Surface Surveys:

Target Reacquisition:

Intrusive Operation:

Donor Explosives Handling/Storage:

MEC Management (Treatment):

MPPEH Management (Inspections):

MPPEH Management (Certification):

MPPEH Management (Disposal):

Demobilization:

Other:

LIST OF MEC ITEMS ID, MPPEH ITEM ID, MDAS, OR NONE
(for documentation see MEC/MPPEH/MDAS Tracking Logs for added details)**:**

Item ID	Description	Item ID	Description

TETRA TECH

MRP FF.2

DAILY MEC ACTIVITY LOG

Facility/Location: _____

Site(s): _____

FIELD ACTIVITY SUBJECT:	**Date:**
DESCRIPTION OF DAILY ACTIVITIES AND EVENTS:	
IMPORTANT PHONE CALLS/DECISIONS:	
FIELD TASK MODIFICATIONS:	
WEATHER CONDITIONS:	
VISITORS ON SITE:	
PERSONNEL ON SITE:	
SIGNATURE:	**DATE:**

TETRA TECH

MRP FF.3
DAILY EQUIPMENT CHECKLIST

Facility/Location: _____

Site(s): _____

Equipment:					**Initial Condition Out of the Box Acceptable (Y/N/NA)**				
Serial Number:					**Inspection**		**Spare parts**		**Cable Shake Test**
Description:									
Date Out	**Time Out**	**Daily Cond. & Comments Out**	**Monument Check (1)**	**Checked Out By**	**Date In**	**Time In**	**Daily Cond. & Comments In**	**Checked In By**	**Monument Check (1)**

(1) For GPS Units, confirm accuracy correlation to referenced monument locations. Please record general description of monument locations in the Daily Activity Log, once established. (Example – GPS QC Location – Well MW-3 or northwest corner of intersection of Perimeter Road and Munitions Street)

Last Revised: 3/31/2011

TETRA TECH

MRP FF.4
VISITOR'S LOG

Facility/Location: _____

Site(s): _____

DATE	Time		PRINT NAME	SIGNATURE	ORGANIZATION	PHONE #	RAC
	In	Out					

Last Revised: 3/31/2011

TETRA TECH

MRP FF.5
Photographic Log

Facility/Location: _____

Site(s): _____

Photograph Number	Date	Taken By (initials)	Subject/Description	Anomaly ID (if applicable)	Remarks/Comments

Last Revised: 3/31/2011

TETRA TECH
MRP FF.6
INSTRUMENT VERIFICATION STRIP (IVS)
INSTALLATION CHECKLIST

Facility/Location: _____

Site(s): _____

Project No:	**Date**:

I. Test Plot Information

Location:

Have survey objectives been determined, clarified, and documented?	Y	N	NA
Will the IVS be available during the project for the evaluation of suspected instrument malfunctions or evaluation of new equipment and operators?	Y	N	NA
Has surface clearance been performed?	Y	N	NA
Has background geophysical survey been performed before burial?	Y	N	NA
Measure depth to top and center of mass of each object?	Y	N	NA

Item No.	Inert Item/Surrogate Description	Depth (inches)	Azimuth/ Inclination Angle(Degrees)	GPSed (Y/N)	Comments
1					
2					
3					
4					
5					
6					
7					

II. Instrument Information

Instrument Type/Manufacture	Instrument Serial Number	Test Plot Items Instrument Tested on (List Item Numbers)	Test Results - Personnel Testing Equipment ☒ indicates good for operation				Comments (pass/fail) Explain below
			AM	AM	PM	PM	
			☐		☐		
			☐		☐		
			☐		☐		
			☐		☐		
			☐		☐		
			☐		☐		
			☐		☐		

III. Problems Encountered / Corrective Actions Taken.

explain in space below:

IV. Supervisor

Name and Signature:	**Title/Company**:	**Date**:

TETRA TECH
MRP FF.7
DAILY IVS REPORT

Facility/Location: _____

Site(s): _____

Project No:	**Date**:

I. Test Plot Information

Location: (See IVS Installation Checklist)

Item No.	Inert Item/Surrogate Description	Depth (inches)	Comments
1			
2			
3			
4			
5			
6			
7			

II. Instrument Information

Instrument Type/Manufacture	Instrument Serial Number	Test Plot Items Instrument Tested on (List Item Numbers)	Test Results - Initials of personnel Testing Equipment ☒ indicates good for operation				Comments (pass/fail) Explain below
			AM	AM	PM	PM	
			☐		☐		
			☐		☐		
			☐		☐		
			☐		☐		
			☐		☐		
			☐		☐		
			☐		☐		
			☐		☐		
			☐		☐		
			☐		☐		

III. Problems Encountered / Corrective Actions Taken.

explain in space below:

IV. Supervisor

Name and Signature:	**Title/Company**:	**Date**:

TETRA TECH
MRP FF.8
MEC/MPPEH LOG FOR UXO AVOIDANCE ACTIVITIES

Facility/Location: _____

Site(s): _____

ID #	Item	Date Identified	GPS Location* US Survey Feet		Physical Condition/ Appearance	Classification (MEC/MPPEH)	Resolution (EOD Called, Left in Place, etc)	Resolution/ Disposition Date
			Northing (feet)	Easting (feet)				

* GPS data were collected using the North American Datum of 1983, _____ (US Survey Feet). See Figure _____ for item locations.

Last Revised: 3/31/2010

Tetra Tech
MRP FF.9

MEC CUMULATIVE SUMMARY LOG

Facility/Location: _____

Sites(s): _____

ID No.	ITEM IDENTIFICATION/CATEGORY, BRIEF DESCRIPTION	DATE FOUND	UXO TECH NAME	DIGITAL PHOTOGRAPH NUMBER	DISPOSITION*		DISPOSITION DATE
					Type - (ex.EOD BIP/MDAS)	GPS (Y/N)	
SUXOS Signature (end of project):					**Date:**		

Last Revised: 3/31/2011

Tetra Tech
MRP FF.9

MEC CUMULATIVE SUMMARY LOG

Facility/Location: _____

Sites(s): _____

*** GPS all disposition/shot/treatment locations if item is not BIP. Record Coordinates on MEC Accountability Form. Record full description on MEC Accountability Log.**

MRP FF.10

Facility/Location: _____

Site(s): _____

MEC DATA AND ACCOUNTABILITY FORM

FOR UXO TEAM USE

Assigned ID No.: | Team Leader:

Grid or Lane Number: | Work Area: | Date:

Location: X (Lat): _____ Y (Long): _____ Location Type (UW or UG):_____

Other Location Information: _____

Depth (feet): _____ Inclination (Degrees): _____ Orientation (N–S, E-W):_____

TARGET/ANOMALY CHARACTERISTICS

Type of Target/Find: ☐ Surface Find ☐ Mag & Dig Target ☐ Primary Geo Target ☐ Validation (QA/QC) ☐ No Dig

Type of Anomaly: ☐ UXO ☐ MEC ☐ Inert ☐ Practice ☐ MC (waste) ☐ MD (scrap) ☐ Metal Waste
☐ No Find ☐ Rock ☐ Rust Layer ☐ Oxidation ☐ Misc.:_____

Diameter/Width: | Length: | Estimated Weight:

DIGITAL PHOTO RECORD

Was photo taken? ☐ Yes ☐ No | Camera No.: | Frame No.: | File Name:

MUNITIONS NOMENCLATURE (If Known, Record Below and record fuze condition and disposition)

Munitions Mark/Mod: | Fuze Mark/Mod: ☐ Nose:_____ ☐ Tail:_____ ☐ Transverse:_____ ☐ Casing:_____ | N.E.W. Total:

MUNITIONS CHARACTERISTICS

Munitions Filler: ☐ Explosive ☐ Inert ☐ Propellant ☐ Pyrotechnic ☐ Unknown ☐ Other:_____

Munitions Category: ☐ Depth Charges ☐ Land Mine ☐ Projectiles ☐ Sea Mines
☐ Bombs ☐ Grenades ☐ Misc. Explosive Devices ☐ Pyrotechnics and Flares ☐ Small Arms
☐ Clusters/Dispensers ☐ Guided Missiles ☐ Mortars ☐ Rockets ☐ Torpedoes

FUZE CHARACTERISTICS

Fuze Location(s) (check all that apply): ☐ Nose ☐ Tail ☐ Transverse ☐ Casing | Breaks in Fuze Body? ☐ Yes ☐ No | Fuze Markings:

Fuzing Type(s): ☐ Hydrostatic ☐ MT Long Delay ☐ Powder Train Time Fuze ☐ Nose MT/Tail Impact Inertia
☐ All-ways Acting ☐ Impact ☐ MT Superquick ☐ Pressure ☐ Pt-initiating-Base-detonating
☐ Base Detonating ☐ Influence ☐ Piezo-Electric ☐ Proximity (VT)
☐ Electric ☐ Mech Time (MT) ☐ Point Detonating (PD) ☐ Nose MT/Tail Pressure

Fuze Length: | Fuze Diameter: | Diameter of Fuze Well:

MEC STATUS & PHYSICAL CONDITION (Check all that apply)

☐ Armed ☐ Unarmed ☐ Fired ☐ Unfired
☐ Intact ☐ Broken Open ☐ Filler Visible ☐ Soil Staining

FOR SUXOS USE

Disposition: (Clarify Under Remarks) (GPS all disposition location if not BIP) | Date:
☐ Transferred ☐ Transported ☐ Left In Place ☐ Destroyed ☐ BIP ☐ Other : _____

Client Notifications By:	Signature:	Date
Transferred To:	Signature:	Date:
Destroyed By:	Signature	Date:

Remarks: (indicate if item completely destroyed or rendered MDAS and disposed of in an MSDA Container, list container number)

SUXOS Signature: | Date:

TETRA TECH

MRP FF.11

DIG SHEET - MANUAL TARGET EXCAVATION RESULTS

Facility/Location: _____

Site(s): _____

Location or Anomaly Number (1)	Coordinates (1)		Detection Equip.	Excavation Dimensions (L x W x D) (inches)/(feet)	Number of Dig Locations	Munitions-Related Items				Non-Munitions Items			No Finds
	N	E				Number and Description	MEC/ MPPEH/ MDAS	Explosive Weight (lbs)	Disposition Date	Number and Description	Approx. Weight (lbs)	Disposition Date	Anomaly Deeper than ___'? (Y/N)

-- = None found or unknown, not applicable.

TETRA TECH
MRP FF.11
DIG SHEET - MANUAL TARGET EXCAVATION RESULTS

Facility/Location: _____

Site(s): _____

1) Coordinates supplied by GPS

Signature: _____Date:_____

TETRA TECH
MRP FF.12
DIG SHEET - TARGET MECHANICAL EXCAVATION RESULTS

Facility/Location: _____

Site(s): _____

Location or Pit/ Trench Number[1]	Coordinates [1]		Date	Excavation Dimensions (L x W x D) (feet)	Munitions-Related Items					Non-Munitions Items			Soil Description
	N	E			Number and Description	Item ID Number	MEC/ MDEH /MDAS	Explosive Weight (lbs)	Disposition Date	Number and Description	Approx. Weight (lbs)	Disposition Date	

-- = Not found or unknown.
1) Coordinates supplied by GPS (end points for trenches or center points for pits, etc.)

Tetra Tech
MRP FF.13
MDAS Addition Form

Facility/Location: _____**Site(s):** _____

Container #_____**Seal/Key #**_____

NO.	Description/NIIN	Quantity	Item No.*	Type of Treatment*
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				

* If applicable.

"This certifies that the material potentially presenting an explosive hazard listed has been 100 percent properly inspected and to the best of our knowledge and belief, is inert and/or free of explosives or related materials"

CERTIFIER PRINTED NAME _____

SIGNATURE _____ DATE _____

POSITION _____

ORGANIZATION NAME _____

ORGANIZATION ADDRESS _____

ORGANIZATION PHONE NUMBER _____

VERIFIER PRINTED NAME _____

SIGNATURE _____ DATE _____

POSITION _____

ORGANIZATION NAME _____

ORGANIZATION ADDRESS _____

ORGANIZATION PHONE NUMBER _____

TETRA TECH
MRP FF.14.1
DAILY DGM QUALITY CONTROL REPORT

Facility/Location: _____

Site(s): _____

Project Number:	Date:
Personnel Present:	
List Features of Work and Equipment Used, Locations (areas surveyed)	
Rework Items Identified Today (Not Corrected by Close of Business)	Rework Items Corrected Today
Remarks/Describe any Idle or Downtime and/or Equipment Problems	
On behalf of the contractor, I certify that this report is complete and correct and the equipment and material used and work performed during this reporting period is in compliance with the contract drawings and specifications to the best of my knowledge except as noted in this report.	_____ ERT Representative Date
Tetra Tech Quality Assurance	
Quality Assurance Representative Remarks and/or Exceptions to the Report	
Inspection of Field Activities Performed	_____ Tetra Tech QA Representative Date

TETRA TECH
MRP FF.14.2
DGM INSTRUMENT VERIFICATION STRIP (IVS) INSTALLATION CHECKLIST

Facility/Location: _____

Site(s): _____

Project No:	**Date**:

I. Test Plot Information

Have survey objectives been determined, clarified, and documented?	Y	N	NA
Will the IVS be available during the project for the evaluation of suspected instrument malfunctions or evaluation of new equipment and operators?	Y	N	NA
Has surface clearance been performed?	Y	N	NA
Has background geophysical survey been performed before burial?	Y	N	NA
Measure depth to top and center of mass of each object?	Y	N	NA

Item No.	Inert Item/Surrogate Description	Depth (inches)	Azimuth/ Inclination Angle (Degrees)	GPSed (Y/N0	Expected Response Range (DGM)	Comment
1						
2						
3						
4						
5						
6						
7						

II. Instrument Information

Instrument Type/Manufacture	Instrument Serial Number	Measured Response (DGM)	Test Results - Initials of personnel Testing Equipment ☒ indicates good for operation				Comments (pass/fail) Explain below
			AM	AM	PM	PM	
			☐		☐		
			☐		☐		
			☐		☐		
			☐		☐		
			☐		☐		
			☐		☐		
			☐		☐		

III. Problems Encountered / Corrective Actions Taken.

explain in space below:

IV. Supervisor

Name and Signature:	**Title/Company**:	**Date**:

TETRA TECH
MRP FF.14.3
DGM DAILY IVS CHECKLIST

Facility/Location: _____

Site(s): _____

Project No:	**Date**:

I. Test Plot Information

Location: (See IVS Installation Checklist)

Item No.	Inert Item/Surrogate Description	Depth (inches)	Expected Response Range (DGM)	Comments
1				
2				
3				
4				
5				
6				
7				

II. Instrument Information

Instrument Type/ Manufacture	Instrument Serial Number	Measured Response (DGM)	GPS Monuments	Test Results,- Personnel Testing Equipment ☒ indicates good for operation				Comments
				AM	AM	PM	PM	
				☐		☐		
				☐		☐		
				☐		☐		
				☐		☐		
				☐		☐		
				☐		☐		
				☐		☐		
				☐		☐		
				☐		☐		
				☐		☐		

III. Problems Encountered / Corrective Actions Taken.

explain in space below:

IV. Supervisor

Name and Signature:	**Title/Company**:	**Date**:

TETRA TECH
MRP FF.14.4
DGM INITIAL INSTRUMENT CHECKLIST

Facility/Location: _____

Site(s): _____

Name and Title: _____
Date: _____

Has the sensor travel test been performed (for underwater surveys), and are the results acceptable to meet survey objectives?	Y	N	NA
Has the GPS unit been checked for accuracy requirements against two known locations?	Y	N	NA
Has the optimum sensor height for each instrument been determined?	Y	N	NA
Have the pull-away and/or interferences tests been performed and successfully demonstrated no influence for navigational or towing equipment?	Y	N	NA
Has an appropriate data acquisition rate been selected?	Y	N	NA

TETRA TECH
MRP FF.14.5
DGM DAILY INSTRUMENT CHECKLIST

Facility/Location: _____

Site(s): _____

Name and Title: _____
Date: _____

Has the operator been checked for presence of metal?	Y	N	NA
Has the instrument been warmed-up?	Y	N	NA
Have the sensor positions been measured and recorded?	Y	N	NA
Has a static background and spike test been performed successfully?	Y	N	NA
Has the equipment function test been performed with detection of all the test targets?	Y	N	NA
Have all loose cables been secured?	Y	N	NA
Has the EM61 or EM31 been nulled (power on)?			
Has the geophysical equipment been set up according to manufacturer's specifications?	Y	N	NA
Were the data monitored during data collection for anything unusual?	Y	N	NA

TETRA TECH
MRP FF.14.6
DGM FIELD EDITING CHECKLIST

Facility/Location: _____

Site(s): _____

Name and Title: _____
Date: _____

Have the following items been evaluated for correctness and edited if necessary:

Line numbers?	Y	N	NA
Start and end points?	Y	N	NA
Line direction?	Y	N	NA
Fiducial locations?	Y	N	NA

Have the data been examined for geophysical noise?	Y	N	NA
Have the data been examined for the presence of drop-outs and spikes?	Y	N	NA
Have the edited data been converted to the appropriate .xyz format?	Y	N	NA

If using magnetics, have the following steps been taken:

Examined base station data for any problems?	Y	N	NA
Performed diurnal correction to field magnetometer data?	Y	N	NA

Have the positional data been evaluated for accuracy and completeness?	Y	N	NA

MRP FF.15

Facility/Location: _____

Site(s): _____

DAILY QUALITY CONTROL REPORT

Project Name: _____ Report No: _____

Project No: Location: Date:

I. Personnel Present (Reference/attach SUXOS's daily report if applicable): See Daily Tailgate Safety Form

II. Definable Feature of Work (see SAP Worksheet No. 12 and revise list as needed)

☐ Mob/Site Prep/Site Security/Surveying	☐ Data Processing and Interpretation	☐
☐ UXO Escort/Avoidance	☐ Donor Explosives Handling	☐
☐ Site-Specific Training/IVS Cert.	☐ MEC Mang./Insp./Cert./Disposal	☐
☐ Detector Surface Sweep	☐ Non-MEC Disposal	☐
☐ Vegetation Management	☐ Demobilization	☐
☐ GPS Positional Data Collection	☐	☐
☐ Surface/Subsurface Clearance	☐	☐
☐ Anomaly Intrusive Investigations	☐	☐ Other:

III. Quality Control Activities (Include blind seed coordinates and results and reference/attach inspection/surveillance reports):

IV. Problems Encountered / Corrective Actions Taken

V. Directions Given / Received:

VI. Special Notes / Lessons Learned

VII. Visitors:

☐ Yes (see Visitor's Log/Daily Activity Log) ☐ No

VIII. Approval

Name and Signature:	Title/Company:	Date:

Revised March 2011

Facility/Location: _____

Site(s): _____

PREPARATORY PHASE INSPECTION REPORT

Project Name: _____ Project No: _____ Report No: _____

UXO Team: _____ Location: _____ Date: _____

I. Definable Feature of Work (see SAP Worksheet No. 12 and revise list as needed)

☐ Project Management	☐ GPS Positional Data	☐ Demobilization
☐ Site Preparation (incl. mobilization)	☐ DGM Equip. Cal./Main./Test./Insp.	☐ Final Report Prep
☐ Site Survey	☐ GSV	☐ Other:
☐ Vegetation Management	☐ Digital Geophysical Mapping	☐ Other:
☐ UXO Detector-aided Surface Survey	☐ Geophysical Data Processing	☐ Other:

II. References (DOD Inst., Corporate references, SOPs, etc.):

III. Personnel Present (employees performing the work) Attach supplemental sheet if necessary

Name	Position	Company

IV. Submittals Reviewed (Work Plan, EHSP, Permits, etc.) Attach supplemental sheet if necessary

Submittals Reviewed.	Item No.	Date	Approval Authority

Have all submittals been approved? ☐ Yes ☐ No

If No, what items have not been submitted/ approved?

Are all submittals on hand? ☐ Yes ☐ No

If No, what items are missing?

Check approved submittals against delivered material. (This should be done as material arrives.)

Comments:

V. Resources (Personnel & Equipment)

Are adequate resources on hand to effectively conduct work? ☐ Yes ☐ No

If No, what action will be taken?

Facility/Location: _____

Site(s): _____

PREPARATORY PHASE INSPECTION REPORT

Project Name: _____ Project No: _____ Report No: _____

UXO Team: _____ Location: _____ Date: _____

VI. Procedures (Project Manger should be involved in this stage of the inspection)

Review contract specifications. (List special requirements such as location accuracy, format for deliverables, etc.)

Discuss procedure for accomplishing the work (Reference WP Section or SOP).

Clarify any differences (revisions needed).

VII. Resolve Differences (What did you do to resolve outstanding issues/problems)

Comments:

VIII. Testing/ Surveillance

Identify Tests/ Surveillance to be performed, frequency, and by whom.

Where will the testing to take place (in the test bed, at a selected monument, etc.)?

Is the Testing/ Surveillance Plan Adequate?

IX. Safety

Review applicable portion of the Health and Safety Plan.

Has the Activity Hazard Analysis been approved? ☐ Yes ☐ No

X. Results of Inspection

☐ Acceptable ☐ Unacceptable NCR #:

Name: Signature: Date:

QCM Comments

QCM Review

☐ Concur ☐ Non-Concur Signature: Date

XI. Distribution

☐ PM ☐ UXO Project MGR ☐ UXOSO/QC ☐ SUXOS ☐ CLIENT REP

Facility/Location: _____

Site(s): _____

INITIAL PHASE INSPECTION REPORT

Project Name: _____ Report No: _____

Project No: _____ Location: _____ Date: _____

I. Definable Feature of Work (See Worksheet No. 12 and update list)

- ☐ Project Management
- ☐ Excavation Observation/Operations
- ☐ Identification of MEC/MPPEH
- ☐ Safety Meetings
- ☐ Documentation Control
- ☐ Field Data Entry
- ☐ UXO Escort/ Avoidance Operations
- ☐ MEC Transfer to EOD
- ☐ Mobilization
- ☐ Document Review
- ☐ MEC Subsurface Excavation
- ☐ MEC Surface Sweep
- ☐ MEC Disposal/Treatment
- ☐ Demobilizaiton
- ☐ Other:

II. References (DOD Inst, Corporate references, SOPs, etc.):

III. Personnel Present (employees performing the work) Attach supplemental sheet if necessary

Name	Position	Company

IV. Preparatory Work (equipment set up & testing, EZ set up, logbook entries, etc.)

Is preliminary work complete and correct? ☐ Yes ☐ No

If No, what action(s) will be taken?

V. Task Execution

Is work being completed in accordance with plans and specifications? ☐ Yes ☐ No

If No, what corrective action(s) will be taken?

Is workmanship acceptable? ☐ Yes ☐ No

If No, what action(s) will be taken?

Facility/Location: _____

Site(s): _____

INITIAL PHASE INSPECTION REPORT

Project Name: _____ Report No: _____

Project No: _____ Location: _____ Date: _____

V. Resolve Differences

Comments:

VI. Safety (Review work conditions using HASP and AHAs)

Comments:

VII. Results of Inspection

☐ Acceptable ☐ Unacceptable NCR #:

Name:	Signature:	Date:

QC Manager Comments

QC Manager Review

☐ Concur	☐ Non-Concur	Signature:	Date

VIII. Distribution

☐ PM ☐ UXO Project MGR ☐ UXOS/QC ☐ SUXOS ☐ CLIENT REP

MRP FF.18

Facility/Location: _____

Site(s): _____

FOLLOW-UP INSPECTION/SURVEILLANCE REPORT

Project Name: _____ Report No: _____

Project No: _____ Location: _____ Date: _____

I. Definable Feature of Work (see SAP Worksheet No. 12 and revise list as needed)

☐ Project Management	☐ Digital Geophysical Mapping	☐
☐ Site Preparation (incl. mobilization)	☐ Geophysical Data Processing	☐
☐ Site Survey	☐ Demobilization	☐
☐ Vegetation Management	☐ Final Report Prep	☐
☐ UXO Detector-aided Surface Survey	☐	☐
☐ GPS Positional Data Collection	☐	☐
☐ DGM Equip. Cal./Main./Test./Insp.	☐	☐
☐ GSV	☐	☐ Other:

II. References (DOD Inst, Corporate references, SOPs, etc.):

III. Activities/Conditions Observed

Conducted By: :	Signature:	Date:

X. UXOSO/QC Review

☐ Acceptable	☐ Unacceptable	NCR #:

Comments:

Name:	Signature:	Date:

XI. Distribution

☐ PM ☐ SUXOS ☐ UXOSO/QC ☐ UXO Program Manager ☐ Client Rep

Facility/Location: _____

Site(s): _____

NON-CONFORMANCE REPORT

Client:	Project Number:
Project:	Specific Process:

Description of Process

I. Description of Nonconformance *(Items involved, specification, code or standard to which items do not comply, submit sketch if applicable)*

Name and Signature of Person Reporting Nonconformance	Title/Company	Date

II. Root Cause Analysis

Immediate Causes: What actions and conditions contributed to this event? Check all that apply:

Substandard Acts	
☐ Operating equipment without authority	☐ Inadequate inspection/peer review
☐ Failure to follow/improper execution of procedure	☐ Poor judgment
☐ Using equipment improperly	☐ Failure to communicate—written and/or verbal
☐ Improper servicing/maintenance of equipment	☐ Acceptance of defective equipment/material
☐ Under influence of alcohol/drugs	☐ Other substandard acts
☐ Horseplay	
Substandard Conditions	
☐ Personnel not properly qualified or trained	☐ Inadequate oversight
☐ Defective equipment/material	☐ Inadequate procedure/instruction

Enter brief explanation of each *immediate cause* below:

Basic Causes: What specific personal or job management system factors contributed to this event? Check all that apply:

Personal Factors	Job Factors
☐ Inadequate physical/physiological capability	☐ Inadequate leadership and/or supervision
☐ Inadequate mental/psychological capability	☐ Inadequate engineering
☐ Physical or physiological stress	☐ Inadequate purchasing
☐ Lack of knowledge	☐ Inadequate maintenance
☐ Lack of skill	☐ Inadequate tools and equipment
☐ Improper motivation	☐ Inadequate work standards
☐ Other personal factors	☐ Excessive wear and tear
	☐ Abuse and misuse
	☐ Change
	☐ Other job factors

Facility/Location: _____

Site(s): _____

	NON-CONFORMANCE REPORT
	(continued)

Enter brief explanation of each *basic cause* below:

Name and Signature of Person Conducting RCA	Title/Company	Date

III. Recommended Disposition *(Submit sketch, if applicable)*

Name and Signature of Person Recommending Disposition	Title/Company	Date

IV. Evaluation of Disposition by Tetra Tech, Reason for Disposition

V. Corrective Action	☐ Required	☐ Not Required

VI. ☐ QA/QC	☐ Project Manager	☐ Client *(if applicable)*	☐ Other
Name *(Signature)*	Name *(Signature)*	Name *(Signature)*	Name *(Signature)*
Date	Date	Date	Date
☐ Accepted ☐ Rejected ☐ Accepted with Comments	☐ Accepted ☐ Rejected ☐ Accepted with Comments	☐ Accepted ☐ Rejected ☐ Accepted with Comments	☐ Accepted ☐ Rejected ☐ Accepted with Comments

VII. Verification of Disposition	☐ Required	☐ Not Required

By	Signature	Title	Date

MRP FF.20

Facility/Location: _____

Site(s): _____

LESSONS LEARNED REPORT FORM

Client:	Project Number:
Project:	Location:
Type Of Project:	

I. TOPIC

II. DESCRIPTION (Narrative of relevant events, problem, impact)

III. LESSON(S) LEARNED (e.g. Project Specific, Location Specific, Company-wide):

IV. RECOMMENDED FUTURE ACTION
(e.g., Revise Project Procedures, Company Procedures, Additional Training):.

V. EVALUATION BY DEPARTMENT HEAD (e.g., Support Recommendation, Alternate Recommendation):

VI. List supporting data/ references (if applicable)

Reference/ Supporting Data:	Location:

VII. ☐ PM	☐ QCM	☐ UXO Program Manager
Name *(Signature)*	Name *(Signature)*	Name *(Signature)*
Date	Date	Date
☐ Accepted ☐ Rejected ☐ Accepted with Comments Comments:	☐ Accepted ☐ Rejected ☐ Accepted with Comments Comments:	☐ Accepted ☐ Rejected ☐ Accepted with Comments Comments:

VIII. Forward Approved Lessons Learned Report to Program Manager

Name *(Signature)*	Date	☐ Accepted ☐ Rejected ☐ Accepted with Comments Comments:

TETRA TECH
MRP FF.21
DAILY SAFETY LOG

Facility/Location: _____

Site(s): _____

FIELD ACTIVITY SUBJECT:		**Date**	
PROJECT NO.:	**TASK CODES**:		
SUMMARY OF DAILY ACTIVITIES AND EVENTS:			
VISITORS ON SITE (indicate if received Site-Specific raining)**:**			
CHANGES FROM PLANS AND SPECIFICATIONS, AND OTHER SPECIAL ORDERS AND IMPORTANT DECISIONS:			
WEATHER CONDITIONS: (temp, wind, humidity, precipitation)	**IMPORTANT TELEPHONE CALLS**:		
PERSONNEL ON SITE: See Tailgate Safety Briefing/Training Record			
SIGNATURE:		**DATE**:	

Last Revised: 2/18/2011

TETRA TECH

MRP FF.22
DAILY TAILGATE SAFETY BRIEFING/TRAINING RECORD

Facility/Location: _____

Site(s): _____

	Name	Signature	Position
1. Briefing(s) Given By:	_____ _____	_____ _____	_____ _____

Date: _____	**Time:** _____	**Team #:** _____

2. Reason for Briefing:

___ **Initial Safety Briefing**	___ **New Site Procedure:**_____
___ **Daily Safety Briefing**	___ **New Site Information:**_____
___ **New Task Briefing:**_____	___ **Review of Site Information**
___ **Periodic Safety Meeting**	___ **Other: (Specify)**_____

3. List Today's Project Tasks (reference definable features of work – See Worksheet 12.)**:**

4. Safety Topics: (Check All That Apply – per AHA or Work Permit)

___ **Site Safety Personnel**	___ **Decontamination Procedures**
___ **Site/Work Area Description**	___ **Emergency Response/Equipment**
___ **Physical Hazards**	___ **On-Site Injuries/Illness**
___ **Chemical/Biological Hazards**	___ **Reporting Procedures**
___ **Heat/Cold Stress**	___ **Directions to Medical Facility**
___ **Work/Support Zones**	___ **Drug and Alcohol Policies**
___ **PPE**	___ **Medical Monitoring**
___ **Safe Work Practices**	___ **Evacuation/Egress Procedures**
___ **Air Monitoring**	___ **Communications**
___ **Task Training**	___ **Confined Spaces**
___ **OE Precautions**	___ **Other:**

5. Remarks:

6. Personnel Attending

Name	Signature	Position

TETRA TECH

MRP FF.22

DAILY TAILGATE SAFETY BRIEFING/TRAINING RECORD

Facility/Location: _____

Site(s): _____

Name	Signature	Position

TETRA TECH
MRP FF.23
FIELD CHANGE REQUEST (FCR)

Facility/Location: _____

Site(s): _____

CONTRACT TASK ORDER NAME:	**CTO #**	**CHANGE REQUEST NO.**
TO:	**LOCATION:**	**DATE:**

RE:

SAP Worksheet: _____ Section: _____

ESS Section: _____

SOP Section: _____

Other: _____

1. DESCRIPTION (cite or attach specific text/figure changes, as necessary):

2. REASON FOR CHANGE

3. RECOMMENDED DISPOSITION (Submit sketch, if applicable):

_____ Minor Change _____ Major Change (Impacts Cost, Schedule)

4. APPROVAL:

_____ Not Approved (give reason).

_____ Considered minor change – APPROVED per recommended disposition – Documents will not be formally revised.

_____ Considered major change – Client approval required via contract modification process

Prepared by (Signature)	**Date:**
Tetra Tech UXO Manager (Signature)	**Date:**
Tetra Tech Project Manager (Signature)	**Date:**
Client Point of Contact / Client Representative (Signature) (Not applicable if minor change)	**Date:**

TETRA TECH

MRP FF.24
EQUIPMENT MAINTENANCE/REPAIR

Facility/Location: _____

Site(s): _____

MAINTENANCE/REPAIR NO._____

NECESSARY ATTACHMENTS _____ PACKING SLIP, and/or _____ MRR, abd _____LOGS

TYPE OF EQUIPMENT	SERIAL NO.
MAKE:	MODEL:
P O NUMBER	DELIVERY ORDER NO.
STANDARD MAINTENANCE	DATE

DESCRIPTION OF PROBLEM (if any)

_____

_____

_____

MAINTENANCE/REPAIRS TO BE PERFORMED

IN-HOUSE REPAIRS	DATE
SENT OUT TO	COST ESTIMATE AIRBILL NO. P O NO. DATE RET'D

CORRECTIVE ACTION

_____

_____

_____

_____

PARTS LIST

PART DESCRIPTION	QUANTITY	COST/EA

TOTAL LABOR (hours) PERFORMED BY	DATE

RETURNED TO WHICH JOB SITE/Stone Mountain, GA

Last Revised: 3/31/2011

APPENDIX B

PROJECT SUPPORT INFORMATION

B-1 SUPPLEMENTAL HISTORICAL INFORMATION

B-2 HISTORICAL AERIAL PHOTOGRAPHS

B-3 PHASE I RFI RESULTS FIGURES AND MEC FINDS TABLE

B-4 SITE WALK AND PHASE I RFI PHOTOGRAPH LOGS

B-5 SOIL BACKGROUND CONCENTRATIONS

B-6 CHEMICAL REFERENCE LIMITS EVALUATION TABLES

B-1 SUPPLEMENTAL HISTORICAL INFORMATION

B-1.1 SITE ENVIRONMENTAL SETTING

FINAL

Phase I/II Environmental Condition of Property Report

Former U.S. Naval Station Roosevelt Roads
Ceiba, Puerto Rico

Prepared For:

Commander, Navy Region Southeast (CNRSE)
U.S. Navy

Prepared By:

Naval Facilities Engineering Command Atlantic
6506 Hampton Blvd.
Norfolk, VA 23508-1278

15 July 2005

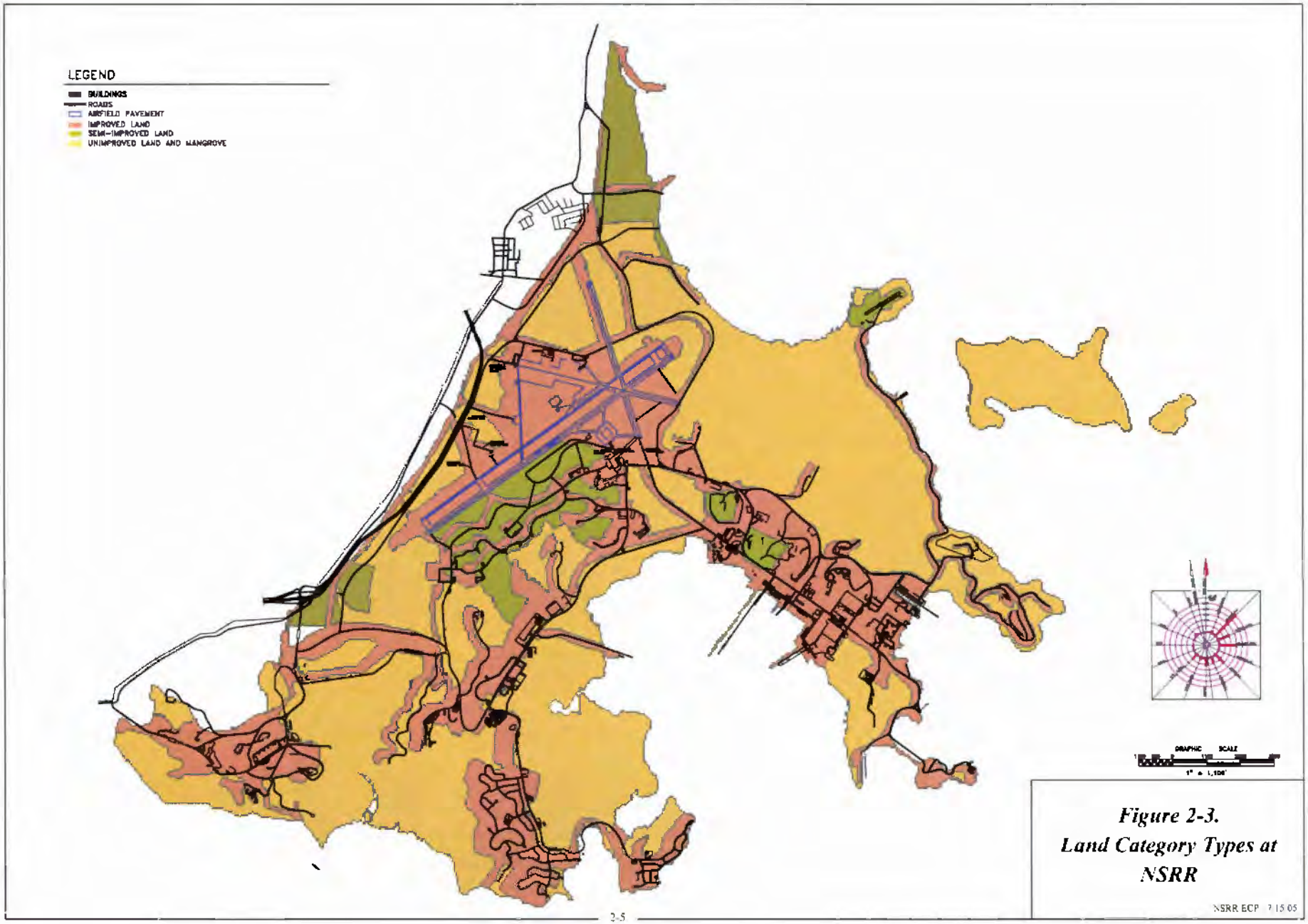


Figure 2-3. Land Category Types at NSRR

NSRR ECP 7/15/05

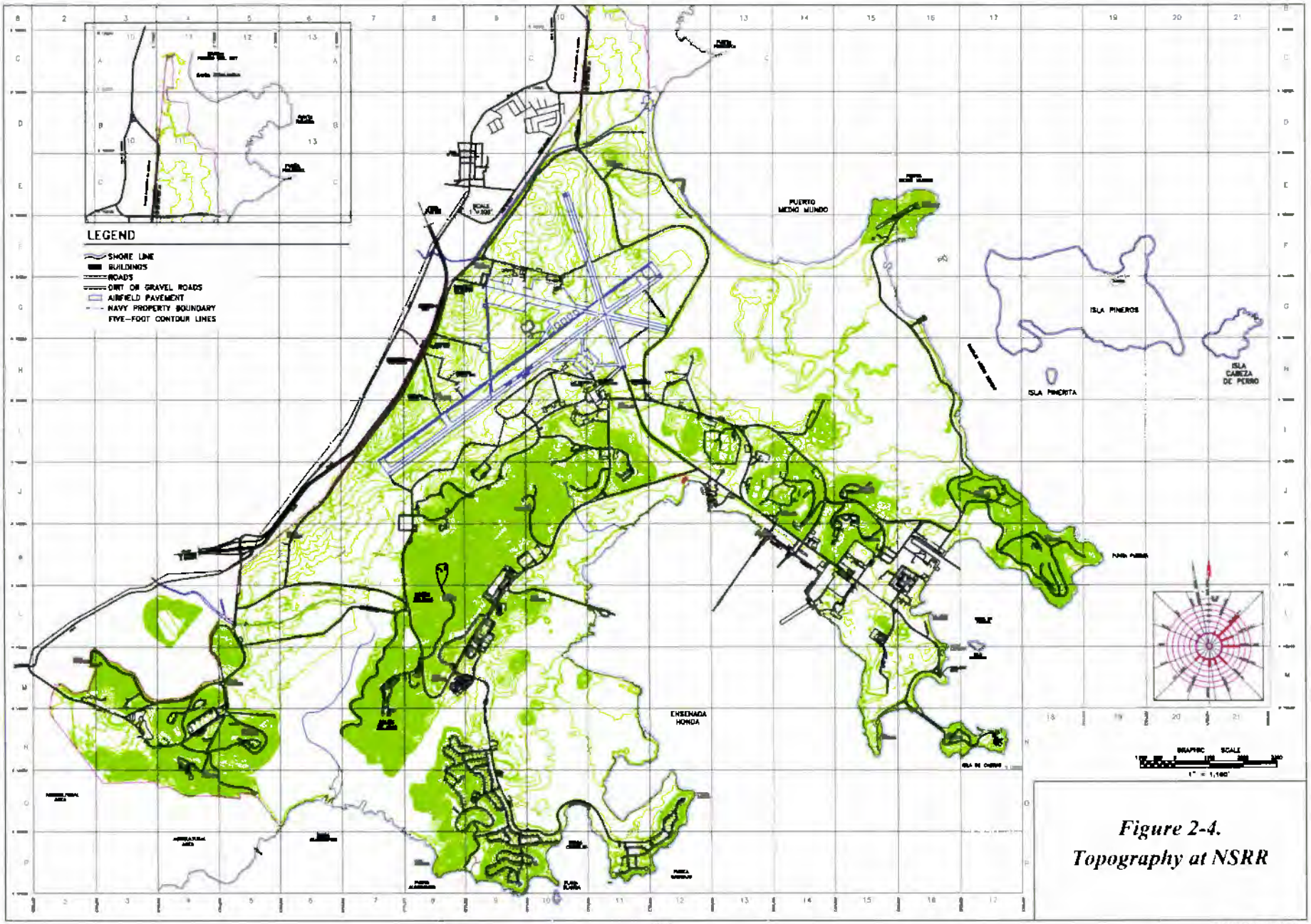


Figure 2-4.
Topography at NSRR

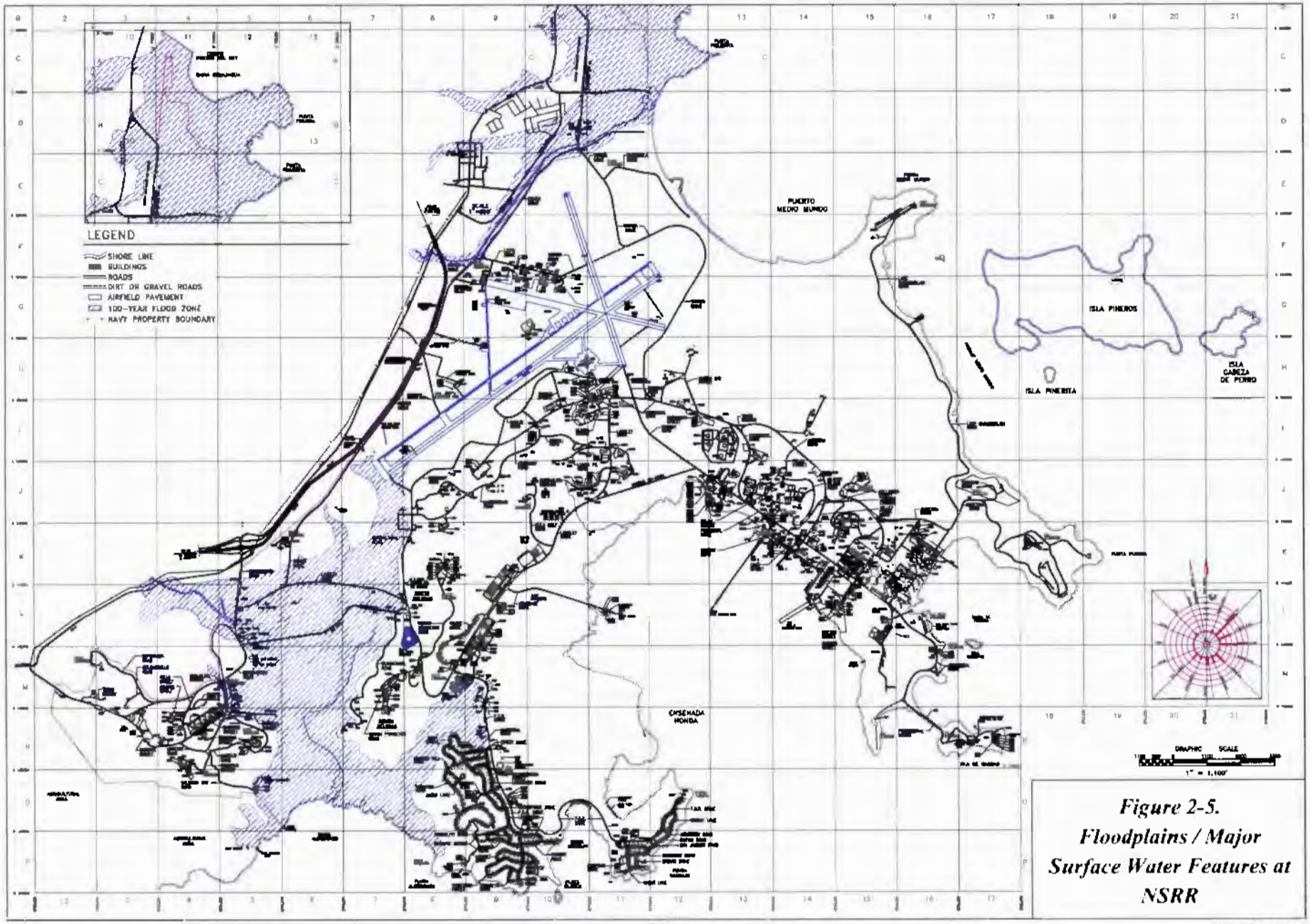


Figure 2-5. Floodplains / Major Surface Water Features at NSRR

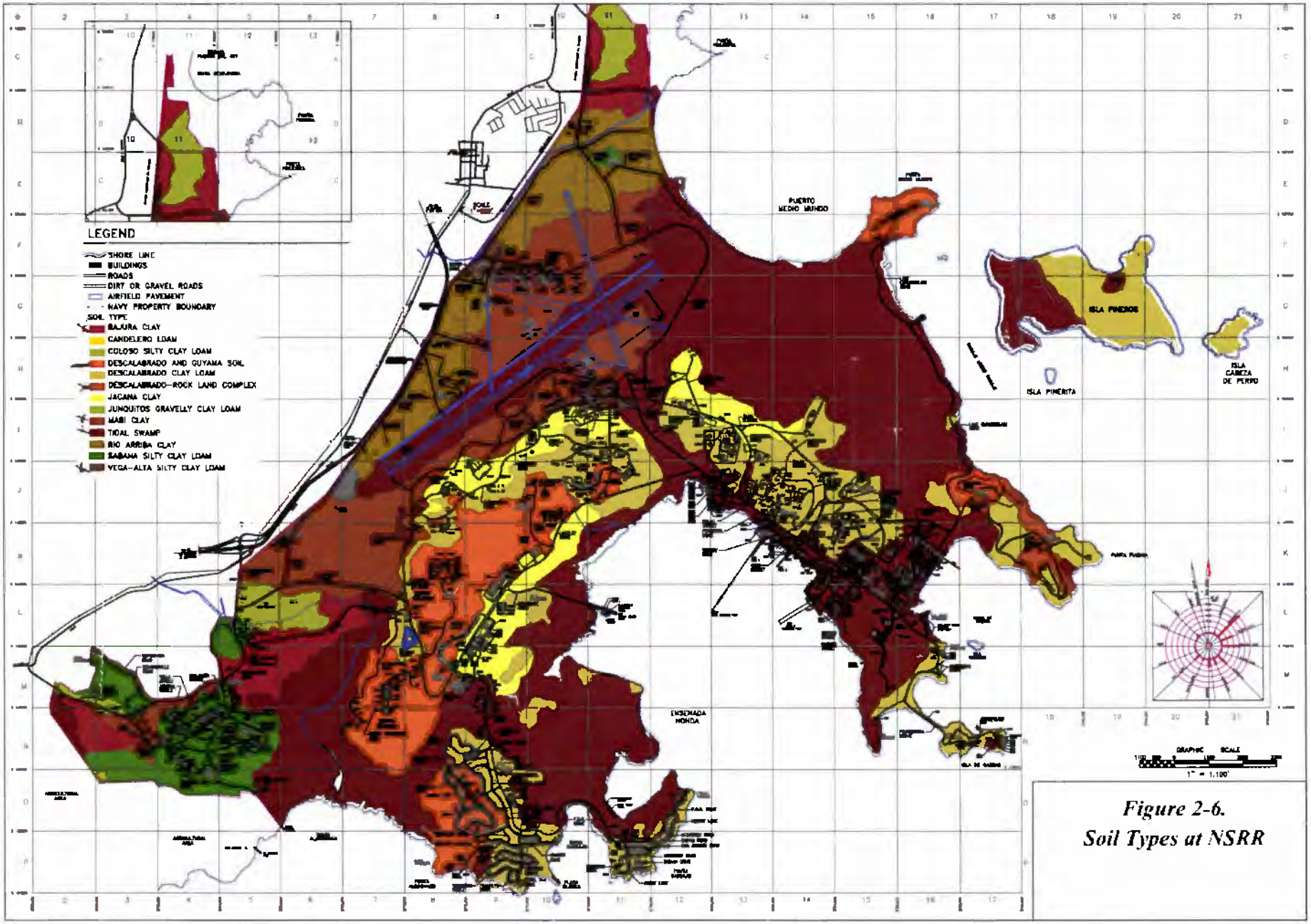


Figure 2-6.
Soil Types at NSRR

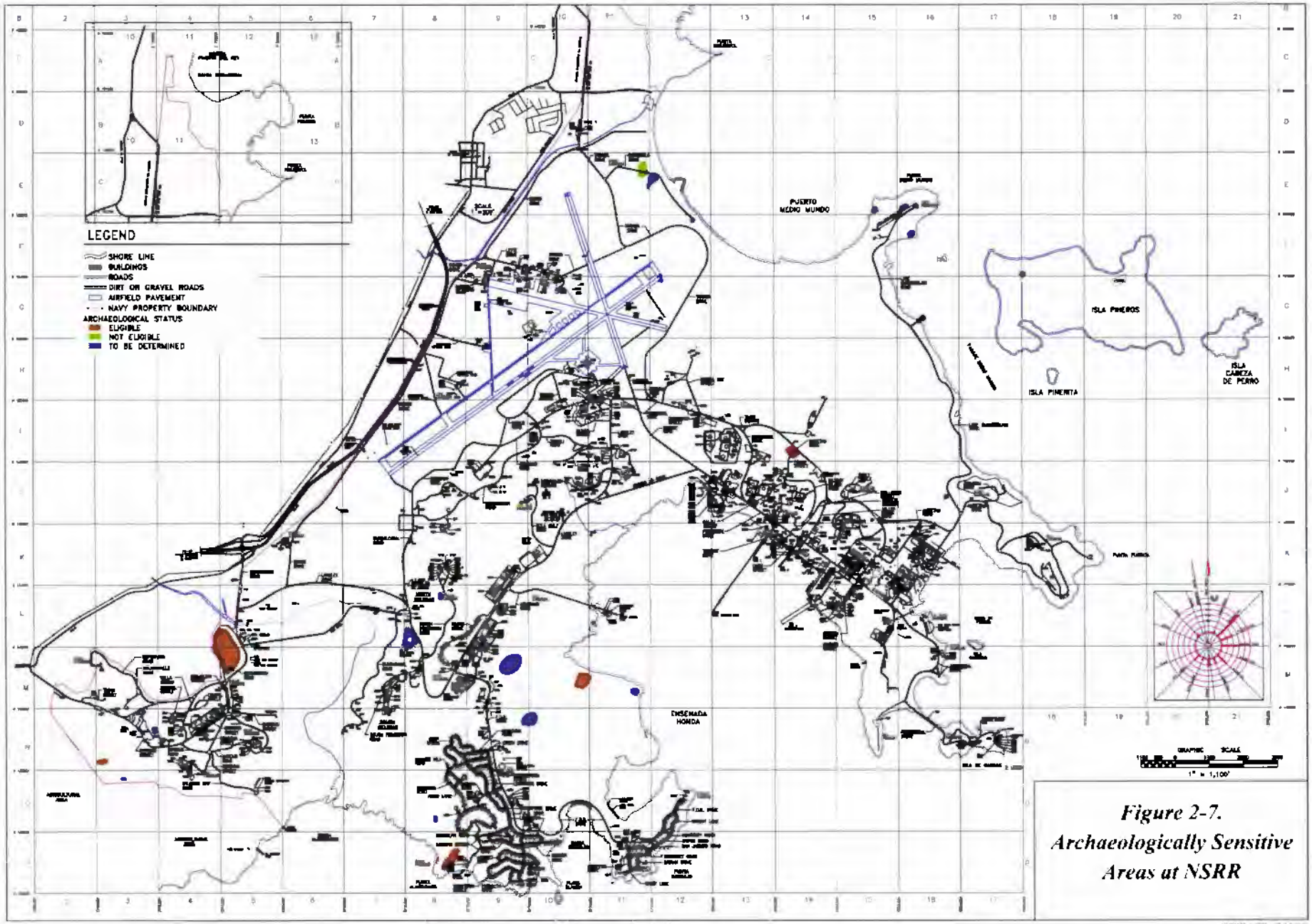


Figure 2-7. Archaeologically Sensitive Areas at NSRR

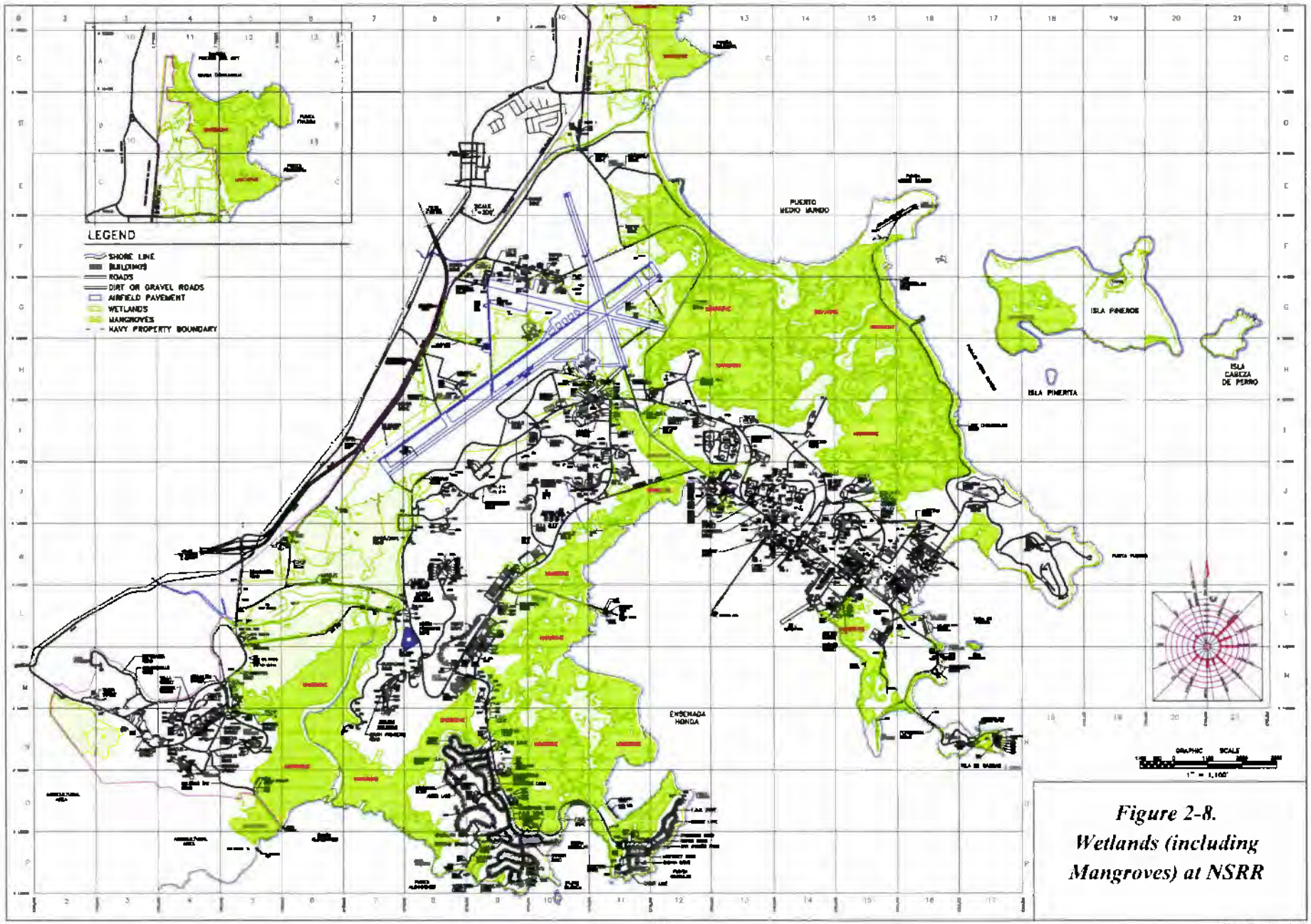


Figure 2-8. Wetlands (including Mangroves) at NSRR

B-1.2 RANGE RECORDS

Klink, Linda

From: Kalal, Daniel (NAPR) CDR OIC [KalalD@napr.navy.mil]
Sent: Monday, August 17, 2009 11:25 AM
To: 'Davidson, Mark E CIV OASN I&E, BRAC PMO SE'; Kalal, Daniel (NAPR) CDR OIC
Cc: Ruiz, Pedro CIV NAVFAC Atlantic; Sanford, Art F CTR OASN (I&E) BRAC PMO SE; Klink, Linda
Subject: RE: Range Records
Attachments: overall expended ammo.xls

Mark,

The attached listing is what we were able to find.

CDR Kalal

-----Original Message-----
From: Davidson, Mark E CIV OASN I&E, BRAC PMO SE [mailto:mark.e.davidson@navy.mil]
Sent: Thursday, July 30, 2009 3:59 PM
To: Kalal, Dan CDR NAPR OIC
Cc: Ruiz, Pedro CIV NAVFAC Atlantic; Sanford, Art F CTR OASN (I&E) BRAC PMO SE; Linda.Klink@tetratech.com
Subject: Range Records

Cdr:

On 19 August we will be on base for the RAB meeting. That morning and afternoon, we will be meeting with the regulators on the upcoming work at the small arms range.
To that end, can you help me with the following:

1) We will do a site visit to the small arms range around 1030. Can you check and ensure the range is not in use that morning.

2) Is there a conference room somewhere on base we can meet in? Your building or other will do. I estimate we will have 12 people.

3) The contractor (Tetra Tech) has requested we try to obtain the "range records". My understanding is these records would be a listing of known items used out at the range from the various entities (Navy, FBI, DHS, etc) that have used it over time. The purpose of having these records is so we know what type of UXO may be still present out there, and what chemical constituents we may need to sample for in the soils. This information will also be beneficial for the development of Health and Safety Plans and the Explosive Safety Submission. The intent IS NOT to lay blame on anyone. The navy will be remediating the range no matter who used what out there. We just want to know what we might encounter and what we should look for. Can you see if such records exist? If yes, can I get a copy of them sometime before we hold our meeting?

Thanks, and give me a call if you would like to discuss.
Mark

Mark E. Davidson
BRAC Environmental Coordinator
BRAC PMO SE
4130 Faber Place Drive

Suite 202
N. Charleston, SC 29405
(843) 743-2124
mark.e.davidson@navy.mil

NAVAL STATION ROOSEVELT ROADS PUERTO RICO N00389 FY 2003

NALC	DODIC NOMENCLATURE	UIC	EXPENDED
A011	Cartridge, 12 Gauge Shotgun, 00 Buck	N00389	**29078**
A071	Cartridge, 5.56 MM Ball, M193	N00389	**30000**
A131	Cartridge, 7.62 MM Linked, 4	N00389	**9600**
A363	Cartridge, 9 MM Nato Ball, M882	N00389	**174176**
A403	Cartridge, Caliber .38 Special Blank	N00389	**559**
G811	Body, Practice Hand Grenade F/M69 PR	N00389	**0**
G911	Grenade, Hand Offensive, MK3A2 W/Fuze	N00389	**0**
G945	Grenade, Hand Smoke M18 Yellow W/Fuze	N00389	**6**
G963	Grenade, Hand CS M7A2, Riot Control	N00389	**0**

NAVAL ACTIVITY PUERTO RICO N40003 AMMO EXPENDED FY 2004

NALC	DODIC NOMENCLATURE	UIC	EXPENDED
A011	Cartridge, 12 Gauge Shotgun, 00 Buck	40003	3234
A059	Cartridge, 5.56 MM Ball, M855	40003	840
A071	Cartridge, 5.56 MM Ball, M193	40003	8258
A080	Cartridge, 5.56 MM Blanks	40003	0
A363	Cartridge, 9 MM Nato Ball, M882	40003	23707

NAVAL ACTIVITY PUERTO RICO N40003 AMMO EXPENDED FY 2005

NALC	DODIC NOMENCLATURE	UIC	EXPENDED
A011	Cartridge, 12 Gauge Shotgun, 00 Buck	40003	1626
A059	Cartridge, 5.56 MM Ball, M855	40003	0
A071	Cartridge, 5.56 MM Ball, M193	40003	3280
A080	Cartridge, 5.56 MM Blanks	40003	0
A363	Cartridge, 9 MM Nato Ball, M882	40003	5634

NAVAL ACTIVITY PUERTO RICO N40003 AMMO EXPENDED FY 2006

NALC	DODIC NOMENCLATURE	UIC	EXPENDED
A011	Cartridge, 12 Gauge Shotgun, 00 Buck	40003	435
A059	Cartridge, 5.56 MM Ball, M855	40003	0
A071	Cartridge, 5.56 MM Ball, M193	40003	782
A080	Cartridge, 5.56 MM Blanks	40003	0
A363	Cartridge, 9 MM Nato Ball, M882	40003	1100

NAVAL ACTIVITY PUERTO RICO N40003 AMMO EXPENDED FY 2007

NALC	DODIC NOMENCLATURE	UIC/TENANTS COMMANDS	EXPENDED
A011	Cartridge, 12 Gauge Shotgun, 00 Buck	40003	792
A059	Cartridge, 5.56 MM Ball, M855	40003	0
A071	Cartridge, 5.56 MM Ball, M193	40003	2140
A080	Cartridge, 5.56 MM Blanks	40003	0
A363	Cartridge, 9 MM Nato Ball, M882	40003	505
	10MM used for the MP5	FBI	5013
	GLOCK .40 CAL	FBI	1000
	M-4 CARBINE RIFLE .223 CAL	FBI	620
	SPRINGFIELD .45	FBI	313
	REMINGTON 308	FBI	250
A363	Cartridge, 9 MM Nato Ball, M882	MARINES	3200
A011	Cartridge, 12 Gauge Shotgun, 00 Buck	USNR	2000
A071	Cartridge, 5.56 MM Ball, M193	USNR	2000
A363	Cartridge, 9 MM Nato Ball, M882	USNR	5000

NAVAL ACTIVITY PUERTO RICO N40003 AMMO EXPENDED FY 2008

NALC	DODIC NOMENCLATURE	UIC/TENANTS COMMANDS	EXPENDED
A011	Cartridge, 12 Gauge Shotgun, 00 Buck	40003	830
A059	Cartridge, 5.56 MM Ball, M855	40003	0
A071	Cartridge, 5.56 MM Ball, M193	40003	5147
A080	Cartridge, 5.56 MM Blanks	40003	0
A363	Cartridge, 9 MM Nato Ball, M882	40003	4900
	9MM	FBI	1425
	10MM used for the MP5	FBI	2400
	GLOCK .40 CAL	FBI	1225
	M-4 CARBINE RIFLE .223 CAL	FBI	400
	SPRINGFIELD .45	FBI	125
	SHOT GUN	FBI	125
	REMINGTON 308	FBI	200
	40 MM SMOKE GRENADE - TRAINING	FBI	30
A363	Cartridge, 9 MM Nato Ball, M882	MARINES	2280
A059	Cartridge, 5.56 MM Ball, M855	MARINES	9680
A011	Cartridge, 12 Gauge Shotgun, 00 Buck	USNR	8000
A071	Cartridge, 5.56 MM Ball, M193	USNR	8600
A363	Cartridge, 9 MM Nato Ball, M882	USNR	9000
A059	Cartridge, 5.56 MM Ball, M855	USNR SEABEES	3360
A363	Cartridge, 9 MM Nato Ball, M882	USNR SEABEES	2000
	9MM PISTOL	DHS CBP	26,600
	12 GA SHOTGUN	DHS CBP	9000
	M-16 RIFLE .223 CAL	DHS CBP	1000
	BOLT ACTION RIFLE .308	DHS CBP	900
	BARRET 50 BMG	DHS CBP	100
	M-4 CARBINE RIFLE .223	DHS CBP	12900

NAVAL ACTIVITY PUERTO RICO N40003 AMMO EXPENDED FY 2009

NALC	DODIC NOMENCLATURE	UIC/TENANTS COMMANDS	EXPENDED
A011	Cartridge, 12 Gauge Shotgun, 00 Buck	40003	972
A059	Cartridge, 5.56 MM Ball, M855	40003	0
A071	Cartridge, 5.56 MM Ball, M193	40003	669
A080	Cartridge, 5.56 MM Blanks	40003	0
A363	Cartridge, 9 MM Nato Ball, M882	40003	3199
	9MM	FBI	500
	10MM used for the MP5	FBI	200
	GLOCK .40 CAL	FBI	1400
	M-4 CARBINE RIFLE .223 CAL	FBI	700
	SPRINGFIELD .45	FBI	300
	SHOT GUN	FBI	0
	REMINGTON 308	FBI	50
	40 MM SMOKE GRENADE - TRAINING	FBI	25
A011	Cartridge, 12 Gauge Shotgun, 00 Buck	USNR	3200
A071	Cartridge, 5.56 MM Ball, M193	USNR	4600
A363	Cartridge, 9 MM Nato Ball, M882	USNR	6000
	9MM PISTOL	DHS CBP	0
	12 GA SHOTGUN	DHS CBP	0
	REMINGTON 700 7.62MM	DHS CBP	500
	M-16 RIFLE 5.56MM	DHS CBP	200
	M240B 7.62MM	DHS CBP	1000
	BOLT ACTION RIFLE .308	DHS CBP	620
	BARRET 50 BMG	DHS CBP	100
	M-4 CARBINE RIFLE .223	DHS CBP	0

B-1.3 TERMINATION OF USE LETTER

DEPARTMENT OF THE NAVY
BASE REALIGNMENT AND CLOSURE
PROGRAM MANAGEMENT OFFICE SOUTHEAST
4130 FABER PLACE DRIVE
SUITE 202
NORTH CHARLESTON, SC 29405

BPMOSE med/0026
09 Nov 09

From: Director, Base Realignment & Closure Program Management Office Southeast
To: Commander Navy Region Southeast, Code N44

Subj: NAVAL ACTIVITY PUERTO RICO (NAPR) SMALL ARMS RANGE CLOSURE

1. The Small Arms Range (SAR) at NAPR is currently an active range and located in Sale Parcel Three. In order to transfer the SAR, various environmental investigations are required to be completed and are scheduled to commence in January 2010. In support of these environmental initiatives, it is requested that Navy Region SE notify NAPR to terminate use of the SAR, including the pistol range, beginning 1 January 2010.

2. Should you have any questions, please contact Mark Davidson at (843) 743-2124 or by email at mark.e.davidson@navy.mil.

James E Anderson
JAMES E. ANDERSON

Copy to:
NAPR (CDR Kalal)

Copy to: (via email)
NAVFAC Atlantic (Pedro Ruiz)
NAVFAC SE (Darrell Gundrum)
Tetra Tech NUS (Linda Klink)

B-1.4 PHASE I RFI EOD RESPONSE

Klink, Linda

From: Davidson, Mark E CIV OASN (EI&E), BRAC PMO SE [mark.e.davidson@navy.mil]
Sent: Friday, August 27, 2010 11:52 AM
To: Gordon.Timothy@epamail.epa.gov; wilmarierivera@jca.gobierno.pr; Toro Agrait, Gloria
Cc: Martin, Stacin CIV NAVFAC Atlantic; Klink, Linda
Subject: FW: EOD Response to Roosevelt Roads 19 AUG 10
Attachments: Demo.jpg; Expended CS.JPG; Full CS.JPG; Broken CS.JPG; FW: Naval Activity Puerto Rico, SWMU 77, M651 CS grenade discovered (1.69 MB)

Tim, Wilmarie, Gloria

On 19 May I emailed you (attached) regarding some MEC discovered on the earthen backstop at SWMU 77, the Small Arms Range, during our Ph I RFI fieldwork. EOD responded on 19 August 2010 and disposed of these items. Below is their notification to me.

Thanks,
Mark

-----Original Message-----
From: Cornely, Charles C LT EODMU6, DET MYPT
Sent: Sunday, August 22, 2010 18:00
To: Davidson, Mark E CIV OASN (EI&E), BRAC PMO SE
Cc: Murray, Douglas CIV NOSSA; Martin, Stacin CIV NAVFAC Atlantic; Kalal, Dan CDR NAPR OIC; Sanford, Art F CTR OASN (EI&E), BRAC PMO SE; mark.ladd@sbcglobal.net; Toy, Jonah T DET MAYPORT EOD LCPO; Simmons, Michael J LT EODMU ONE
Subject: EOD Response to Roosevelt Roads 19 AUG 10

Good Evening Mark,
Here are the details and pictures from our 19 August 2010 response to the 40mm, CS, M651 grenades located at Roosevelt Roads.

We found 1x intact, full up 40mm located at 20Q KF 24393 20950, this was also the consolidation point for our disposal operation.

1x broken 40mm was located at 20Q KF 24389 20947.

1x expended 40mm was located at 20Q KF 24390 20951.

All items were disposed of onsite.

Please let me know if you have any additional questions and thank you for your time.

V/R,
LT Chuck Cornely
OIC, EODMU 6 PLATOON MAYPORT
NS MAYPORT FL, Bldg 190
Mayport, FL 32228-0023
Cell: (904) 219-7242
Office: (904) 270-5412/5416/5439
DSN: 312-960-...
charles.cornely@navy.mil

B-2 HISTORICAL AERIAL PHOTOGRAPHS

B-2.1 SWMU 77 HISTORICAL AERIAL PHOTOGRAPHS 1936 to 1995

Appendix B-2.1
AERIAL PHOTOGRAPHY ANALYSIS

1.0 INTRODUCTION

Environmental Research, Inc. undertook an analysis of aerial photography to support an ongoing Environmental Baseline Survey (EBS) being conducted at the Naval Station, Roosevelt Roads, Puerto Rico. The analysis documents activity at 25 sites of potential environmental contamination, including SWMU 77 that was identified at the time as ECP Site 1. Aerial photography used in the analysis spanned the period 1936 to 1999. Section 3.0 provides a description of activity and features observed at each site on each date of photography analyzed. The accompanying aerial map and compact disc display the findings from the analysis.

2.0 METHODOLOGY

ERI analysts conducted this aerial photographic analysis by viewing stereo frames of film transparencies through a zoom stereoscope; the film transparencies were backlit on a light table. Stereoscopic viewing creates a three-dimensional effect, which, when combined with viewing at various magnifications, enables an analyst to identify signatures associated with various features and environmental conditions. (The term "signature" refers to a combination of visible characteristics, such as tone, shadow, texture, size, shape, pattern, and association, which enable an analyst recognize a specific object or condition on aerial photography.) At least one other senior imagery analyst reviewed the analysis to ensure completeness and consistency; this quality control step is standard practice in the field of photo interpretation. Mosaics were made from the aerial photography, and findings from the analysis were digitized and included as a data layer on the mosaics. The findings can be viewed on the accompanying compact discs or hard copy map and can be used in combination with this narrative report.

3.0 SWMU 77 (Site 1) AERIAL PHOTOGRAPHY

18 June 1958

Small-arms ranges, on the northeast side of the base at Punta Medio Mundo, were maintained and used as of this date. Three pits, possibly for munitions disposal or detonation, were immediately southwest of the range area.

18, 19, and 26 October 1961

Small-arms ranges, on the northeast side of the base at Punta Medio Mundo, were maintained and used as of this date. The three pits seen on 1958 photography appeared to have been filled.

15 February 1962 (Partial)

Small-arms ranges, on the northeast side of the base at Punta Medio Mundo, were maintained and used as of this date. A pistol range had been constructed so that it was contiguous with the rifle range.

15 January 1964 (Partial)

Small-arms ranges, on the northeast side of the base at Punta Medio Mundo, were maintained and used as of this date. Vegetation was growing on the pistol range seen in 1962, and it was probably no longer in use.

3 March 1965 (Partial)

Not Covered

6 December 1976 (Partial)

Small-arms ranges, on the northeast side of the base at Punta Medio Mundo, were maintained and used as of this date. A new pistol range had been constructed on the southwestern side of the range area, and a bermed area containing light-toned material and/or debris was on the northwestern side of the range area.

February 1977; 18 and 20 December 1977

Small-arms ranges, on the northeast side of the base at Punta Medio Mundo, were maintained and used as of this date. Additional light-toned material and/or debris were in the bermed area on the northwestern side of the ranges.

26 January, 1 February, and 8 March 1979

Small-arms ranges, on the northeast side of the base at Punta Medio Mundo, were maintained and used as of this date. Light-toned material and/or debris were in the bermed area on the northwestern side of the ranges. (Area annotated on 1977 photography.)

6 and 8 February 1983

Small-arms ranges, on the northeast side of the base at Punta Medio Mundo, were maintained and used as of this date. Possible debris was in the bermed area on the northwestern side of the ranges. (Area annotated on 1985 photography.)

1985

At least some of the small-arms ranges, on the northeast side of the base at Punta Medio Mundo, were maintained and used as of this date. No debris was visible in the bermed area on the northwestern side of the ranges. (Area annotated on 1985 photography.)

October 1995

Small-arms ranges, on the northeast side of the base at Punta Medio Mundo, were maintained and used as of this date. (A possible pistol range, constructed immediately southwest of the rifle range between 1985 and 1995, was becoming overgrown.) No debris was visible at the bermed area on the northwestern side of the ranges, and vegetation was growing in that location. (Area annotated on 1995 photography.)

B-2.2 FORMER PISTOL RANGE SUBAREA SITE DEVELOPMENT

Former Pistol Range Subarea

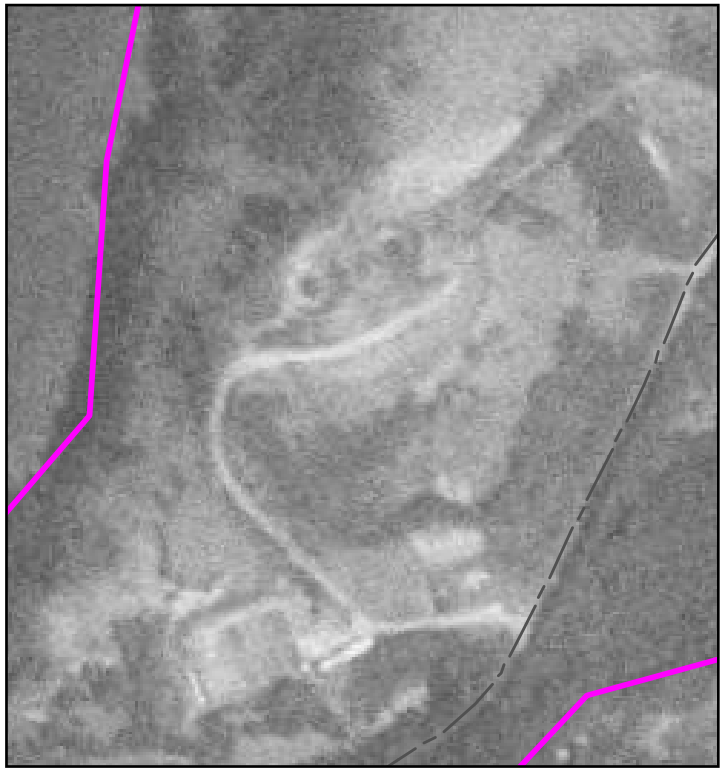
1964 **1976** **2006**

B-2.3 POTENTIAL OB/OD SUBAREA SITE DEVELOPMENT

Potential OB/OD Subarea

1976

1977



B-2.4 POTENTIAL MUNITIONS TRENCH SUBAREA SITE DEVELOPMENT

Potential Munitions Trench Subarea

1958

1995

B-3 PHASE I RFI POSITIVE DETECTION FIGURES AND MEC FINDS TABLE

EXECUTIVE SUMMARY

Tetra Tech NUS, Inc. (Tetra Tech) has been retained by the United States Department of Navy, Base Realignment and Closure (BRAC) Program Management Office (PMO) Southeast (SE) and funded by the Naval Facilities Engineering Command (NAVFAC) Mid-Atlantic (LANT) to perform a Phase I Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI) for Solid Waste Management Unit (SWMU) 77 at Naval Activity Puerto Rico (NAPR) located in Ceiba, Puerto Rico. The work was conducted for Contract Task Order (CTO) JM04 under the Comprehensive Long-term Environmental Action Navy (CLEAN) Contract No. N62470-08-D-1001. The Phase I RFI is equivalent to a Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Preliminary Assessment (PA)/Site Inspection (SI).

This report describes activities performed to assess Munitions Constituents (MC) and Munitions and Explosives of Concern (MEC) at SWMU 77, focusing on the following six subareas:

- Rifle Range Subarea
- Potential Open Burn/Open Detonation (OB/OD) Subarea
- Potential Munitions Trench Subarea
- Detonation Area Near Concrete Pad Subarea
- Pistol Range Subarea
- Former Pistol Range Subarea

As applicable for a given subarea, field activities included unexploded ordnance (UXO) analog detector-aided surveys, geophysical investigations, and MC sampling of surface and subsurface soil, including analysis of lead and other select metals, explosives, and the propellant nitroglycerine (NG).

The recommendation is to move forward to a Full RFI for SWMU 77. The scope of effort for the Full RFI, which will include further characterization and delineation of soil contamination and intrusive investigations to investigate subsurface anomalies will be determined during project planning. The need for and scope of groundwater investigation for SWMU 77 as a whole will also be discussed during the project planning meeting associated with the Full RFI for SWMU 77. For informational purposes, to aid in evaluation of the potential for contaminants to migrate to groundwater, United States Environmental Protection Agency (USEPA) migration to groundwater soil screening levels (SSLs) are included on the frequency of detection tables presented within each subsection. Summary conclusions and recommendations for each individual SWMU 77 subarea evaluated during this Phase I RFI are as follows:

RIFLE RANGE SUBAREA

A Full RFI is recommended for MC and MEC/MPPEH in the subsurface at the Rifle Range Subarea, no further investigation is recommended for surface MEC/MPPEH in the Full RFI.

MEC

MPPEH items previously observed on the constructed earthen berm and the grassy strip at the toe of the wooded embankment during site walks in support of Phase I RFI SAP planning were removed when SWMU 77 was closed in January 2010; no MPPEH items remain on the ground surface. For the wooded embankment, eight munitions items were encountered during the meandering path analog detector aided survey of the Phase I RFI; one of the items, a CS M651 grenade, was classified as MEC. Those MEC/MPPEH items warranting detonation were addressed by Mayport EOD on August 19, 2010. The detector-aided survey of the wooded embankment entailed meandering pathways through thickly vegetated areas, the survey did not provide 100 percent coverage; therefore, there is a high probability that MEC/MPPEH items are still present in this area.

The Phase I RFI information is adequate to recommend a path forward for surface MEC/MPPEH at the wooded embankment without additional investigation during the Full RFI. Elsewhere at the Rifle Range Subarea, no MEC/MPPEH is present on the ground surface.

More than 50 random subsurface anomalies were identified during the detector-aided survey of the earthen constructed berm area and wooded embankment. Although MEC/MPPEH is not expected in the subsurface, there is a probability that the subsurface anomalies could be MEC/MPPEH considering the history of MEC/MPPEH in and around the area.

The Full RFI should include intrusive investigation to determine the source of the subsurface anomalies.

MC

NG at the firing lines and metals (antimony, arsenic, copper, lead, and zinc) and explosives at berm/embankment areas were investigated in surface soil. Based on the Phase I RFI findings, NG was only a potential risk concern at the 200-yard firing line for the Rifle Range, which may have been more heavily used than the other firing lines. For the earthen constructed berm area/wooded embankment, metals, particularly the primary contaminant lead, were present at elevated concentrations compared to the Project Action Limits (PALs). Maximum lead concentrations for the constructed earthen berm and

wooded embankment were 89,000 and 118,000 mg/kg, respectively. A high density of bullets was observed on the constructed earthen berm and, also, a high density of bullets may be present on the wooded embankment (heavily wooded vegetation prevented visual observation) due to its location relative to the constructed earthen berm. The explosive, RDX, was detected, but did not exceed the PAL.

The Full RFI should determine lateral and vertical extent of MC, in particular metals (antimony, arsenic, copper, lead, and zinc) in and around the constructed earthen berm and wooded embankment and further investigate NG at the 200-yard Rifle Range firing line. A high density of bullets was observed on the constructed earthen berm and may be present on the wooded embankment, which should be evaluated.

POTENTIAL OB/OD SUBAREA

A Full RFI is recommended for the OB/OD Subarea

MEC

No MEC/MPPEH was discovered on the ground surface during the Phase I RFI of the OB/OD Subarea. Twelve subsurface anomalies were encountered during the analog detector-aided survey; the locations generally matched that of the electromagnetic (EM) geophysical surveys subsequently conducted. For the OB/OD Subarea, EM geophysical data was collected (EM61 inphase response, EM31 quadrature response, and EM 31 inphase response). The EM61 results were most instructive of shallow anomalies; 58 anomalies were identified and most were indicative of individual items, although four clusters of anomalies were identified. The EM31 data was more instructive of potential deeper anomalies. The nature of the buried metallic items detected cannot be determined from the geophysical survey alone. The anomalies may be reflective of outcrops of volcanic bedrock present at SWMU 77. Weathered bedrock was exposed at the OB/OD Subarea land surface, particularly at steep embankments and, moreover, refusal due to bedrock during soil boring occurred at shallow depths. A limited subsurface investigation was conducted but if bedrock is encountered consistently at shallow locations throughout the subarea, it is unlikely that subsurface disposal would have been conducted, although surface OB/OD operations may still have occurred. Additional investigation is needed to determine if the shallow depth to bedrock is consistent throughout areas where anomalies were present.

The Full RFI should include intrusive investigation of the subsurface anomalies encountered during the Phase I RFI to determine the source of the anomalies. The intrusive investigation should focus on, but not be limited to, the four clusters of anomalies encountered.

MC

NG, metals (antimony, arsenic, copper, lead, and zinc), and explosives were investigated during the Phase I RFI. Based on the Phase I RFI, where surface and subsurface soil were investigated in anomalous areas identified during the geophysical survey, only lead was of potential ecological concern based on evaluation of analytical results; the PAL for lead was based on facility background concentration and although not elevated at the OB/OD Subarea (74 mg/kg maximum), may present an ecological risk. The data is inconclusive until intrusive subsurface investigation is conducted.

The Full RFI should be coordinated with the MEC/MPPEH Full RFI to collect biased maximum concentration samples if and where subsurface materials are encountered during intrusive investigation that could be sources of contamination, either MC [to include metals considered chemicals of potential concern (COPCs) for the Full RFI: antimony, arsenic, copper, lead, and zinc] or non-MC related; full analyte list to be developed during the Full RFI project planning meeting. Also, additional soil sampling is warranted in and around the area, targeting anomaly areas as well as additional locations within the historical berm locations to adequately characterize these areas.

POTENTIAL MUNITIONS TRENCH SUBAREA

A Full RFI is recommended for the Potential Munitions Trench Subarea.

MEC

No surface MEC/MPPEH was discovered during the Phase I RFI of the Potential Munitions Trench Subarea. More than 70 subsurface anomalies were encountered during the detector-aided survey. The general locations matched that of the EM geophysical surveys subsequently conducted over the main suspect trench area in the eastern portion of the subarea. Geophysical survey data was collected for the EM61 inphase response, EM31 quadrature response, and EM 31 inphase response. For the northeastern side of the subarea, lines of anomalies were identified trending northwest to southeast, aligned in the same direction as the orientation of the suspect trenches shown on the historical aerial photographs. For the western portion of the subarea, no subsurface anomalies were encountered during the detector-aided survey and the area was too thickly wooded to conduct a geophysical survey. The source of the anomalies detected cannot be determined from the geophysical survey alone. Moreover, anomalies are not necessarily indicative of buried metal but instead could be reflective of outcrops of naturally occurring volcanic bedrock present at SWMU 77. Weathered bedrock was exposed at the Potential Munitions Trench Subarea land surface, particularly at steep embankments and, moreover, refusal due to bedrock during soil boring occurred at shallow depths. A limited subsurface investigation

was conducted but if bedrock is encountered consistently at shallow locations throughout the subarea, it is unlikely that subsurface disposal would have been conducted. Additional investigation is needed to determine if the shallow depth to bedrock is consistent throughout areas where anomalies were present.

The Full RFI should include intrusive investigation to determine the source of the anomalies. The intrusive investigation should focus on, but not be limited to, the six linear anomaly lines identified, recognizing the anomalies may be wider than they appear considering the geophysical survey did not extend out into the wooded areas. An expanded geophysical survey into the wooded areas should be considered during the Full RFI.

MC

NG, metals (antimony, arsenic, copper, lead, and zinc), explosives, and non-MC contaminants were investigated during the Phase I RFI. The Phase I RFI sampling was limited in that only a few surface soil samples were collected, although no PALs were exceeded. The data is inconclusive until intrusive subsurface investigation is conducted.

The Full RFI should be coordinated with the MEC/MPPEH Full RFI to collect biased maximum concentration samples if and where subsurface materials are encountered during intrusive investigation that could be sources of contamination, either MC (to include metals considered COPCs for the Full RFI: antimony, arsenic, copper, lead, and zinc) or non-MC related; full analyte list to be developed during the Full RFI project planning meeting. Also, additional soil sampling is warranted in and around the area, targeting anomaly areas in the northeastern portion of the subarea and also including the southwestern portion of the subarea to adequately characterize these areas.

DETONATION AREA NEAR CONCRETE PAD SUBAREA

A Full RFI is recommended with focus on metals considered COPCs for the Full RFI (antimony, arsenic, copper, lead, and zinc), for the Detonation Area Near Concrete Pad Subarea based on Phase I RFI MEC/MPPEH and MC investigation findings. Further sampling is recommended for this subarea during the Full RFI to further characterize and delineate select metals.

MEC

No surface MEC/MPPEH was discovered during the Phase I RFI of the Detonation Area Near Concrete Pad Subarea and no evidence of subsurface detonation activities was present other than the subject one-time event of concern. No subsurface anomalies were present within the depression area where the one-

time event occurred, which indicates the one-time detonation was complete and no subsurface MEC/MPPEH remained after the detonation.

MC

Surface soil was investigated at two biased locations, the remaining depression area where the one-time event occurred and the low-lying drainage area for the subarea. Based on evaluation of the data, human health risks are acceptable. Only lead was of potential ecological concern based on evaluation of analytical results; the PAL for lead was based on facility background concentration and although not elevated at the Detonation Area Near Concrete Pad Subarea (40.7 mg/kg maximum), may present an ecological risk, although the site is small and samples collected were from locations anticipated to have biased high concentrations. Moreover, the lead contamination may be anthropogenic, from vehicle traffic in and around the area, or may be windborne from the lead-contaminated Rifle Range Subarea berm, especially when considering that results from the two sampling locations were close in concentration.

PISTOL RANGE SUBAREA

A Full RFI is recommended for the Pistol Range Subarea.

MC

NG at the firing lines and metals (antimony, arsenic, copper, lead, and zinc) and explosives at the berm area were investigated in surface soil. Based on the Phase I RFI findings, NG was determined to be neither a human health nor ecological issue. For the berm, metals, particularly the primary contaminant lead, were elevated (maximum lead concentration of 58,400 mg/kg) and present both a human health and ecological risk issue. A high density of bullets and fragments were ubiquitous on the main side of earthen berm directly behind the target areas, and much less present on the far right side to the north; similarly, lead contamination was much higher on the main side of the berm versus the northern side.

The Full RFI should determine lateral and vertical extent of metals (antimony, arsenic, copper, lead, and zinc) contamination in and around the berm. Moreover, the high density of bullets observed on the berm directly behind the targets will ultimately need to be addressed.

FORMER PISTOL RANGE SUBAREA

A Full RFI is recommended for the Former Pistol Range Subarea.

MC

NG and metals (antimony, arsenic, copper, lead, and zinc) were investigated. Surface soil was investigated at each side of the subarea to investigate berm potential historical locations, and inside the perceived historical range boundaries to obtain data concerning firing lines. NG did not exceed the PAL. For the berm, metals, particularly the primary contaminant lead, were elevated (maximum concentration of 12,295 mg/kg), which would present both a human health and ecological risk issue. The most highly contaminated area was encountered in the northwestern area of the subarea. A low density of bullets and fragments were observed in the area.

The Full RFI should determine lateral and vertical extent of metals considered COPCs for the Full RFI (antimony, arsenic, copper, lead, and zinc) contamination located in and around the northwestern portion of the subarea.

TABLE 4-3

FREQUENCY OF DETECTION IN SURFACE SOIL
SWMU 77 - RIFLE RANGE SUBAREA - EARTHEN CONSTRUCTED BERM
NAVAL ACTIVITY PUERTO RICO
CEIBA, PUERTO RICO

Parameter	Frequency of Detection	Minimum Result	Maximum Result	Location of Maximum Detection	Sample of Maximum Detection	Minimum Non-Detection	Maximum Non-Detection	Project Action Limit [1]	USEPA Generic SSLs Migration to GW [2] DAF=20
Inorganics (mg/kg)									
ANTIMONY	8/10	4.69	425 J	77RR-SB015	77RR-SS015-G00.5	0.601	1.46	3.1	5.4
ARSENIC	10/10	1.23 J	38.3	77RR-SB015	77RR-SS015-G00.5	--	--	2.65	5.8
COPPER	10/10	110	13300	77RR-SB003	77RR-SS003-G00.5	--	--	168	920
LEAD	10/10	347	89000	77RR-SB015	77RR-SS015-G00.5	--	--	22	280
LEAD-CALC	30/30	117	40686	77RR-SB002	77RR-SS002/15-G00.5	--	--	22	280
LEAD-XRF	30/30	51	10972.33	77RR-SB002	77RR-SS002/15-G00.5	--	--	22	280
ZINC	10/10	62.9	1620	77RR-SB003	77RR-SS003-G00.5	--	--	115	13600
Miscellaneous Parameters									
pH	1/1	7.38	7.38	77RR-SB026	77RR-SS026-G00.5	--	--	NA	NA

1. Refer to Appendix J for PAL source and reference.
2. USEPA generic soil screening level (SSLs) migration to groundwater screening levels are presented for informational purposes. A dilution atttenuation factor of 20 has been applied to values as presented in the November 2010 USEPA RSL Table.

Associated Samples:

77RR-SS001-G00.5	77RR-SS016-G00.5
77RR-SS002-G00.5	77RR-SS017-0006
77RR-SS003-G00.5	77RR-SS018-G00.5
77RR-SS004-0006	77RR-SS019-0006
77RR-SS005-0006	77RR-SS020-0006
77RR-SS006-0006	77RR-SS021-0006
77RR-SS007-G00.5	77RR-SS022-0006
77RR-SS007-G00.5-AVG	77RR-SS023-0006
77RR-SS007-G00.5-D	77RR-SS023-0006-AVG
77RR-SS008-G00.5	77RR-SS023-0006-D
77RR-SS009-0006	77RR-SS024-0006
77RR-SS010-0006	77RR-SS025-0006
77RR-SS011-0006	77RR-SS026-G00.5
77RR-SS012-0006	77RR-SS027-0006
77RR-SS012-0006-AVG	77RR-SS028-0006
77RR-SS012-0006-D	77RR-SS029-G00.5
77RR-SS013-0006	77RR-SS030-0006
77RR-SS014-0006	77RR-SS031-C00.5
77RR-SS015-G00.5	77RR-SS032-C00.5

mg/kg = Milligrams per kilogram.
J = Value is estimated.
NA = Not applicable.

Note: Explosives, including nitroglycerin (NG), were analyzed (locations 77RRSB031 and 77RRSB032) but not detected.

TABLE 4-4

SUMMARY OF DETECTED CONCENTRATIONS IN SURFACE SOIL
SWMU 77 - RIFLE RANGE SUBAREA - EARTHEN CONSTRUCTED BERM
NAVAL ACTIVITY PUERTO RICO
CEIBA, PUERTO RICO

SAMPLE ID LOCATION DATE SAMPLE CODE	PAL Surface Soil	77RR-SS001-G00.5 77RR-SB001 20100522 NORMAL		77RR-SS002-G00.5 77RR-SB002 20100522 NORMAL		77RR-SS003-G00.5 77RR-SB003 20100522 NORMAL		77RR-SS004-0006 77RR-SB004 20100522 NORMAL		77RR-SS005-0006 77RR-SB005 20100522 NORMAL		77RR-SS006-0006 77RR-SB006 20100522 NORMAL		77RR-SS007-G00.5 77RR-SB007 20100522 NORMAL		77RR-SS007-G00.5-AVG 77RR-SB007 20100522 NORMAL	
		RESULT	MDL	RESULT	MDL	RESULT	MDL	RESULT	MDL	RESULT	MDL	RESULT	MDL	RESULT	MDL	RESULT	MDL
Inorganics (mg/kg)																	
ANTIMONY	3.1	11.2 [SS]	1.54	13.5 [SS]	1.51	22.6 [SS]	1.54	--	--	--	--	--	--	0.601 U	0.601	1.0305 UJ	0.601
ARSENIC	2.65	8.99 [SS]	0.926	7.27 [SS]	0.903	8.85 [SS]	0.926	--	--	--	--	--	--	1.24	0.361	1.235 J	0.361
COPPER	168	557 [SS]	1.54	7130 [SS]	30.1	13300 [SS]	30.9	--	--	--	--	--	--	138	0.601	182 [SS]	0.601
LEAD	22	12500 [SS]	9.26	14800 [SS]	9.03	22900 [SS]	9.26	--	--	--	--	--	--	347 [SS]	0.18	375 [SS]	0.18
LEAD-CALC	22	36440 [SS]	7	40686 [SS]	7	39994 [SS]	7	35502 [SS]	7	31089 [SS]	7	32289 [SS]	7	117 [SS]	7	117 [SS]	7
LEAD-XRF	22	9812 [SS]	0	10972.33 [SS]	0	10783.33 [SS]	0	9555.67 [SS]	0	8350.33 [SS]	0	8677.67 [SS]	0	51 [SS]	0	51 [SS]	0
ZINC	115	149 [SS]	1.54	864 [SS]	1.51	1620 [SS]	1.54	--	--	--	--	--	--	62.9	0.601	73.05	0.601
Miscellaneous Parameters																	
PH	NA	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

TABLE 4-4

SUMMARY OF DETECTED CONCENTRATIONS IN SURFACE SOIL
SWMU 77 - RIFLE RANGE SUBAREA - EARTHEN CONSTRUCTED BERM
NAVAL ACTIVITY PUERTO RICO
CEIBA, PUERTO RICO

SAMPLE ID LOCATION DATE SAMPLE CODE	PAL Surface Soil	77RR-SS007-G00.5-D 77RR-SB007 20100522 NORMAL		77RR-SS008-G00.5 77RR-SB008 20100522 NORMAL		77RR-SS009-0006 77RR-SB009 20100522 NORMAL		77RR-SS010-0006 77RR-SB010 20100522 NORMAL		77RR-SS011-0006 77RR-SB011 20100523 NORMAL		77RR-SS012-0006 77RR-SB012 20100523 NORMAL		77RR-SS012-0006-AVG 77RR-SB012 20100523 NORMAL		77RR-SS012-0006-D 77RR-SB012 20100523 NORMAL		77RR-SS013-0006 77RR-SB013 20100523 NORMAL	
		RESULT	MDL	RESULT	MDL	RESULT	MDL	RESULT	MDL	RESULT	MDL	RESULT	MDL	RESULT	MDL	RESULT	MDL	RESULT	MDL
Inorganics (mg/kg)																			
ANTIMONY	3.1	1.46 UJ	1.46	1.46 U	1.46	--	--	--	--	--	--	--	--	--	--	--	--	--	--
ARSENIC	2.65	1.23 J	0.875	1.32 J	0.875	--	--	--	--	--	--	--	--	--	--	--	--	--	--
COPPER	168	226 [SS]	1.46	110	1.46	--	--	--	--	--	--	--	--	--	--	--	--	--	--
LEAD	22	403 [SS]	0.438	881 [SS]	0.438	--	--	--	--	--	--	--	--	--	--	--	--	--	--
LEAD-CALC	22	--	--	464 [SS]	7	14129 [SS]	7	10699 [SS]	7	17291 [SS]	7	27736 [SS]	7	29088.5 [SS]	7	30441 [SS]	7	32359 [SS]	7
LEAD-XRF	22	--	--	268.67 [SS]	0	3716.33 [SS]	0	2779.33 [SS]	0	4579.67 [SS]	0	7434.33 [SS]	0	7803.5 [SS]	0	8172.67 [SS]	0	8697 [SS]	0
ZINC	115	83.2	1.46	65.2	1.46	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Miscellaneous Parameters																			
PH	NA	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

TABLE 4-4

SUMMARY OF DETECTED CONCENTRATIONS IN SURFACE SOIL
SWMU 77 - RIFLE RANGE SUBAREA - EARTHEN CONSTRUCTED BERM
NAVAL ACTIVITY PUERTO RICO
CEIBA, PUERTO RICO

SAMPLE ID LOCATION DATE SAMPLE CODE	PAL Surface Soil	77RR-SS014-0006 77RR-SB014 20100523 NORMAL		77RR-SS015-G00.5 77RR-SB015 20100523 NORMAL		77RR-SS016-G00.5 77RR-SB016 20100523 NORMAL		77RR-SS017-0006 77RR-SB017 20100523 NORMAL		77RR-SS018-G00.5 77RR-SB018 20100523 NORMAL		77RR-SS019-0006 77RR-SB019 20100523 NORMAL		77RR-SS020-0006 77RR-SB020 20100523 NORMAL		77RR-SS021-0006 77RR-SB021 20100523 NORMAL	
		RESULT	MDL	RESULT	MDL	RESULT	MDL	RESULT	MDL	RESULT	MDL	RESULT	MDL	RESULT	MDL	RESULT	MDL
Inorganics (mg/kg)																	
ANTIMONY	3.1	--	--	425 J [SS]	1.38	8.39 [SS]	0.555	--	--	43.3 [SS]	0.611	--	--	--	--	--	--
ARSENIC	2.65	--	--	38.3 [SS]	0.829	2.54	0.333	--	--	12.7 [SS]	0.367	--	--	--	--	--	--
COPPER	168	--	--	3860 [SS]	27.6	12200 [SS]	6.93	--	--	5960 [SS]	30.6	--	--	--	--	--	--
LEAD	22	--	--	89000 [SS]	20.7	8820 [SS]	2.08	--	--	34600 [SS]	9.17	--	--	--	--	--	--
LEAD-CALC	22	24263 [SS]	7	40686 [SS]	7	5582 [SS]	7	11218.86 [SS]	7	39485 [SS]	7	23956 [SS]	7	29200 [SS]	7	25467 [SS]	7
LEAD-XRF	22	6485.33 [SS]	0	10972.33 [SS]	0	1381 [SS]	0	2921.33 [SS]	0	10643.67 [SS]	0	6401.33 [SS]	0	7833.67 [SS]	0	6813.67 [SS]	0
ZINC	115	--	--	507 [SS]	1.38	1570 [SS]	6.93	--	--	626 [SS]	0.611	--	--	--	--	--	--
Miscellaneous Parameters																	
PH	NA	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

TABLE 4-4

SUMMARY OF DETECTED CONCENTRATIONS IN SURFACE SOIL
SWMU 77 - RIFLE RANGE SUBAREA - EARTHEN CONSTRUCTED BERM
NAVAL ACTIVITY PUERTO RICO
CEIBA, PUERTO RICO

SAMPLE ID LOCATION DATE SAMPLE CODE	PAL Surface Soil	77RR-SS022-0006 77RR-SB022 20100523 NORMAL		77RR-SS023-0006 77RR-SB023 20100523 NORMAL		77RR-SS023-0006-AVG 77RR-SB023 20100523 NORMAL		77RR-SS023-0006-D 77RR-SB023 20100523 NORMAL		77RR-SS024-0006 77RR-SB024 20100523 NORMAL		77RR-SS025-0006 77RR-SB025 20100523 NORMAL		77RR-SS026-G00.5 77RR-SB026 20100523 NORMAL		77RR-SS027-0006 77RR-SB027 20100523 NORMAL		77RR-SS028-0006 77RR-SB028 20100523 NORMAL	
		RESULT	MDL	RESULT	MDL	RESULT	MDL	RESULT	MDL	RESULT	MDL	RESULT	MDL	RESULT	MDL	RESULT	MDL	RESULT	MDL
Inorganics (mg/kg)																			
ANTIMONY	3.1	--	--	--	--	--	--	--	--	--	--	--	--	4.69 [SS]	1.5	--	--	--	--
ARSENIC	2.65	--	--	--	--	--	--	--	--	--	--	--	--	1.32 J	0.9	--	--	--	--
COPPER	168	--	--	--	--	--	--	--	--	--	--	--	--	370 [SS]	1.5	--	--	--	--
LEAD	22	--	--	--	--	--	--	--	--	--	--	--	--	5710 [SS]	2.25	--	--	--	--
LEAD-CALC	22	27879 [SS]	7	10007 [SS]	7	10602 [SS]	7	11197 [SS]	7	23150 [SS]	7	13686 [SS]	7	9353 [SS]	7	35576 [SS]	7	32052 [SS]	7
LEAD-XRF	22	7472.67 [SS]	0	2589.67 [SS]	0	2752.5 [SS]	0	2915.33 [SS]	0	6180.67 [SS]	0	3595.33 [SS]	0	2411.33 [SS]	0	9576.33 [SS]	0	8612.67 [SS]	0
ZINC	115	--	--	--	--	--	--	--	--	--	--	--	--	110	1.5	--	--	--	--
Miscellaneous Parameters																			
PH	NA	--	--	--	--	--	--	--	--	--	--	--	--	7.38	0.1	--	--	--	--

TABLE 4-4

SUMMARY OF DETECTED CONCENTRATIONS IN SURFACE SOIL
SWMU 77 - RIFLE RANGE SUBAREA - EARTHEN CONSTRUCTED BERM
NAVAL ACTIVITY PUERTO RICO
CEIBA, PUERTO RICO

SAMPLE ID LOCATION DATE SAMPLE CODE	PAL Surface Soil	77RR-SS029-G00.5 77RR-SB029 20100523 NORMAL		77RR-SS030-0006 77RR-SB030 20100523 NORMAL		77RR-SS031-C00.5 77RR-SB031 20100522 NORMAL		77RR-SS032-C00.5 77RR-SB032 20100523 NORMAL	
		RESULT	MDL	RESULT	MDL	RESULT	MDL	RESULT	MDL
Inorganics (mg/kg)									
ANTIMONY	3.1	16.7 [SS]	0.594	--	--	--	--	--	--
ARSENIC	2.65	2.67 [SS]	0.356	--	--	--	--	--	--
COPPER	168	161	0.594	--	--	--	--	--	--
LEAD	22	5250 [SS]	0.891	--	--	--	--	--	--
LEAD-CALC	22	4151 [SS]	7	13265 [SS]	7	--	--	--	--
LEAD-XRF	22	990.33 [SS]	0	3480.33 [SS]	0	--	--	--	--
ZINC	115	71.8	0.594	--	--	--	--	--	--
Miscellaneous Parameters									
PH	NA	--	--	--	--	--	--	--	--

PAL = Project Action Limit.
SS = Surface soil.
mg/kg = Milligrams per kilogram.
NA = Not applicable.
J = Value is estimated.
U = Analyte not detected at the reported detection limit.
UJ = Numerical detection limit for the undetected result is estimated.
MDL = Method detection limit.
XRF = X-ray Fluorescence.
Shaded concentrations exceed PALs.
Note: Explosives, including nitroglycerin (NG), were analyzed (locations 77RRSB031 and 77RRSB032) but not detected.

TABLE 4-5

FREQUENCY OF DETECTION IN SURFACE SOIL
SWMU 77 - RIFLE RANGE SUBAREA - FIRING LINES AND WOODED EMBANKMENT
NAVAL ACTIVITY PUERTO RICO
CEIBA, PUERTO RICO

Parameter	Frequency of Detection	Minimum Result	Maximum Result	Location of Maximum Detection	Sample of Maximum Detection	Minimum Non-Detection	Maximum Non-Detection	Project Action Limit [1]	USEPA Generic SSLs Migration to GW [2] DAF=20
Explosives and NG (mg/kg)									
NITROGLYCERIN	8/10	1.18 J	11.5 J	77RR-SB037	77RR-SS037-C00.5	0.25	0.25	0.61	0.032
RDX	3/3	0.136 J	0.161 J	77RR-SB042	77RR-SS042-C00.5	--	--	5.5	0.0046
Inorganics (mg/kg)									
ANTIMONY	9/9	1.94 J	6510 J	77RR-SB055	77RR-SS055-G00.5	--	--	3.1	5.4
ARSENIC	9/9	1.78	60.5	77RR-SB055	77RR-SS055-G00.5	--	--	2.65	5.8
COPPER	8/8	154	36700	77RR-SB052	77RR-SS052-G00.5	--	--	168	920
LEAD	9/9	1860	118000	77RR-SB055	77RR-SS055-G00.5	--	--	22	280
LEAD-CALC	15/15	-9999	83540	77RR-SB056	77RR-SS056-G00.5	--	--	22	280
LEAD-XRF	15/15	2712	40528.67	77RR-SB054	77RR-SS054-G00.5	--	--	22	280
ZINC	8/8	66.3	3470	77RR-SB052	77RR-SS052-G00.5	--	--	115	13600

1. Refer to Appendix J for PAL source and reference.
2. USEPA generic soil screening level (SSLs) migration to groundwater screening levels are presented for informational purposes. A dilution atttenuation factor of 20 has been applied to values as presented in the November 2010 USEPA RSL Table.

Associated Samples:

77RR-SS033-C00.5	77RR-SS041-C00.5	77RR-SS049-0006
77RR-SS034-C00.5	77RR-SS042-C00.5	77RR-SS050-G00.5
77RR-SS035-C00.5	77RR-SS043-0006	77RR-SS051-0006
77RR-SS036-C00.5	77RR-SS044-0006	77RR-SS052-G00.5
77RR-SS037-C00.5	77RR-SS044-0006-AVG	77RR-SS053-0006
77RR-SS038-C00.5	77RR-SS044-0006-D	77RR-SS054-G00.5
77RR-SS039-C00.5	77RR-SS045-G00.5	77RR-SS054-G00.5-AVG
77RR-SS039-C00.5-AVG	77RR-SS046-G00.5	77RR-SS054-G00.5-D
77RR-SS039-C00.5-D	77RR-SS047-G00.5	77RR-SS055-G00.5
77RR-SS040-C00.5	77RR-SS048-G00.5	77RR-SS056-G00.5
		77RR-SS057-0006

mg/kg = Milligrams per kilogram.
J = Value is estimated.
RDX = Cyclotrimethylenetrinitramine.
NG = Nitroglycerin

TABLE 4-6

SUMMARY OF DETECTED CONCENTRATIONS IN SURFACE SOIL
SWMU 77 - RIFLE RANGE SUBAREA - FIRING LINES AND WOODED EMBANKMENT
NAVAL ACTIVITY PUERTO RICO
CEIBA, PUERTO RICO

SAMPLE ID LOCATION DATE SAMPLE CODE	PAL Surface Soil	77RR-SS033-C00.5 77RR-SB033 20100523 NORMAL		77RR-SS034-C00.5 77RR-SB034 20100523 NORMAL		77RR-SS035-C00.5 77RR-SB035 20100523 NORMAL		77RR-SS036-C00.5 77RR-SB036 20100524 NORMAL		77RR-SS037-C00.5 77RR-SB037 20100524 NORMAL		77RR-SS038-C00.5 77RR-SB038 20100524 NORMAL		77RR-SS039-C00.5 77RR-SB039 20100524 NORMAL		77RR-SS039-C00.5-AVG 77RR-SB039 20100524 NORMAL	
		RESULT	MDL	RESULT	MDL	RESULT	MDL	RESULT	MDL	RESULT	MDL	RESULT	MDL	RESULT	MDL	RESULT	MDL
Explosives and NG (mg/kg)																	
NITROGLYCERIN	0.61	3.26 J [SS]	0.25	7.38 J [SS]	0.25	4.92 J [SS]	0.25	2.51 J [SS]	0.25	11.5 J [SS]	0.25	4.15 J [SS]	0.25	2.65 J [SS]	0.25	1.915 J [SS]	0.25
RDX	5.5	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Inorganics (mg/kg)																	
ANTIMONY	3.1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
ARSENIC	2.65	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
COPPER	168	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
LEAD	22	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
LEAD-CALC	22	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
LEAD-XRF	22	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
ZINC	115	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

TABLE 4-6

SUMMARY OF DETECTED CONCENTRATIONS IN SURFACE SOIL
SWMU 77 - RIFLE RANGE SUBAREA - FIRING LINES AND WOODED EMBANKMENT
NAVAL ACTIVITY PUERTO RICO
CEIBA, PUERTO RICO

SAMPLE ID LOCATION DATE SAMPLE CODE	PAL Surface Soil	77RR-SS039-C00.5-D 77RR-SB039 20100524 NORMAL		77RR-SS040-C00.5 77RR-SB040 20100525 NORMAL		77RR-SS041-C00.5 77RR-SB041 20100525 NORMAL		77RR-SS042-C00.5 77RR-SB042 20100525 NORMAL		77RR-SS043-0006 77RR-SB043 20100525 NORMAL		77RR-SS044-0006 77RR-SB044 20100525 NORMAL		77RR-SS044-0006-AVG 77RR-SB044 20100525 NORMAL	
		RESULT	MDL	RESULT	MDL	RESULT	MDL	RESULT	MDL	RESULT	MDL	RESULT	MDL	RESULT	MDL
Explosives and NG (mg/kg)															
NITROGLYCERIN	0.61	1.18 J [SS]	0.25	2.5 J [SS]	0.25	0.25 U	0.25	0.25 U	0.25	--	--	--	--	--	--
RDX	5.5	--	--	0.136 J	0.1	0.148 J	0.1	0.161 J	0.1	--	--	--	--	--	--
Inorganics (mg/kg)															
ANTIMONY	3.1	--	--	--	--	--	--	--	--	--	--	--	--	--	--
ARSENIC	2.65	--	--	--	--	--	--	--	--	--	--	--	--	--	--
COPPER	168	--	--	--	--	--	--	--	--	--	--	--	--	--	--
LEAD	22	--	--	--	--	--	--	--	--	--	--	--	--	--	--
LEAD-CALC	22	--	--	--	--	--	--	--	--	10736 [SS]	7	27323 [SS]	7	27718 [SS]	7
LEAD-XRF	22	--	--	--	--	--	--	--	--	2789.33 [SS]	0	7321 [SS]	0	7428.835 [SS]	0
ZINC	115	--	--	--	--	--	--	--	--	--	--	--	--	--	--

TABLE 4-6

SUMMARY OF DETECTED CONCENTRATIONS IN SURFACE SOIL
SWMU 77 - RIFLE RANGE SUBAREA - FIRING LINES AND WOODED EMBANKMENT
NAVAL ACTIVITY PUERTO RICO
CEIBA, PUERTO RICO

SAMPLE ID LOCATION DATE SAMPLE CODE	PAL Surface Soil	77RR-SS044-0006-D 77RR-SB044 20100525 NORMAL		77RR-SS045-G00.5 77RR-SB045 20100525 NORMAL		77RR-SS046-G00.5 77RR-SB046 20100525 NORMAL		77RR-SS047-G00.5 77RR-SB047 20100525 NORMAL		77RR-SS048-G00.5 77RR-SB048 20100525 NORMAL		77RR-SS049-0006 77RR-SB049 20100525 NORMAL	
		RESULT	MDL	RESULT	MDL	RESULT	MDL	RESULT	MDL	RESULT	MDL	RESULT	MDL
Explosives and NG (mg/kg)													
NITROGLYCERIN	0.61	--	--	--	--	--	--	--	--	--	--	--	--
RDX	5.5	--	--	--	--	--	--	--	--	--	--	--	--
Inorganics (mg/kg)													
ANTIMONY	3.1	--	--	12.1 [SS]	1.44	123 [SS]	0.58	15.3 [SS]	0.553	1.94 J	1.44	--	--
ARSENIC	2.65	--	--	4.95 [SS]	0.861	7.99 [SS]	0.348	4.36 [SS]	0.332	1.78	0.863	--	--
COPPER	168	--	--	477 [SS]	1.44	713 [SS]	0.58	1230 [SS]	6.91	154	1.44	--	--
LEAD	22	--	--	6600 [SS]	2.15	50500 [SS]	8.7	8910 [SS]	2.07	1860 [SS]	0.432	--	--
LEAD-CALC	22	28113 [SS]	7	32641 [SS]	7	11347 [SS]	7	17748 [SS]	7	10454 [SS]	7	50626 [SS]	7
LEAD-XRF	22	7536.67 [SS]	0	8774 [SS]	0	2955.67 [SS]	0	4705.33 [SS]	0	2712 [SS]	0	13688 [SS]	0
ZINC	115	--	--	141 [SS]	1.44	129 [SS]	0.58	170 [SS]	0.553	66.3	1.44	--	--

TABLE 4-6

SUMMARY OF DETECTED CONCENTRATIONS IN SURFACE SOIL
SWMU 77 - RIFLE RANGE SUBAREA - FIRING LINES AND WOODED EMBANKMENT
NAVAL ACTIVITY PUERTO RICO
CEIBA, PUERTO RICO

SAMPLE ID LOCATION DATE SAMPLE CODE	PAL Surface Soil	77RR-SS050-G00.5 77RR-SB050 20100525 NORMAL		77RR-SS051-0006 77RR-SB051 20100525 NORMAL		77RR-SS052-G00.5 77RR-SB052 20100525 NORMAL		77RR-SS053-0006 77RR-SB053 20100525 NORMAL		77RR-SS054-G00.5 77RR-SB054 20100525 NORMAL		77RR-SS054-G00.5-AVG 77RR-SB054 20100525 NORMAL		77RR-SS054-G00.5-D 77RR-SB054 20100525 NORMAL	
		RESULT	MDL	RESULT	MDL	RESULT	MDL	RESULT	MDL	RESULT	MDL	RESULT	MDL	RESULT	MDL
Explosives and NG (mg/kg)															
NITROGLYCERIN	0.61	--	--	--	--	--	--	--	--	--	--	--	--	--	--
RDX	5.5	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Inorganics (mg/kg)															
ANTIMONY	3.1	27.8 [SS]	1.4	--	--	1040 [SS]	1.41	--	--	348 J [SS]	1.4	321.5 J [SS]	1.4	295 J [SS]	0.556
ARSENIC	2.65	7.2 [SS]	0.839	--	--	34.3 [SS]	0.845	--	--	24.6 [SS]	0.842	25.65 [SS]	0.842	26.7 [SS]	0.334
COPPER	168	339 [SS]	1.4	--	--	36700 [SS]	141	--	--	1800 R	1.4	9700 R	1.4	17600 R	27.8
LEAD	22	19700 [SS]	42	--	--	73600 [SS]	42.3	--	--	55300 [SS]	8.42	53750 [SS]	8.42	52200 [SS]	8.34
LEAD-CALC	22	29892 [SS]	7	30035 [SS]	7	61072 [SS]	7	16793 [SS]	7	NA	7	NA	7	--	--
LEAD-XRF	22	8023.33 [SS]	0	8061.67 [SS]	0	16541.67 [SS]	0	4444.33 [SS]	0	40528.67 [SS]	0	40528.67 [SS]	0	--	--
ZINC	115	92.6	1.4	--	--	3470 [SS]	141	--	--	295 R	1.4	1002.5 R	1.4	1710 R	27.8

TABLE 4-6

SUMMARY OF DETECTED CONCENTRATIONS IN SURFACE SOIL
SWMU 77 - RIFLE RANGE SUBAREA - FIRING LINES AND WOODED EMBANKMENT
NAVAL ACTIVITY PUERTO RICO
CEIBA, PUERTO RICO

SAMPLE ID LOCATION DATE SAMPLE CODE	PAL Surface Soil	77RR-SS055-G00.5 77RR-SB055 20100525 NORMAL		77RR-SS056-G00.5 77RR-SB056 20100525 NORMAL		77RR-SS057-0006 77RR-SB057 20100525 NORMAL	
		RESULT	MDL	RESULT	MDL	RESULT	MDL
Explosives and NG (mg/kg)							
NITROGLYCERIN	0.61	--	--	--	--	--	--
RDX	5.5	--	--	--	--	--	--
Inorganics (mg/kg)							
ANTIMONY	3.1	6510 J [SS]	138	918 J [SS]	1.38	--	--
ARSENIC	2.65	60.5 [SS]	0.165	49.6 [SS]	0.826	--	--
COPPER	168	959 [SS]	1.38	1810 [SS]	1.38	--	--
LEAD	22	118000 [SS]	41.3	52100 [SS]	8.26	--	--
LEAD-CALC	22	61745 [SS]	7	83540 [SS]	7	53836 [SS]	7
LEAD-XRF	22	16726 [SS]	0	22681 [SS]	0	14565 [SS]	0
ZINC	115	164 [SS]	0.275	283 [SS]	1.38	--	--

PAL = Project Action Limit.
SS = Surface soil.
RDX = Cyclotrimethylenetrinitramine.
mg/kg = Milligrams per kilogram.
NA = Not applicable.
J = Value is estimated.
U = Analyte not detected at the reported detection limit.
R = Analyte may or may not be present. Value is unreliable.
XRF = X-ray Fluorescence.
NG = Nitroglycerin.
Shaded concentrations exceed PALs.

TABLE 5-2

FREQUENCY OF DETECTION IN SURFACE AND SUBSURFACE SOIL
SWMU 77 - POTENTIAL OPEN BURN/OPEN DETONATION SUBAREA
NAVAL ACTIVITY PUERTO RICO
CEIBA, PUERTO RICO

Parameter	Frequency of Detection	Minimum Result		Maximum Result		Location of Maximum Detection	Sample of Maximum Detection	Minimum Non-Detection	Maximum Non-Detection	PAL - Surface Soil [1]	PAL - Subsurface Soil [1]	USEPA Generic SSLs Migration to GW [2] DAF=20
Explosives (mg/kg)												
HMX	1/7	1.78	NJ	1.78	NJ	77OB-SB005	77OB-SS005-G00.5	0.1	0.1	29	29	46
RDX	5/7	0.112	J	0.21	J	77OB-SB002	77OB-SS002-G00.5	0.1	0.1	5.5	5.5	0.0046
Inorganics (mg/kg)												
ARSENIC	6/7	0.825		3.41		77OB-SB001	77OB-SS001-G00.5	0.82	0.82	2.65	6.6	5.8
COPPER	6/6	74.9		133		77OB-SB005	77OB-SS005-G00.5	--	--	168	120	920
LEAD	7/7	2.18		74		77OB-SB005	77OB-SS005-G00.5	--	--	22	11	280
ZINC	6/6	65		81.5		77OB-SB005	77OB-SS005-G00.5	--	--	115	92	13600
Miscellaneous Parameters												
PH	1/1	5.79		5.79		77OB-SB002	77OB-SS002-G00.5	--	--	NA	NA	NA

1. Refer to Appendix J for PAL source and reference.
2. USEPA generic soil screening level (SSLs) migration to groundwater screening levels are presented for informational purposes. A dilution atttenuation factor of 20 has been applied to values as presented in the November 2010 USEPA RSL Table.

Associated Samples:
77OB-SB001-G0102
77OB-SS001-G00.5
77OB-SS001-G00.5-AVG
77OB-SS001-G00.5-D
77OB-SS002-G00.5
77OB-SS003-G00.5
77OB-SS004-G00.5
77OB-SS005-G00.5
77OB-SS006-G00.5

mg/kg = Milligrams per kilogram.
J = Value is estimated.
NJ = Tentative detection.
NA = Not applicable.
HMX = Cyclotetramethylene-tetranitramine.
RDX = Cyclotrimethylenetrinitramine.
PAL = Project Action Limit.

TABLE 5-3

SUMMARY OF DETECTED CONCENTRATIONS IN SURFACE AND SUBSURFACE SOIL
POTENTIAL OPEN BURN/OPEN DETONATION SUBAREA
NAVAL ACTIVITY PUERTO RICO
CEIBA, PUERTO RICO

SAMPLE ID LOCATION DATE SAMPLE CODE	PAL Surface Soil	PAL Subsurface Soil	77OB-SS001-G00.5 77OB-SB001 20100522 NORMAL		77OB-SS001-G00.5-AVG 77OB-SB001 20100522 NORMAL		77OB-SS001-G00.5-D 77OB-SB001 20100522 NORMAL		77OB-SB001-G0102 77OB-SB001 20100522 NORMAL		77OB-SS002-G00.5 77OB-SB002 20100522 NORMAL		77OB-SS003-G00.5 77OB-SB003 20100522 NORMAL	
			RESULT	MDL	RESULT	MDL	RESULT	MDL	RESULT	MDL	RESULT	MDL	RESULT	MDL
Explosives (mg/kg)														
HMX	29	NA	0.1 U	0.1	0.10 U	0.1	0.1 U	0.1	0.1 U	0.1	0.1 U	0.1	0.1 U	0.1
RDX	5.5	NA	0.112 J	0.1	0.1195 J	0.1	0.127 J	0.1	0.205 J	0.1	0.21 J	0.1	0.1 U	0.1
Inorganics (mg/kg)														
ARSENIC	2.65	6.66	3.41 [SS]	0.855	3.285 [SS]	0.855	3.16 [SS]	0.855	0.825	0.313	1.37 J	0.796	0.82 U	0.82
COPPER	168	120	128 R	1.42	6314 R	1.42	12500 R	14.3	114	0.521	83	1.33	95.2	1.37
LEAD	22	11	22.8 [SS]	0.427	24.05 [SS]	0.427	25.3 [SS]	4.28	2.18	0.156	13.3	0.398	15.4	0.41
ZINC	115	92	212 R	1.42	569.5 R	1.42	927 R	1.43	75.1	0.521	72.5	1.33	77.4	1.37
Miscellaneous Parameters														
PH	NA	NA	--	--	--	--	--	--	--	--	5.79	0.1	--	--

TABLE 5-3

SUMMARY OF DETECTED CONCENTRATIONS IN SURFACE AND SUBSURFACE SOIL
POTENTIAL OPEN BURN/OPEN DETONATION SUBAREA
NAVAL ACTIVITY PUERTO RICO
CEIBA, PUERTO RICO

SAMPLE ID LOCATION DATE SAMPLE CODE	PAL Surface Soil	PAL Subsurface Soil	77OB-SS004-G00.5 77OB-SB004 20100522 NORMAL		77OB-SS005-G00.5 77OB-SB005 20100522 NORMAL		77OB-SS006-G00.5 77OB-SB006 20100522 NORMAL	
			RESULT	MDL	RESULT	MDL	RESULT	MDL
Explosives (mg/kg)								
HMX	29	NA	0.1 U	0.1	1.78 NJ	0.1	0.1 U	0.1
RDX	5.5	NA	0.138 J	0.1	0.167 NJ	0.1	0.1 U	0.1
Inorganics (mg/kg)								
ARSENIC	2.65	6.66	1.49 J	0.908	2	0.413	1.45	0.341
COPPER	168	120	99.3	1.51	133	0.688	74.9	0.569
LEAD	22	11	26.1 [SS]	0.454	74 [SS]	0.206	9.66	0.171
ZINC	115	92	71.9	1.51	81.5	0.688	65	0.569
Miscellaneous Parameters								
PH	NA	NA	--	--	--	--	--	--

mg/kg = Milligrams per kilogram.
J = Value is estimated.
U = Analyte not detected at the reporting limit left of the letter.
NJ = Tentative detection.
R = Analyte may or may not be present. Value is unreliable.
SS = Surface soil.
NA = Not applicable.
HMX = Cyclotetramethylene-tetranitramine.
RDX = Cyclotrimethylenetrinitramine.
MDL = Method detection limit.
PAL = Project Action Limit.
Shaded concentrations exceed PALs.

TABLE 6-2

FREQUENCY OF DETECTION IN SURFACE SOIL
SWMU 77 - POTENTIAL MUNITIONS TRENCH SUBAREA
NAVAL ACTIVITY PUERTO RICO
CEIBA, PUERTO RICO

Parameter	Frequency of Detection	Minimum Result	Maximum Result	Location of Maximum Detection	Sample of Maximum Detection	Minimum Non-Detection	Maximum Non-Detection	Project Action Limit [1]	USEPA Generic SSLs Migration to GW [2] DAF=20
Explosives (mg/kg)									
RDX	3/3	0.169 J	0.232 NJ	77MT-SB001	77MT-SS001G-00.5	--	--	5.5	0.0046
Inorganics (mg/kg)									
ANTIMONY	2/3	0.541 J	0.633 J	77MT-SB002	77MT-SS002G-00.5	0.3	0.3	3.1	5.4
ARSENIC	3/3	0.675	1.53	77MT-SB002	77MT-SS002G-00.5	--	--	2.65	5.8
COPPER	3/3	1.89	92.3	77MT-SB002	77MT-SS002G-00.5	--	--	168	920
LEAD	2/3	2.47	3.89	77MT-SB002	77MT-SS002G-00.5	3.13	3.13	22	280
ZINC	3/3	35.3	57.1	77MT-SB003	77MT-SS003G-00.5	--	--	115	13600
Miscellaneous Parameters									
pH	1/1	5.44	5.44	77MT-SB002	77MT-SS002G-00.5	--	--	NA	NA

1. Refer to Appendix J for PAL source and reference.
2. USEPA generic soil screening level (SSLs) migration to groundwater screening levels are presented for informational purposes. A dilution atttenuation factor of 20 has been applied to values as presented in the November 2010 USEPA RSL Table.

Associated Samples:
77MT-SS001G-00.5
77MT-SS002G-00.5
77MT-SS003G-00.5

mg/kg = Milligrams per kilogram.
J = Value is estimated.
NJ = Tentative detection.
NA = Not applicable.
RDX = Cyclotrimethylenetrinitramine.

TABLE 6-3

SUMMARY OF DETECTED CONCENTRATIONS IN SURFACE SOIL
SWMU 77 - POTENTIAL MUNITIONS TRENCH SUBAREA
NAVAL ACTIVITY PUERTO RICO
CEIBA, PUERTO RICO

SAMPLE ID LOCATION DATE SAMPLE CODE	Project Action Limit	77MT-SS001G-00.5 77MT-SB001 20100522 NORMAL		77MT-SS002G-00.5 77MT-SB002 20100522 NORMAL		77MT-SS003G-00.5 77MT-SB003 20100522 NORMAL	
		RESULT	MDL	RESULT	MDL	RESULT	MDL
Explosives (mg/kg)							
RDX	5.5	0.232 NJ	0.1	0.169 J	0.1	0.19 J	0.1
Inorganics (mg/kg)							
ANTIMONY	3.1	0.3 U	0.3	0.633 J	0.601	0.541 J	0.298
ARSENIC	2.65	0.675	0.18	1.53	0.361	1.27	0.179
COPPER	168	1.89	0.3	92.3	0.601	13.4	0.298
LEAD	22	2.47	0.0899	3.89	0.18	3.13 U	0.0894
ZINC	115	35.3	0.3	48.8	0.601	57.1	0.298
Miscellaneous Parameters							
pH	NA	--	--	5.44	0.1	--	--

mg/kg = Milligrams per kilogram.
RDX = Cyclotrimethylenetrinitramine.
NJ = Tentative detection.
U = Analyte not detected at the reporting limit left of the letter.
J = Value is estimated.
NA = Not applicable.
MDL = Method detection limit.

TABLE 7-2

FREQUENCY OF DETECTION IN SURFACE SOIL
SWMU 77 - DETONATION AREA NEAR CONCRETE PAD SUBAREA
NAVAL ACTIVITY PUERTO RICO
CEIBA, PUERTO RICO

Parameter	Frequency of Detection	Minimum Result	Maximum Result	Location of Maximum Detection	Sample of Maximum Detection	Minimum Non-Detection	Maximum Non-Detection	Project Action Limit [1]	USEPA Generic SSLs Migration to GW [2] DAF=20
Explosives and NG (mg/kg)									
NITROGLYCERIN	2/2	0.48 J	2.42 J	77DA-SB001	77DA-SS001G-00.5	--	--	0.61	0.032
Inorganics (mg/kg)									
ARSENIC	2/2	1.87 J	2.44	77DA-SB002	77DA-SS002G-00.5	--	--	2.65	5.8
COPPER	2/2	51.4	129	77DA-SB001	77DA-SS001G-00.5	--	--	168	920
LEAD	2/2	34.1	40.7	77DA-SB002	77DA-SS002G-00.5	--	--	22	280
ZINC	2/2	62.1	112	77DA-SB001	77DA-SS001G-00.5	--	--	115	13600
Misellaneous									
pH	1/1	8	8	77DA-SB002	77DA-SS002G-00.5	--	--	NA	NA

1. Refer to Appendix J for PAL source and reference.
2. USEPA generic soil screening level (SSLs) migration to groundwater screening levels are presented for informational purposes. A dilution atttenuation factor of 20 has been applied to values as presented in the November 2010 USEPA RSL Table.

Associated Samples:
77DA-SS001G-00.5
77DA-SS002G-00.5

mg/kg = Milligrams per kilogram.
J = Value is estimated.
NA = Not applicable.

TABLE 7-3

SUMMARY OF DETECTED CONCENTRATIONS IN SURFACE SOIL
DETONATION AREA NEAR CONCRETE PAD SUBAREA
NAVAL ACTIVITY PUERTO RICO
CEIBA, PUERTO RICO

SAMPLE ID LOCATION DATE SAMPLE CODE	PAL Surface Soil	77DA-SS001G-00.5 77DA-SB001 20100522 NORMAL		77DA-SS002G-00.5 77DA-SB002 20100522 NORMAL	
		RESULT	MDL	RESULT	MDL
Explosives and NG (mg/k					
NITROGLYCERIN	0.61	2.42 J	0.25	0.48 J	0.25
Inorganics (mg/kg)					
ARSENIC	2.65	1.87 J	0.959	2.44	0.355
COPPER	168	129	1.6	51.4	0.591
LEAD	22	34.1 [SS]	0.48	40.7 [SS]	0.177
ZINC	115	112	1.6	62.1	0.591
Misellaneous Parameters					
pH	NA	--	--	8	0.1

PAL = Project Action Limit.
NA = Not applicable.
SS = Surface soil.
mg/kg = Milligrams per kilogram.
J = Value is estimated.
MDL = Method detection limit.
Shaded concentrations exceed PALs.

TABLE 8-2

FREQUENCY OF DETECTION IN SURFACE SOIL
SWMU 77 - PISTOL RANGE SUBAREA
NAVAL ACTIVITY PUERTO RICO
CEIBA, PUERTO RICO

Parameter	Frequency of Detection	Minimum Result	Maximum Result	Location of Maximum Detection	Sample of Maximum Detection	Minimum Non-Detection	Maximum Non-Detection	Project Action Limit [1]	USEPA Generic SSLs Migration to GW [2] DAF=20
NG (mg/kg)									
NITROGLYCERIN	6/6	0.674 J	7.85 J	77PR-SB032	77PR-SS032-C00.5	--	--	0.61	0.032
Inorganics (mg/kg)									
ANTIMONY	6/10	1.72 J	326	77PR-SB010	77PR-SS010-G00.5	0.602	1.44	3.1	5.4
ARSENIC	8/10	0.641 J	42.8	77PR-SB010	77PR-SS010-G00.5	0.821	0.849	2.65	5.8
COPPER	10/10	105	7990	77PR-SB010	77PR-SS010-G00.5	--	--	168	920
LEAD	10/10	33.6	58400	77PR-SB010	77PR-SS010-G00.5	--	--	22	280
LEAD-CALC	30/30	49.6	41008	77PR-SB011	77PR-SS011-G00.5	--	--	22	280
LEAD-XRF	30/30	8.5	11059.7	77PR-SB011	77PR-SS011-G00.5	--	--	22	280
ZINC	10/10	72.9	856	77PR-SB010	77PR-SS010-G00.5	--	--	115	13600
Miscellaneous Parameters									
PH	1/1	8.15	8.15	77PR-SB032	77PR-SS032-C00.5	--	--	NA	NA

mg/kg = Milligrams per kilogram.
J = Value is estimated.
NA = Not applicable.

1. Refer to Appendix J for PAL source and reference.
2. USEPA generic soil screening level (SSLs) migration to groundwater screening levels are presented for informational purposes. A dilution atttenuation factor of 20 has been applied to values as presented in the November 2010 USEPA RSL Table.

Associated Samples:

77PR-SS001-G00.5	77PR-SS016-0006	77PR-SS027-0006
77PR-SS002-0006	77PR-SS017-0006	77PR-SS028-0006
77PR-SS003-0006	77PR-SS017-0006-AVG	77PR-SS029-0006
77PR-SS004-0006	77PR-SS017-0006-D	77PR-SS030-G00.5
77PR-SS005-0006	77PR-SS018-0006	77PR-SS031-C00.5
77PR-SS006-G00.5	77PR-SS019-G00.5	77PR-SS032-C00.5
77PR-SS007-0006	77PR-SS020-0006	77PR-SS033-C00.5
77PR-SS008-G00.5	77PR-SS021-G00.5	77PR-SS034-C00.5
77PR-SS009-0006	77PR-SS022-0006	77PR-SS035-C00.5
77PR-SS010-G00.5	77PR-SS023-0006	77PR-SS036-C00.5
77PR-SS011-G00.5	77PR-SS023-0006-AVG	
77PR-SS012-G00.5	77PR-SS023-0006-D	
77PR-SS013-G00.5	77PR-SS024-0006	
77PR-SS014-0006	77PR-SS025-0006	
77PR-SS015-0006	77PR-SS026-0006	

TABLE 8-3

SUMMARY OF DETECTED CONCENTRATIONS IN SURFACE SOIL
SWMU 77 - PISTOL RANGE SUBAREA
NAVAL ACTIVITY PUERTO RICO
CEIBA, PUERTO RICO

SAMPLE ID LOCATION DATE SAMPLE CODE	PAL Surface Soil	77PR-SS001-G00.5 77PR-SB001 20100524 NORMAL		77PR-SS002-0006 77PR-SB002 20100524 NORMAL		77PR-SS003-0006 77PR-SB003 20100524 NORMAL		77PR-SS004-0006 77PR-SB004 20100524 NORMAL		77PR-SS005-0006 77PR-SB005 20100524 NORMAL		77PR-SS006-G00.5 77PR-SB006 20100524 NORMAL		77PR-SS007-0006 77PR-SB007 20100524 NORMAL		77PR-SS008-G00.5 77PR-SB008 20100524 NORMAL	
		RESULT	MDL	RESULT	MDL	RESULT	MDL	RESULT	MDL	RESULT	MDL	RESULT	MDL	RESULT	MDL	RESULT	MDL
NG (mg/kg)																	
NITROGLYCERIN	0.61	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Inorganics (mg/kg)																	
ANTIMONY	3.1	1.44 U	1.44	--	--	--	--	--	--	--	--	1.72 J	0.58	--	--	5.05 [SS]	0.564
ARSENIC	2.65	1.22 J	0.862	--	--	--	--	--	--	--	--	4.14 [SS]	0.348	--	--	2.06	0.338
COPPER	168	290 [SS]	1.44	--	--	--	--	--	--	--	--	174 [SS]	0.58	--	--	176 [SS]	0.564
LEAD	22	556 [SS]	0.431	--	--	--	--	--	--	--	--	754 [SS]	0.174	--	--	5370 [SS]	0.846
LEAD-CALC	22	567 [SS]	7	4931 [SS]	7	7423 [SS]	7	7559 [SS]	7	4356 [SS]	7	658 [SS]	7	647 [SS]	7	11534 [SS]	7
LEAD-XRF	22	334 [SS]	0	1202.67 [SS]	0	1884 [SS]	0	1921 [SS]	0	1046.33 [SS]	0	391 [SS]	0	384.33 [SS]	0	3006.67 [SS]	0
ZINC	115	156 [SS]	1.44	--	--	--	--	--	--	--	--	110	0.58	--	--	90	0.564
Miscellaneous Parameters																	
PH	NA	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

TABLE 8-3

SUMMARY OF DETECTED CONCENTRATIONS IN SURFACE SOIL
SWMU 77 - PISTOL RANGE SUBAREA
NAVAL ACTIVITY PUERTO RICO
CEIBA, PUERTO RICO

SAMPLE ID LOCATION DATE SAMPLE CODE	PAL Surface Soil	77PR-SS009-0006 77PR-SB009 20100524 NORMAL		77PR-SS010-G00.5 77PR-SB010 20100524 NORMAL		77PR-SS011-G00.5 77PR-SB011 20100524 NORMAL		77PR-SS012-G00.5 77PR-SB012 20100524 NORMAL		77PR-SS013-G00.5 77PR-SB013 20100524 NORMAL		77PR-SS014-0006 77PR-SB014 20100524 NORMAL		77PR-SS015-0006 77PR-SB015 20100524 NORMAL		77PR-SS016-0006 77PR-SB016 20100524 NORMAL	
		RESULT	MDL	RESULT	MDL	RESULT	MDL	RESULT	MDL	RESULT	MDL	RESULT	MDL	RESULT	MDL	RESULT	MDL
NG (mg/kg)																	
NITROGLYCERIN	0.61	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Inorganics (mg/kg)																	
ANTIMONY	3.1	--	--	326 [SS]	0.54	65.8 [SS]	0.564	7.42 [SS]	0.59	2.24	0.551	--	--	--	--	--	--
ARSENIC	2.65	--	--	42.8 [SS]	0.324	8.69 [SS]	0.339	4.11 [SS]	0.354	2.1	0.331	--	--	--	--	--	--
COPPER	168	--	--	7990 [SS]	135	1060 [SS]	0.564	401 [SS]	0.59	251 [SS]	0.551	--	--	--	--	--	--
LEAD	22	--	--	58400 [SS]	40.5	31800 [SS]	8.46	22000 [SS]	8.84	3720 [SS]	0.826	--	--	--	--	--	--
LEAD-CALC	22	3273 [SS]	7	20021 [SS]	7	41008 [SS]	7	12935 [SS]	7	12137 [SS]	7	271 [SS]	7	308 [SS]	7	553 [SS]	7
LEAD-XRF	22	750 [SS]	0	5325.67 [SS]	0	11059.67 [SS]	0	3389.67 [SS]	0	3172 [SS]	0	147.67 [SS]	0	171.33 [SS]	0	325.33 [SS]	0
ZINC	115	--	--	856 [SS]	0.54	295 [SS]	0.564	110	0.59	94.5	0.551	--	--	--	--	--	--
Miscellaneous Parameters																	
PH	NA	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

TABLE 8-3

SUMMARY OF DETECTED CONCENTRATIONS IN SURFACE SOIL
SWMU 77 - PISTOL RANGE SUBAREA
NAVAL ACTIVITY PUERTO RICO
CEIBA, PUERTO RICO

SAMPLE ID LOCATION DATE SAMPLE CODE	PAL Surface Soil	77PR-SS017-0006 77PR-SB017 20100524 NORMAL		77PR-SS017-0006-AVG 77PR-SB017 20100524 NORMAL		77PR-SS017-0006-D 77PR-SB017 20100524 NORMAL		77PR-SS018-0006 77PR-SB018 20100524 NORMAL		77PR-SS019-G00.5 77PR-SB019 20100524 NORMAL		77PR-SS020-0006 77PR-SB020 20100524 NORMAL		77PR-SS021-G00.5 77PR-SB021 20100524 NORMAL		77PR-SS022-0006 77PR-SB022 20100524 NORMAL	
		RESULT	MDL	RESULT	MDL	RESULT	MDL	RESULT	MDL	RESULT	MDL	RESULT	MDL	RESULT	MDL	RESULT	MDL
NG (mg/kg)																	
NITROGLYCERIN	0.61	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Inorganics (mg/kg)																	
ANTIMONY	3.1	--	--	--	--	--	--	--	--	0.602 U	0.602	--	--	1.37 U	1.37	--	--
ARSENIC	2.65	--	--	--	--	--	--	--	--	0.641 J	0.361	--	--	0.821 U	0.821	--	--
COPPER	168	--	--	--	--	--	--	--	--	132	0.602	--	--	106	1.37	--	--
LEAD	22	--	--	--	--	--	--	--	--	297 [SS]	0.181	--	--	57.5 [SS]	0.411	--	--
LEAD-CALC	22	6194 [SS]	7	6633 [SS]	7	7072 [SS]	7	9656 [SS]	7	2076 [SS]	7	2420 [SS]	7	134 [SS]	7	201 [SS]	7
LEAD-XRF	22	1547.67 [SS]	0	1667.835 [SS]	0	1788 [SS]	0	2494 [SS]	0	423.33 [SS]	0	516.67 [SS]	0	61.67 [SS]	0	103.67 [SS]	0
ZINC	115	--	--	--	--	--	--	--	--	72.9	0.602	--	--	75.6	1.37	--	--
Miscellaneous Parameters																	
PH	NA	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

TABLE 8-3

SUMMARY OF DETECTED CONCENTRATIONS IN SURFACE SOIL
SWMU 77 - PISTOL RANGE SUBAREA
NAVAL ACTIVITY PUERTO RICO
CEIBA, PUERTO RICO

SAMPLE ID LOCATION DATE SAMPLE CODE	PAL Surface Soil	77PR-SS023-0006 77PR-SB023 20100524 NORMAL		77PR-SS023-0006-AVG 77PR-SB023 20100524 NORMAL		77PR-SS023-0006-D 77PR-SB023 20100524 NORMAL		77PR-SS024-0006 77PR-SB024 20100524 NORMAL		77PR-SS025-0006 77PR-SB025 20100524 NORMAL		77PR-SS026-0006 77PR-SB026 20100524 NORMAL		77PR-SS027-0006 77PR-SB027 20100524 NORMAL		77PR-SS028-0006 77PR-SB028 20100524 NORMAL	
		RESULT	MDL	RESULT	MDL	RESULT	MDL	RESULT	MDL	RESULT	MDL	RESULT	MDL	RESULT	MDL	RESULT	MDL
NG (mg/kg)																	
NITROGLYCERIN	0.61	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Inorganics (mg/kg)																	
ANTIMONY	3.1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
ARSENIC	2.65	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
COPPER	168	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
LEAD	22	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
LEAD-CALC	22	221 [SS]	7	214.5 [SS]	7	208 [SS]	7	126 [SS]	7	246 [SS]	7	348 [SS]	7	83.8 [SS]	7	49.6 [SS]	7
LEAD-XRF	22	116 [SS]	0	112.165 [SS]	0	108.33 [SS]	0	56.67 [SS]	0	132.33 [SS]	0	196.33 [SS]	0	30 [SS]	0	8.5	0
ZINC	115	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Miscellaneous Parameters																	
PH	NA	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

TABLE 8-3

SUMMARY OF DETECTED CONCENTRATIONS IN SURFACE SOIL
SWMU 77 - PISTOL RANGE SUBAREA
NAVAL ACTIVITY PUERTO RICO
CEIBA, PUERTO RICO

SAMPLE ID LOCATION DATE SAMPLE CODE	PAL Surface Soil	77PR-SS029-0006 77PR-SB029 20100524 NORMAL		77PR-SS030-G00.5 77PR-SB030 20100524 NORMAL		77PR-SS031-C00.5 77PR-SB031 20100521 NORMAL		77PR-SS032-C00.5 77PR-SB032 20100521 NORMAL		77PR-SS033-C00.5 77PR-SB033 20100521 NORMAL		77PR-SS034-C00.5 77PR-SB034 20100521 NORMAL		77PR-SS035-C00.5 77PR-SB035 20100521 NORMAL		77PR-SS036-C00.5 77PR-SB036 20100521 NORMAL	
		RESULT	MDL	RESULT	MDL	RESULT	MDL	RESULT	MDL	RESULT	MDL	RESULT	MDL	RESULT	MDL	RESULT	MDL
NG (mg/kg)																	
NITROGLYCERIN	0.61	--	--	--	--	0.674 J [SS]	0.25	7.85 J [SS]	0.25	4.24 J [SS]	0.25	5.57 J [SS]	0.25	5.85 J [SS]	0.25	0.984 J [SS]	0.25
Inorganics (mg/kg)																	
ANTIMONY	3.1	--	--	1.42 U	1.42	--	--	--	--	--	--	--	--	--	--	--	--
ARSENIC	2.65	--	--	0.849 U	0.849	--	--	--	--	--	--	--	--	--	--	--	--
COPPER	168	--	--	105	1.42	--	--	--	--	--	--	--	--	--	--	--	--
LEAD	22	--	--	33.6 [SS]	0.425	--	--	--	--	--	--	--	--	--	--	--	--
LEAD-CALC	22	74.3 [SS]	7	110 [SS]	7	--	--	--	--	--	--	--	--	--	--	--	--
LEAD-XRF	22	24 [SS]	0	47 [SS]	0	--	--	--	--	--	--	--	--	--	--	--	--
ZINC	115	--	--	77	1.42	--	--	--	--	--	--	--	--	--	--	--	--
Miscellaneous Parameters																	
PH	NA	--	--	--	--	--	--	8.15	0.1	--	--	--	--	--	--	--	--

PAL = Project Action Limit.
SS = Surface soil.
SB = Subsurface soil.
mg/kg = Milligrams per kilogram.
NA = Not applicable.
J = Value is estimated.
U = Analyte not detected at the reporting limit left of the letter.
MDL = Method detection limit.
XRF = X-ray fluorescence
Shaded concentrations exceed PALs.

TABLE 9-2

FREQUENCY OF DETECTION IN SURFACE SOIL
SWMU 77 - FORMER PISTOL RANGE SUBAREA
NAVAL ACTIVITY PUERTO RICO
CEIBA, PUERTO RICO

Parameter	Frequency of Detection	Minimum Result	Maximum Result	Location of Maximum Detection	Sample of Maximum Detection	Minimum Non-Detection	Maximum Non-Detection	Project Action Limit [1]	USEPA Generic SSLs Migration to GW [2] DAF=20
Inorganics (mg/kg)									
ANTIMONY	5/10	0.57 J	6.26 J	77FP-SB010	77FP-SS010-G00.5	0.606	1.57	3.1	5.4
ARSENIC	8/10	1.02	1.82	77FP-SB013	77FP-SS012/13-G00.5	0.943	0.944	2.65	5.8
COPPER	10/10	28.8	4400	77FP-SB009	77FP-SS009-G00.5	--	--	168	920
LEAD	9/10	59.6	2430	77FP-SB010	77FP-SS010-G00.5	30	30	22	280
LEAD-CALC	30/30	40.4	12295	77FP-SB010	77FP-SS010-G00.5	--	--	22	280
LEAD-XRF	24/30	13.33	3215	77FP-SB010	77FP-SS010-G00.5	2.67	5.5	22	280
ZINC	10/10	30.6	437	77FP-SB009	77FP-SS009-G00.5	--	--	115	13600
Miscellaneous Parameters									
PH	1/1	5.67	5.67	77FP-SB009	77FP-SS009-G00.5	--	--	NA	NA

mg/kg = Milligrams per kilogram
J = Value is estimated.
NA = Not applicable.

1. Refer to Appendix J for PAL source and reference.
2. USEPA generic soil screening level (SSLs) migration to groundwater screening levels are presented for informational purposes. A dilution atttenuation factor of 20 has been applied to values as presented in the November 2010 USEPA RSL Table.

Associated Samples:

77FP-SS001-0006	77FP-SS014-0006	77FP-SS025-G00.5-D
77FP-SS002-0006	77FP-SS015-0006	77FP-SS026-G00.5
77FP-SS003-0006	77FP-SS016-0006	77FP-SS026-G00.5-AVG
77FP-SS004-G00.5	77FP-SS017-0006	77FP-SS026-G00.5-D
77FP-SS005-0006	77FP-SS018-G00.5	77FP-SS027-0006
77FP-SS006-0006	77FP-SS019-0006	77FP-SS028-0006
77FP-SS007-0006	77FP-SS020-G00.5	77FP-SS029-0006
77FP-SS008-0006	77FP-SS021-0006	77FP-SS030-0006
77FP-SS009-G00.5	77FP-SS022-G00.5	77FP-SS031-C00.5
77FP-SS010-G00.5	77FP-SS023-0006	77FP-SS032-C00.5
77FP-SS011-0006	77FP-SS024-0006	
77FP-SS012-G00.5	77FP-SS025-G00.5	

TABLE 9-2

FREQUENCY OF DETECTION IN SURFACE SOIL
SWMU 77 - FORMER PISTOL RANGE SUBAREA
NAVAL ACTIVITY PUERTO RICO
CEIBA, PUERTO RICO

77FP-SS013-G00.5 77FP-SS025-G00.5-AVG

TABLE 9-3

SUMMARY OF DETECTED CONCENTRATIONS IN SURFACE SOIL
SWMU 77 - FORMER PISTOL RANGE SUBAREA
NAVAL ACTIVITY PUERTO RICO
CEIBA, PUERTO RICO

SAMPLE ID LOCATION DATE SAMPLE CODE	PAL Surface Soil	77FP-SS001-0006 77FP-SB001 20100521 NORMAL		77FP-SS002-0006 77FP-SB002 20100521 NORMAL		77FP-SS003-0006 77FP-SB003 20100521 NORMAL		77FP-SS004-G00.5 77FP-SB004 20100521 NORMAL		77FP-SS005-0006 77FP-SB005 20100521 NORMAL		77FP-SS006-0006 77FP-SB006 20100521 NORMAL		77FP-SS007-0006 77FP-SB007 20100521 NORMAL	
		RESULT	MDL	RESULT	MDL	RESULT	MDL	RESULT	MDL	RESULT	MDL	RESULT	MDL	RESULT	MDL
Inorganics (mg/kg)															
ANTIMONY	3.1	--	--	--	--	--	--	0.57 J	0.291	--	--	--	--	--	--
ARSENIC	2.65	--	--	--	--	--	--	1.08	0.175	--	--	--	--	--	--
COPPER	168	--	--	--	--	--	--	28.8	0.291	--	--	--	--	--	--
LEAD	22	--	--	--	--	--	--	375 [SS]	0.0873	--	--	--	--	--	--
LEAD-CALC	22	44.6 [SS]	0	69.5 [SS]	7	40.4 [SS]	7	518 [SS]	7	70.6 [SS]	7	41.3 [SS]	7	57.2 [SS]	7
LEAD-XRF	22	5.33 U	0	21	0	2.67 U	0	302.67 [SS]	0	21.67	0	3.33 U	0	13.33	0
ZINC	115	--	--	--	--	--	--	30.6	0.291	--	--	--	--	--	--
Miscellaneous Parameters															
PH	NA	--	--	--	--	--	--	--	--	--	--	--	--	--	--

TABLE 9-3

SUMMARY OF DETECTED CONCENTRATIONS IN SURFACE SOIL
SWMU 77 - FORMER PISTOL RANGE SUBAREA
NAVAL ACTIVITY PUERTO RICO
CEIBA, PUERTO RICO

SAMPLE ID LOCATION DATE SAMPLE CODE	PAL Surface Soil	77FP-SS008-0006 77FP-SB008 20100521 NORMAL		77FP-SS009-G00.5 77FP-SB009 20100521 NORMAL		77FP-SS010-G00.5 77FP-SB010 20100521 NORMAL		77FP-SS011-0006 77FP-SB011 20100521 NORMAL		77FP-SS012-G00.5 77FP-SB012 20100521 NORMAL		77FP-SS013-G00.5 77FP-SB013 20100521 NORMAL		77FP-SS014-0006 77FP-SB014 20100521 NORMAL		77FP-SS015-0006 77FP-SB015 20100521 NORMAL	
		RESULT	MDL	RESULT	MDL	RESULT	MDL	RESULT	MDL	RESULT	MDL	RESULT	MDL	RESULT	MDL	RESULT	MDL
Inorganics (mg/kg)																	
ANTIMONY	3.1	--	--	1.62 J	1.56	6.26 J [SS]	1.51	--	--	3.8 J [SS]	1.76	1.19 J	0.694	--	--	--	--
ARSENIC	2.65	--	--	1.51 J	0.936	1.3 J	0.908	--	--	1.82 J	1.05	1.82	0.416	--	--	--	--
COPPER	168	--	--	4400 [SS]	7.8	204 [SS]	1.51	--	--	99	1.76	61.7	0.694	--	--	--	--
LEAD	22	--	--	577 [SS]	0.468	2430 [SS]	0.454	--	--	765 [SS]	0.527	466 [SS]	0.208	--	--	--	--
LEAD-CALC	22	248 [SS]	7	2944 [SS]	7	12295 [SS]	7	80.1 [SS]	7	7863 [SS]	7	2299 [SS]	7	63.1 [SS]	7	94.9 [SS]	7
LEAD-XRF	22	132.67 [SS]	0	660.33 [SS]	0	3215 [SS]	0	27.67 [SS]	0	2004 [SS]	0	483.67 [SS]	0	17	0	37 [SS]	0
ZINC	115	--	--	437 [SS]	1.56	69.2	1.51	--	--	53.1	1.76	38.6	0.694	--	--	--	--
Miscellaneous Parameters																	
PH	NA	--	--	5.67	0.1	--	--	--	--	--	--	--	--	--	--	--	--

TABLE 9-3

SUMMARY OF DETECTED CONCENTRATIONS IN SURFACE SOIL
SWMU 77 - FORMER PISTOL RANGE SUBAREA
NAVAL ACTIVITY PUERTO RICO
CEIBA, PUERTO RICO

SAMPLE ID LOCATION DATE SAMPLE CODE	PAL Surface Soil	77FP-SS016-0006 77FP-SB016 20100521 NORMAL		77FP-SS017-0006 77FP-SB017 20100521 NORMAL		77FP-SS018-G00.5 77FP-SB018 20100521 NORMAL		77FP-SS019-0006 77FP-SB019 20100521 NORMAL		77FP-SS020-G00.5 77FP-SB020 20100521 NORMAL		77FP-SS021-0006 77FP-SB021 20100526 NORMAL		77FP-SS022-G00.5 77FP-SB022 20100526 NORMAL	
		RESULT	MDL	RESULT	MDL	RESULT	MDL	RESULT	MDL	RESULT	MDL	RESULT	MDL	RESULT	MDL
Inorganics (mg/kg)															
ANTIMONY	3.1	--	--	--	--	0.606 U	0.606	--	--	1.57 U	1.57	--	--	1.56 U	1.56
ARSENIC	2.65	--	--	--	--	1.02	0.363	--	--	0.944 U	0.944	--	--	1.13 J	0.937
COPPER	168	--	--	--	--	56.7	0.606	--	--	147	1.57	--	--	93.4	1.56
LEAD	22	--	--	--	--	59.6 [SS]	0.182	--	--	30 U	0.472	--	--	285 [SS]	0.468
LEAD-CALC	22	44.8 [SS]	7	68.4 [SS]	7	88.6 [SS]	7	41.3 [SS]	7	80.1 [SS]	7	41.7 [SS]	7	2307 [SS]	7
LEAD-XRF	22	5.5 U	0	20.33	0	33 [SS]	0	3.33 U	0	27.67 [SS]	0	3.5 U	0	486 [SS]	0
ZINC	115	--	--	--	--	45.1	0.606	--	--	69.3	1.57	--	--	49.1	1.56
Miscellaneous Parameters															
PH	NA	--	--	--	--	--	--	--	--	--	--	--	--	--	--

TABLE 9-3

SUMMARY OF DETECTED CONCENTRATIONS IN SURFACE SOIL
SWMU 77 - FORMER PISTOL RANGE SUBAREA
NAVAL ACTIVITY PUERTO RICO
CEIBA, PUERTO RICO

SAMPLE ID LOCATION DATE SAMPLE CODE	PAL Surface Soil	77FP-SS023-0006 77FP-SB023 20100526 NORMAL		77FP-SS024-0006 77FP-SB024 20100526 NORMAL		77FP-SS025-G00.5 77FP-SB025 20100526 NORMAL		77FP-SS025-G00.5-AVG 77FP-SB025 20100526 NORMAL		77FP-SS025-G00.5-D 77FP-SB025 20100526 NORMAL		77FP-SS026-G00.5 77FP-SB026 20100526 NORMAL		77FP-SS026-G00.5-AVG 77FP-SB026 20100526 NORMAL	
		RESULT	MDL	RESULT	MDL	RESULT	MDL	RESULT	MDL	RESULT	MDL	RESULT	MDL	RESULT	MDL
Inorganics (mg/kg)															
ANTIMONY	3.1	--	--	--	--	1.53 U	1.53	1.53 U	1.53	--	--	1.57 U	1.57	1.57 U	1.57
ARSENIC	2.65	--	--	--	--	1.16 J	0.918	1.16 J	0.918	--	--	0.943 U	0.943	0.943 U	0.943
COPPER	168	--	--	--	--	122	1.53	122	1.53	--	--	2110 [SS]	1.57	2110 [SS]	1.57
LEAD	22	--	--	--	--	226 [SS]	0.459	226 [SS]	0.459	--	--	422 [SS]	0.472	422 [SS]	0.472
LEAD-CALC	22	283 [SS]	7	357 [SS]	7	492 [SS]	7	497 [SS]	7	502 [SS]	7	519 [SS]	7	501 [SS]	7
LEAD-XRF	22	154.67 [SS]	0	202.33 [SS]	0	286.67 [SS]	0	289.67 [SS]	0	292.67 [SS]	0	303.67 [SS]	0	292.17 [SS]	0
ZINC	115	--	--	--	--	64.5	1.53	64.5	1.53	--	--	269 [SS]	1.57	269 [SS]	1.57
Miscellaneous Parameters															
PH	NA	--	--	--	--	--	--	--	--	--	--	--	--	--	--

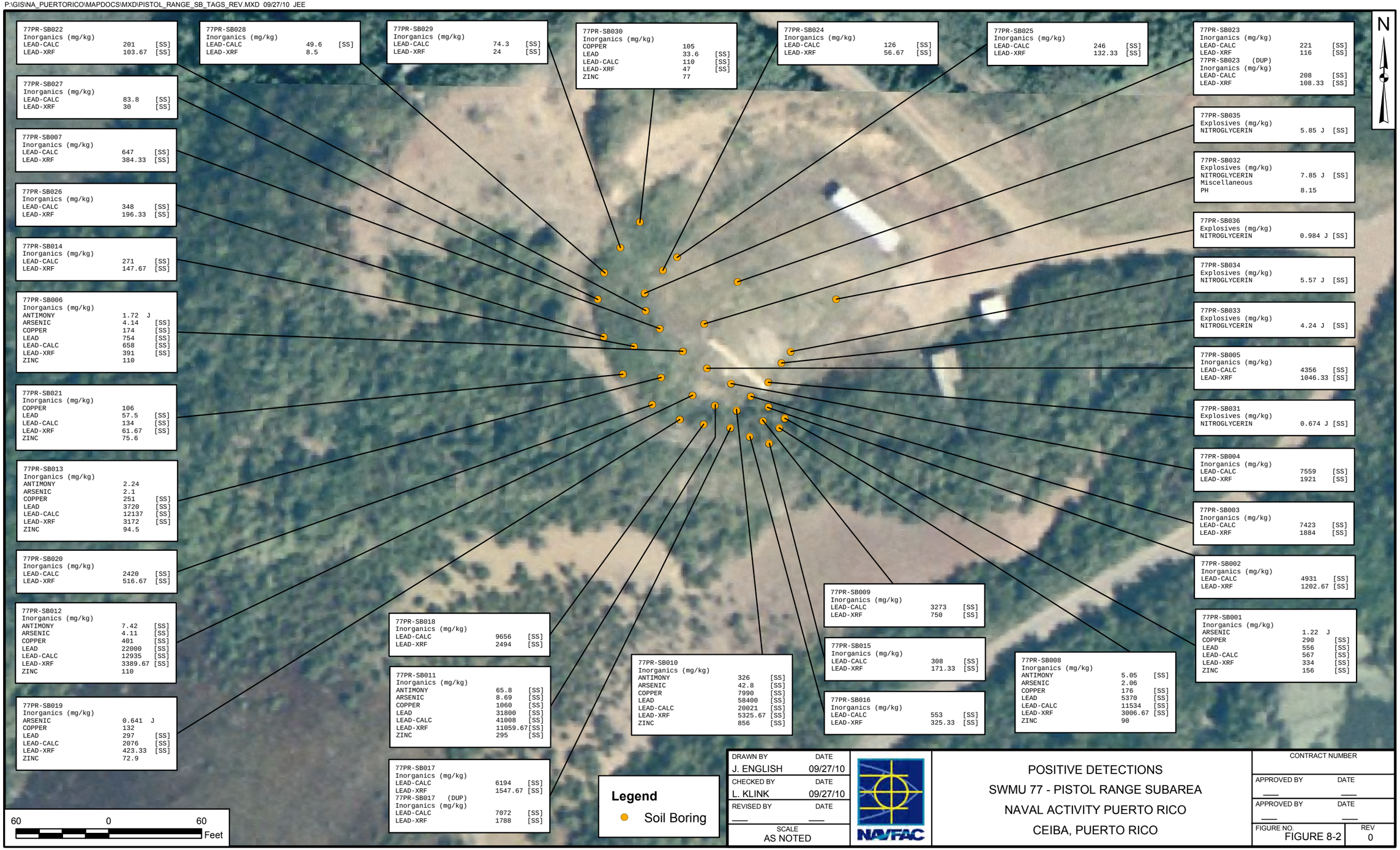
TABLE 9-3

SUMMARY OF DETECTED CONCENTRATIONS IN SURFACE SOIL
SWMU 77 - FORMER PISTOL RANGE SUBAREA
NAVAL ACTIVITY PUERTO RICO
CEIBA, PUERTO RICO

SAMPLE ID LOCATION DATE SAMPLE CODE	PAL Surface Soil	77FP-SS026-G00.5-D 77FP-SB026 20100526 NORMAL		77FP-SS027-0006 77FP-SB027 20100526 NORMAL		77FP-SS028-0006 77FP-SB028 20100526 NORMAL		77FP-SS029-0006 77FP-SB029 20100526 NORMAL		77FP-SS030-0006 77FP-SB030 20100526 NORMAL		77FP-SS031-C00.5 77FP-SB031 20100520 NORMAL		77FP-SS032-C00.5 77FP-SB032 20100520 NORMAL	
		RESULT	MDL	RESULT	MDL	RESULT	MDL	RESULT	MDL	RESULT	MDL	RESULT	MDL	RESULT	MDL
Inorganics (mg/kg)															
ANTIMONY	3.1	--	--	--	--	--	--	--	--	--	--	--	--	--	--
ARSENIC	2.65	--	--	--	--	--	--	--	--	--	--	--	--	--	--
COPPER	168	--	--	--	--	--	--	--	--	--	--	--	--	--	--
LEAD	22	--	--	--	--	--	--	--	--	--	--	--	--	--	--
LEAD-CALC	22	483 [SS]	7	408 [SS]	7	305 [SS]	7	410 [SS]	7	152 [SS]	7	--	--	--	--
LEAD-XRF	22	280.67 [SS]	0	233.67 [SS]	0	169 [SS]	0	234.67 [SS]	0	73 [SS]	0	--	--	--	--
ZINC	115	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Miscellaneous Parameters															
PH	NA	--	--	--	--	--	--	--	--	--	--	--	--	--	--

mg/kg = Milligrams per kilogram.
U = Analyte not detected at the reporting limit left of the letter.
J = Value is estimated.
NA = Not applicable.
SS = Surface soil.
XRF = X-ray fluorescence.
PAL = Project Action Limit.
Shaded concentrations exceed PALs.

P:\GIS\NA_PUERTORICO\MAPDOCS\MXD\PISTOL_RANGE_SB_TAGS_REV.MXD 09/27/10 JEE



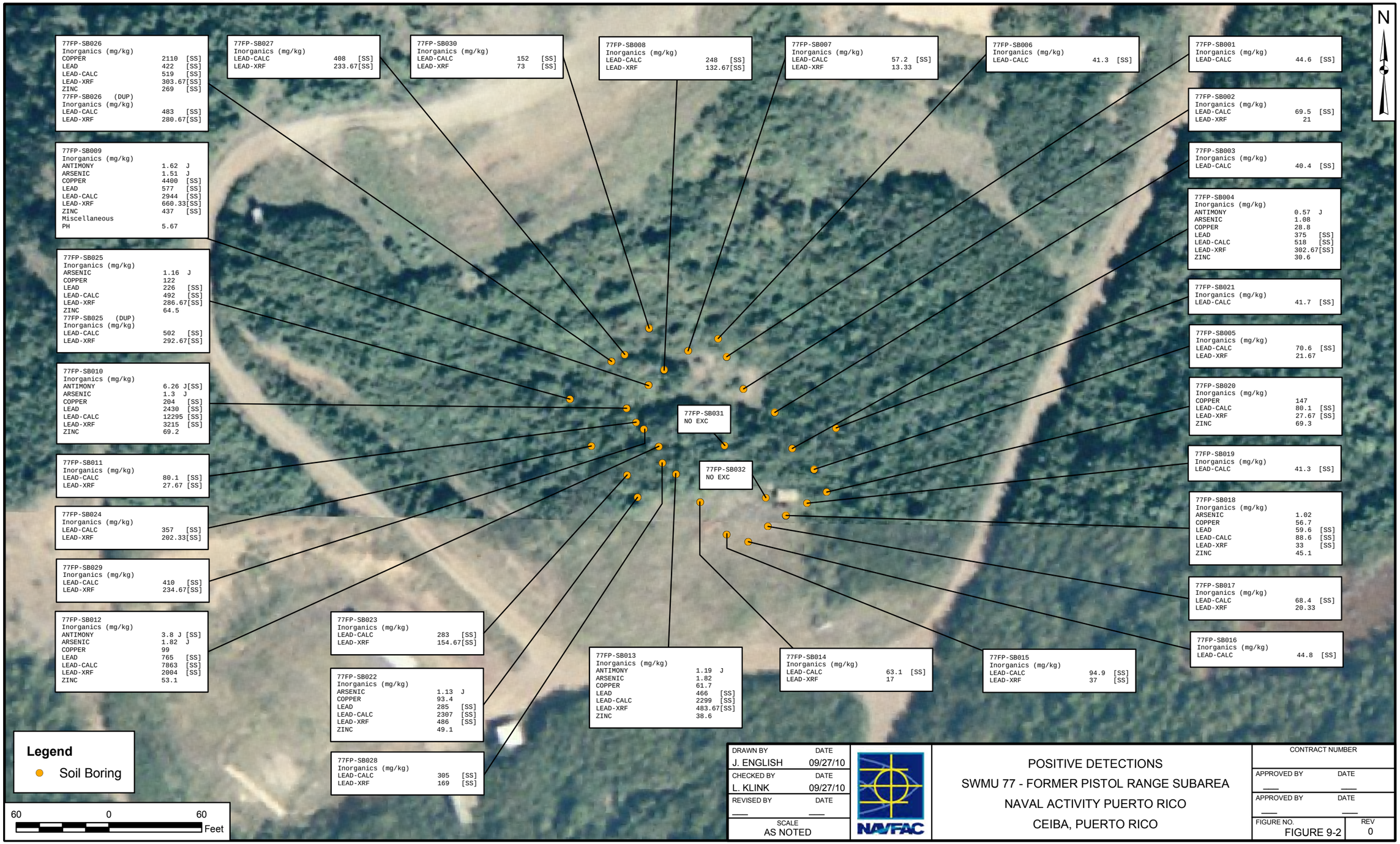
DRAWN BY	DATE
J. ENGLISH	09/27/10
CHECKED BY	DATE
L. KLINK	09/27/10
REVISED BY	DATE
___	___
SCALE	
AS NOTED	

NAVFAC

POSITIVE DETECTIONS
SWMU 77 - PISTOL RANGE SUBAREA
NAVAL ACTIVITY PUERTO RICO
CEIBA, PUERTO RICO

CONTRACT NUMBER	
APPROVED BY	DATE
___	___
APPROVED BY	DATE
___	___
FIGURE NO. FIGURE 8-2	REV 0

P:\GIS\NA_PUERTORICO\MAPDOCS\MXD\FORMER_PISTOL_RANGE_SB_TAG_REV.MXD 09/27/10 JEE



DRAWN BY	DATE
J. ENGLISH	09/27/10
CHECKED BY	DATE
L. KLINK	09/27/10
REVISED BY	DATE
SCALE	
AS NOTED	

NAVFAC

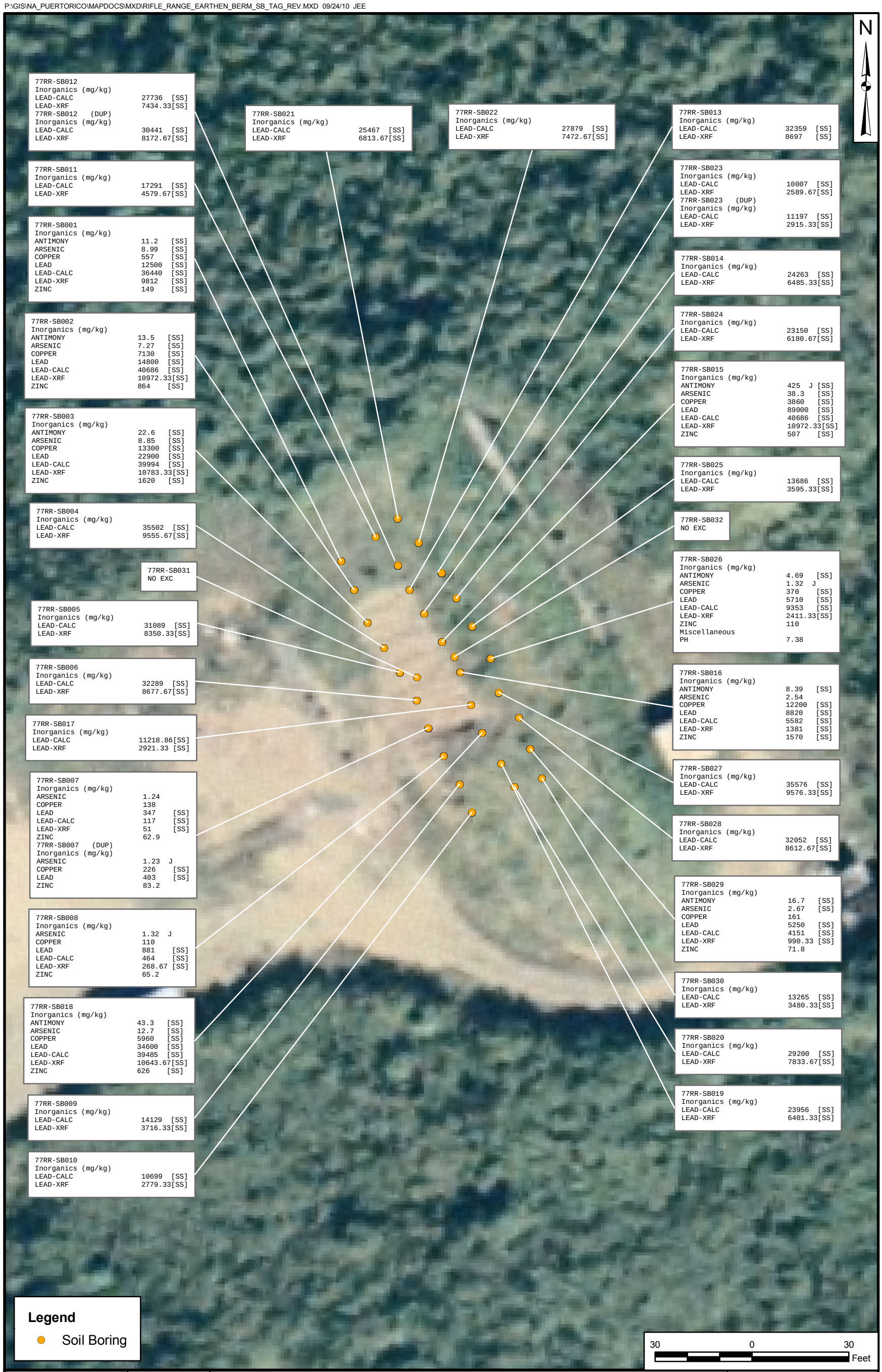
POSITIVE DETECTIONS
SWMU 77 - FORMER PISTOL RANGE SUBAREA
NAVAL ACTIVITY PUERTO RICO
CEIBA, PUERTO RICO

CONTRACT NUMBER	
APPROVED BY	DATE
APPROVED BY	DATE
FIGURE NO. FIGURE 9-2	REV 0

P:\GIS\NA_PUERTORICO\MAPDOCS\MXD\DETONATION_AREA_SB_TAG.MXD 09/28/10 JEE

DRAWN BY J. ENGLISH	DATE 08/18/10	POSITIVE DETECTIONS	CONTRACT NUMBER —
CHECKED BY L. KLINK	DATE 09/28/10	SWMU 77 - DETONATION AREA NEAR CONCRETE PAD SUBAREA	APPROVED BY — / DATE —
REVISED BY —	DATE —	NAVAL ACTIVITY PUERTO RICO	APPROVED BY — / DATE —
SCALE AS NOTED	NAVFAC	CEIBA, PUERTO RICO	FIGURE NO. FIGURE 7-3 / REV 0

P:\GIS\NA_PUERTORICO\MAPDOCS\MXD\RIFLE_RANGE_EARTHEN_BERM_SB_TAG_REV.MXD 09/24/10 JEE

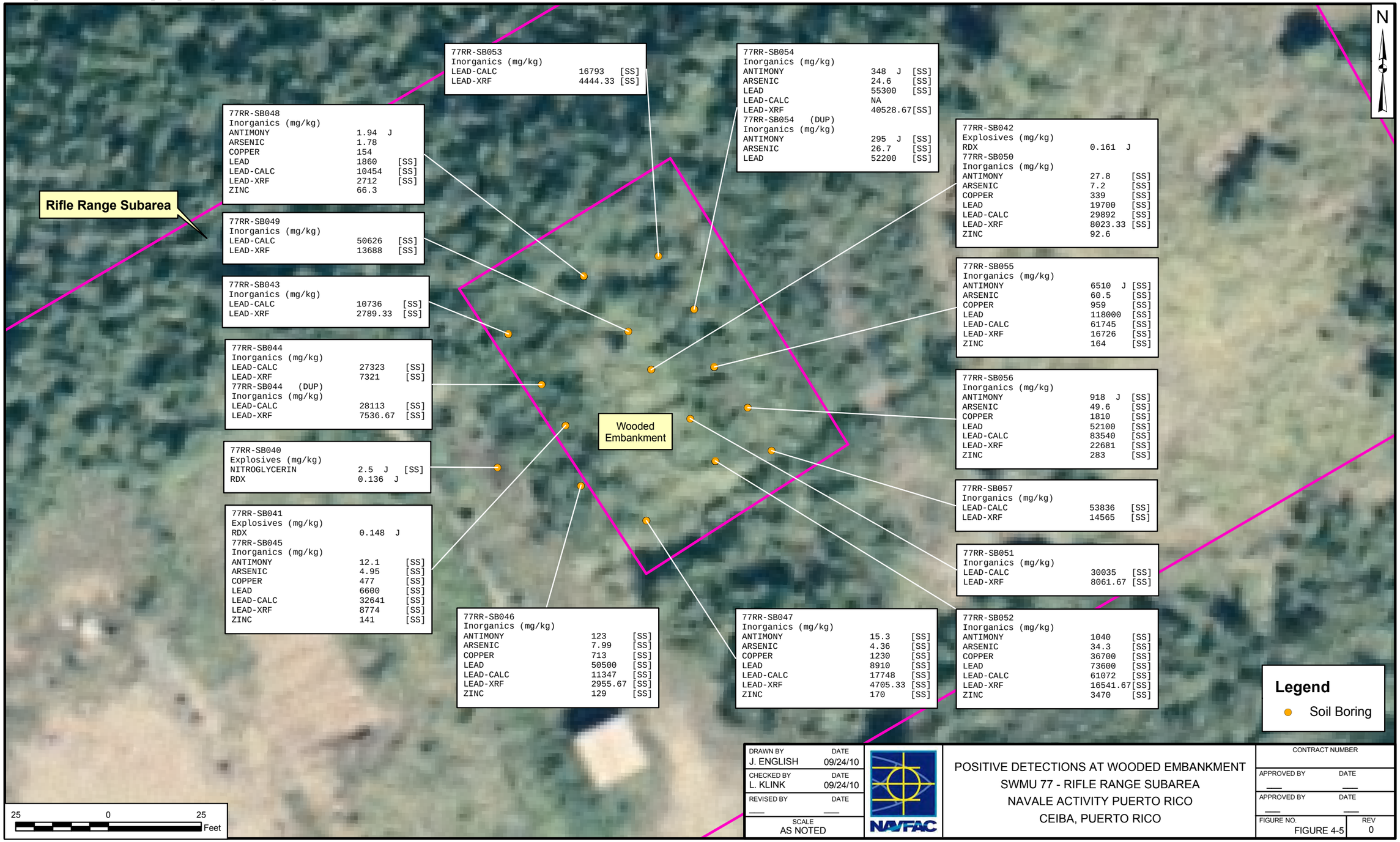


DRAWN BY	DATE		CONTRACT NUMBER
J. ENGLISH	09/24/10		___
CHECKED BY	DATE		APPROVED BY / DATE
L. KLINK	09/24/10		___ / ___
REVISED BY	DATE		APPROVED BY / DATE
___	___		___ / ___
SCALE			FIGURE NO. / REV
AS NOTED			FIGURE 4-4 / 0

NAVFAC

POSITIVE DETECTIONS
RIFLE RANGE AT EARTHERN BERM
NAVAL ACTIVITY PUERTO RICO
CEIBA, PUERTO RICO

P:\GIS\NA_PUERTORICO\MAPDOCS\MXD\RIFLE_RANGE_WOODED_EMBANKMENT_SB_TAGS.MXD 09/24/10 JEE



DRAWN BY	DATE
J. ENGLISH	09/24/10
CHECKED BY	DATE
L. KLINK	09/24/10
REVISED BY	DATE
—	—
SCALE	
AS NOTED	

NAVFAC

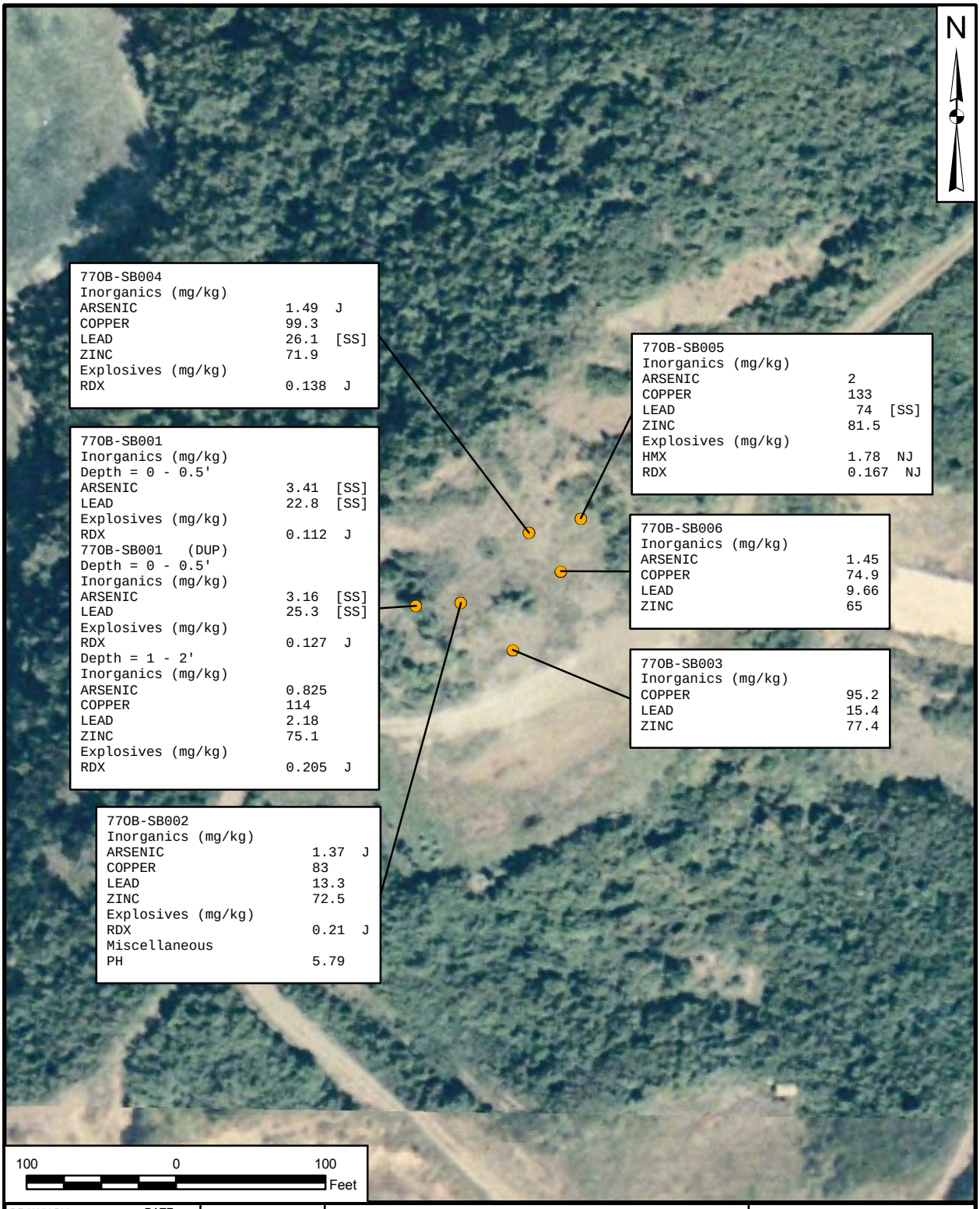
POSITIVE DETECTIONS AT WOODED EMBANKMENT
SWMU 77 - RIFLE RANGE SUBAREA
NAVALE ACTIVITY PUERTO RICO
CEIBA, PUERTO RICO

CONTRACT NUMBER	
APPROVED BY	DATE
—	—
APPROVED BY	DATE
—	—
FIGURE NO.	REV
FIGURE 4-5	0

P:\GIS\NA_PUERTORICO\MAPDOCS\MXD\RIFLE_RANGE_FIRINNG_LINES_SB_TAGS.MXD 09/24/10 JEE

DRAWN BY J. ENGLISH	DATE 09/24/10	POSITIVE DETECTIONS AT FIRING LINES SWMU 77 - RIFLE RANGE SUBAREA NAVALE ACTIVITY PUERTO RICO CEIBA, PUERTO RICO	CONTRACT NUMBER
CHECKED BY L. KLINK	DATE 09/24/10		APPROVED BY ___ DATE ___
REVISED BY ___	DATE ___		APPROVED BY ___ DATE ___
SCALE AS NOTED			FIGURE NO. FIGURE 4-6 / REV 0

P:\GIS\NA_PUERTORICO\MAPDOCS\MXD\POT_OBOD_SB_TAG.MXD 09/25/10 JEE



DRAWN BY J. ENGLISH	DATE 08/18/10	POSITIVE DETECTIONS POTENTIAL OB/OD SUBAREA NAVAL ACTIVITY PUERTO RICO CEIBA, PUERTO RICO	CONTRACT NUMBER ___
CHECKED BY L. KLINK	DATE 09/25/10		APPROVED BY ___ DATE ___
REVISED BY ___	DATE ___		APPROVED BY ___ DATE ___
SCALE AS NOTED			FIGURE NO. FIGURE 5-7 REV 0

TABLE 4-1

ITEMS DISCOVERED DURING DETECTOR-AIDED SURFACE SURVEYS
SWMU 77 – RIFLE RANGE SUBAREA
NAVAL ACTIVITY PUERTO RICO
CEIBA, PUERTO RICO

ID #	Item	Date Identified	GPS Location* US Survey Feet		Physical Condition/ Appearance	Classification	Resolution(1)
			Northing (feet)	Easting (feet)			
1	40MM CS M651 Grenade	5/15/10	811843.99	943050.54	Fired/Closed/ Intact	MEC	Mayport EOD consolidated and detonated on site on August 19, 2010 at location of ID #1
2	37MM CS Grenade	5/16/10	811755.45	943082.85	Corroded/ Fired/Spent	MDAS	Left in Place
3	40MM CS Grenade	5/16/10	811855.38	943037.81	Fired/Spent/Open	MPPEH	Left in Place
4	40MM M781 Practice Grenade	5/16/10	811809.37	943003.03	Fired/Spent/Open	MDAS	Left in Place
5	40MM M781 Practice Grenade	5/16/10	811790.51	943014.27	Fired/Spent/Open	MDAS	Left in Place
6	40MM CS Grenade	5/20/2010	811857.45	943038.13	Fired/Spent/Open	MDAS	Left in Place
7	40MM CS Grenade	5/20/2010	811826.05	9429889.91	Fired/Not Known if Spent/Closed	MPPEH	Mayport EOD consolidated and detonated on site on August 19, 2010 at location of ID #1
8	Han-Ball CS 1902 Grenade	5/20/2010	811763.44	943022.15	Fired/Spent	MDAS	Left in Place

MEC =Munitions and Explosives of Concern.
MPPEH = Material Potentially Presenting an Explosive Hazard. Hazard could not be determined through visual inspection while practicing anomaly avoidance.
MDAS = Material Documented as Safe.

* GPS data were collected using the North American Datum of 1983, Puerto Rico Plane (US Survey Feet).

See Figure 4-1 for item locations.

(1) On August 19, 2010, Mayport EOD detonated munitions items including three CS grenades believed to include ID #1 and #7, as well as an unknown CS grenade not observed during the Phase I RFI.

B-4 SITE WALK AND PHASE I RFI PHOTOGRAPHIC LOGS

Appendix B-3 –500-yard Rifle Range Subarea

Photograph 1 Rifle Range Subarea up range view to the southwest 500-yard firing line in the background, unpaved road between the Rifle Range and the Potential OB/OD Subarea in the foreground. (August, 2009)

Photograph 2 Rifle Range Subarea view down range form the 300-yard firing line, to the northeast, 200-yard firing line beyond trucks, 100-yard firing line not visible, constructed earthen berm/bullet stop and wooded natural embankment/bullet stop in the background. (June, **2009)**

Photograph 3 Rifle Range Subarea up range view, from the 200-yard firing line to the southwest 300-yard firing line beyond the truck, 500-yard firing line in the background. (June, 2009)

Photograph 4 Rifle Range Subarea view to the north, typical firing line showing nine shooting stations (vertical white posts). (June, 2009)

Photograph 5 Rifle Range Subarea view down range, to the northeast from the 200-yard firing line, 100-yard firing line and constructed earthen berm/bullet stop and wooded natural embankment/bullet stop in the background. (June, 2009)

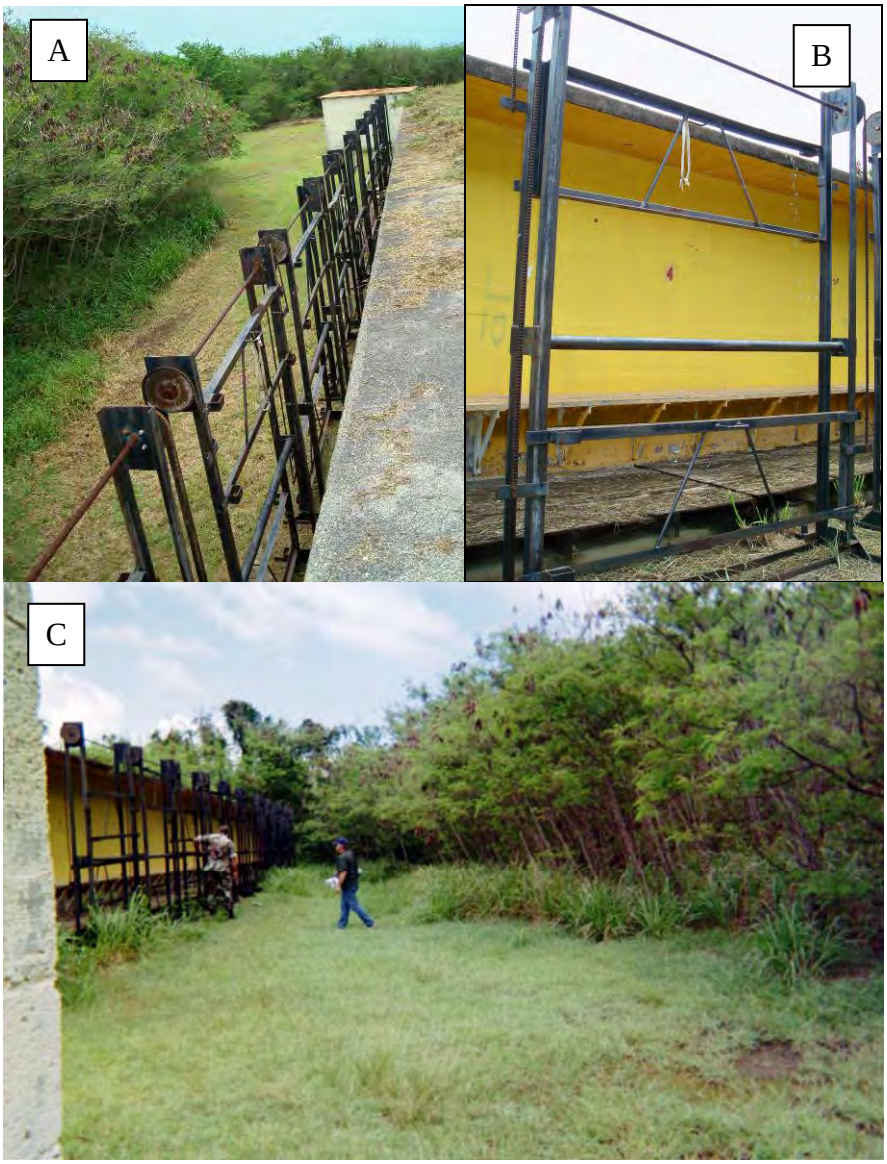
Photograph 6 Rifle Range Subarea view of the 100-yard firing range looking down the firing line. Vertical posts are firing stations. (August, 2009)

Photograph 7 Rifle Range Subarea, view down range from the 100-yard firing line. Note the shooting stations in the foreground (vertical posts). Short-Yardage Range, constructed earthen berm/bullet stop, and wooded natural embankment/bullet stop in the background. The range viewing area is to the right of the white truck. (June, 2009)

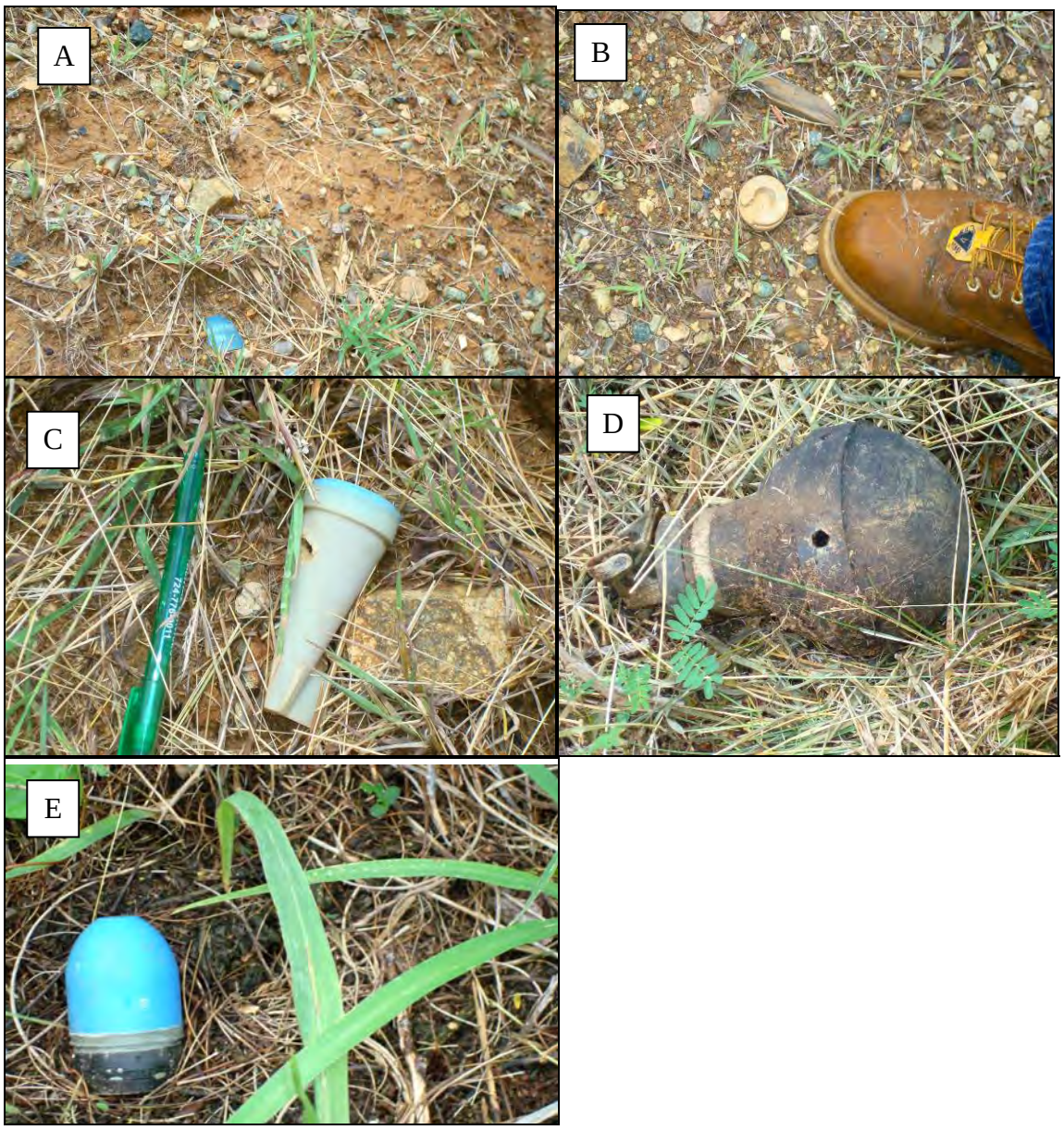
Photograph 8 Rifle Range Subarea, view down range from the 100-yard firing line, viewing area to the right and Short-Yardage Range, constructed earthen berm/bullet stop, and wooded natural embankment/bullet stop in the background. Note constructed earthen berm extends to the south beyond the Short-yardage Range to protect the target storage building behind (not visible). (August, 2009)

Photograph 9 Short-Yardage Range view down range, to the northeast. Note the 25-yard, 15-yard, and 7-yard firing line markers along the right/south edge of the Short-Yardage Range target markers far end of range, and the constructed earthen berm/bullet stop and wooded natural embankment/bullet stop in the background. (August, 2009)

Photograph 10 Short-Yardage Range, view to the south-southwest, note the viewing area in the background. (June, 2009)



Photograph 11 Rifle Range Subarea Target Carrier Mechanism.
A View looking down from the top of the constructed earthen berm/bullet stop. Note concrete wall at the back of the berm. (June, 2009)
B View looking at the target carrier lift mechanism from the rear of the constructed earthen berm. (June, 2009)
C View looking down the cleared path between the constructed earthen berm/bullet stop, target carrier lift mechanism and the wooded natural embankment/bullet stop. (August, 2009)



Photograph 12 Rifle Range Subarea various MEC/MPPEH items and fragments found in the vicinity of the constructed earthen berm and the wooded natural embankment. (June, 2009)
A M781 40 mm practice grenade fragments (blue in foreground) on earthen berm/bullet stop.
B A piece of munitions debris from a 40mm rifle grenade
C Unknown fin on earthen berm/bullet stop
D Smoke grenade at fringe of woods
E M781 40mm practice grenade, intact, at fringe of woods.

Appendix B-3 – Potential OB/OD Subarea

Photograph 13 Potential OB/OD Subarea Beyond two men on unpaved road clear area surrounded by trees. (June, 2009)

Photograph 14 Potential OB/OD Subarea view looking north from the southeast, note the slight surface depression in the left center of the picture. Note: there had been rain throughout the day prior to the photograph the surface depression appears to be a puddle evident only after a rain event. (June, 2009)

Photograph 15 Potential OB/OD Subarea view looking north from the unpaved road, note the slight surface depression on the right side of the picture. Note: there had been rain throughout the day prior to the photograph and the surface depression appears to be a puddle evident only after a rain event. (June, 2009)

Photograph 16 Potential OB/OD Subarea, unpaved road in foreground. Note the steep wooded embankment north of the subarea. (June, 2009)

Photograph 17 Potential OB/OD Subarea with steep wooded embankment north of the subarea beyond Commander Kalal. (August, 2009)

Photograph 18 Potential OB/OD Subarea various bullet cartridges found on the wooded slope beyond (northeast) of the subarea. (June, 2009)

Appendix B-3 – Potential Munitions Trench Subarea

Photograph 19 Potential Munitions Trench Subarea looking south at a man standing on a trench footprint. Note high grass on trench and overgrown brush/trees on terraces between trenches. (August, 2009)

Appendix B-3 – Detonation Area Near Concrete Pad Subarea

Photograph 20 Detonation Area Near Concrete Pad Subarea slight surface impression believed to be the detonation pit. Note puddle of water in center of depression after rain event. (August, 2009)

Photograph 21 Detonation Area Near Concrete Pad Subarea looking northwest concrete pad in the foreground, detonation pit beyond trucks (not visible). Note steep embankment between the concrete pad and the unpaved road to the north. (August, 2009)

Photograph 22 Detonation Area Near Concrete Pad Subarea close up of the concrete pad. View looking southeast. Note circular holes in the concrete made from PVC pipe inserted and cut flush with the top of the pad. The function of the pad and PVC is unknown. (August, 2009)

Photograph 23 Detonation Area Near Concrete Pad Subarea typical metal debris observed around the detonation pit and concrete pad. (August, 2009)

Appendix B-3 - Pistol Range Subarea

Photograph 24 Pistol Range Subarea looking south across the range towards the target berm area. The range entrance, storage building, and viewing area are out of frame to the left. Note two firing ranges (left used exclusively from 2004 to present). (August, 2009)

Photograph 25 Pistol Range Subarea storage building (left), range firing lines (center) and berm area/bullet stop (right). The view is looking to the south. (August, 2009)

Photograph 26 Pistol Range Subarea firing lines and berm area/bullet Stop. Note second set of firing lines to the right. The view is from the entrance to the Pistol Range Subarea. (August, 2009)

Photograph 27 Pistol Range Subarea earthen berm/bullet stop. Note small target markers at the base of the hill. (August, 2009)

Photograph 28 Pistol Range Subarea target markers and earthen berm/bullet stop. (June, 2009)

Photograph 29 Pistol Range Subarea looking to the southwest with the target storage building on the left and viewing area on the right. (June, 2009)

Photograph 30 Pistol Range Subarea viewing area benches, cover, and range rules. The view is looking to the northeast. (June, 2009)

Appendix B-3 – Former Pistol Range Subarea

Photograph 31 Former Pistol Range Subarea begins at tree line and extends north into the trees. The cleared area in the foreground was not part of the Former Pistol Range. (August, 2009)

Photograph 32 Former Pistol Range is overgrown obscuring the range layout. The view is to the north. (August, 2009)

Photograph #-1: Instrument Verification Strip, Industry Standard Object Small

Photograph #-2: Instrument Verification Strip, Industry Standard Object Medium

Photograph #-3: Instrument Verification Strip, Industry Standard Object Large

Photograph #-4: Rifle Range Subarea (eastern berm) UXO Technicians conducting analog detector-aided surface survey

Photograph #-5: Rifle Range Subarea (wooded embankment) UXO Technicians conducting analog detector-aided surface survey in thick woods with limited brush clearance

Photograph #-6: : Rifle Range Subarea (wooded embankment) 40mm CS M651 Grenade fired/spent on surface, top view (Phase 1 RFI Report Table 4-1 Item 1)

Photograph #-7: Rifle Range Subarea (wooded embankment) 40mm CS M651 Grenade fired/spent on surface, front view (Phase 1 RFI Report Table 4-1 Item 1)

Photograph #-8: Rifle Range Subarea (wooded embankment) 37mm CS Grenade fired/spent on surface (Phase 1 RFI Report Table 4-1 Item 2)

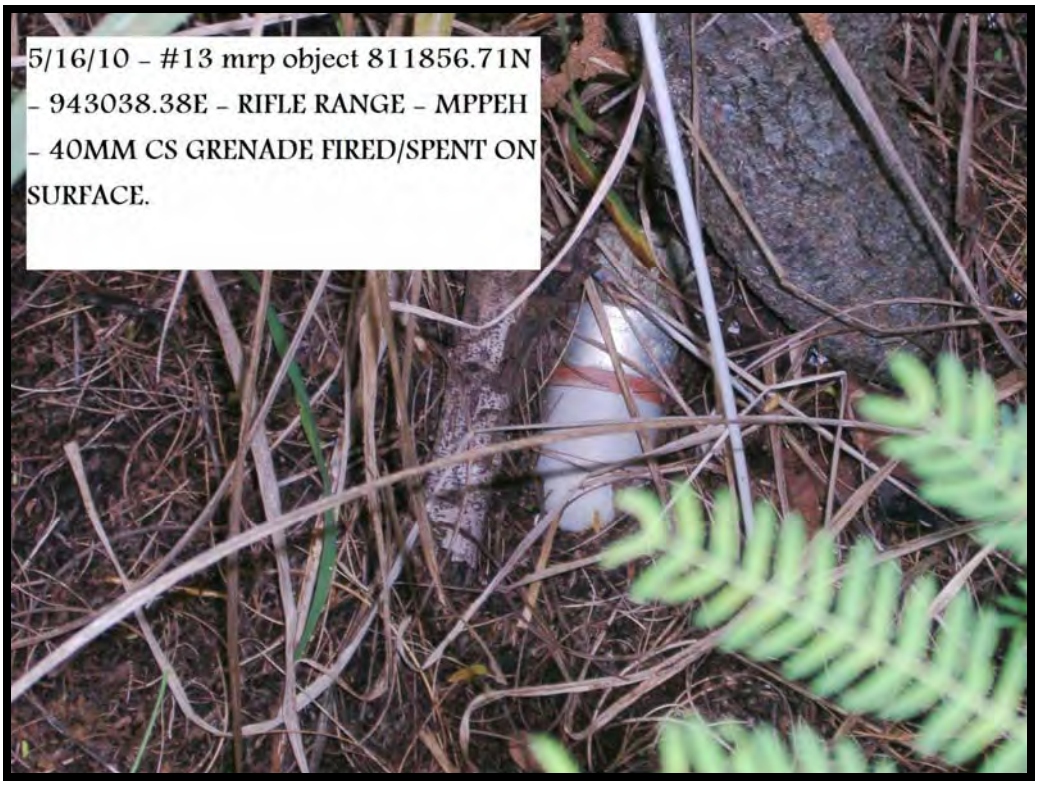
Photograph #-9: Rifle Range Subarea (wooded embankment) 40mm M781 Practice Grenade fired/spent on surface (Phase 1 RFI Report Table 4-1 Item 4)

Photograph #-10: Rifle Range Subarea (wooded embankment) 40mm M781 Practice Grenade fired/spent on surface (Phase 1 RFI Report Table 4-1 Item 5)

Photograph #-11: Rifle Range (wooded embankment) 40mm CS Grenade fired/spent on surface (Phase 1 RFI Report Table 4-1 Item 6)

Photograph #-12: Rifle Range Subarea (wooded embankment) 40mm CS Grenade fired, not known if spent, in good condition but half buried (Phase 1 RFI Report Table 4-1 Item 7)

Photograph #-13: Rifle Range Subarea (wooded embankment) Han-Ball CS 1902 Grenade fired/spent on surface (Phase 1 RFI Report Table 4-1 Item 8)



Photograph #-14: Rifle Range Subarea (wooded embankment) 40mm CS Grenade, fired/spent on surface (Phase 1 RFI Report Table 4-1 Item 3)

Photograph #-15: Rifle Range Subarea (wooded embankment) photograph by Mayport EOD of munitions items consolidated for detonation including three 40mm CS Grenades, 08/19/2010

Photograph #-1: Pistol Range Subarea: Overall view of range and berm with viewing area in the foreground.

Photograph #-2: Pistol Range Subarea: Overall view from berm.

Photograph #3: Pistol Range Subarea: Overall view from berm.

Photograph #-4: Pistol Range Subarea: Sampling on northern side of berm.

Photograph #-5: Pistol Range Subarea: Area above Pistol Range Subarea, old flag pole.

Photograph #-6: Pistol Range Subarea: Debris area above Pistol Range Subarea near old flag pole.

Photograph #-7: Pistol Range Subarea: Area above Pistol Range Subarea near old flag pole, old viewing stand debris.

Photograph #-8: Pistol Range Subarea: Area above Pistol Range Subarea near old flag pole, target, and target stand debris.

Photograph #-1: Former Pistol Range Subarea: Thickly wooded area of site in background; existing storage box in foreground, equipment, decon supplies in near foreground.

Photograph #-2: Former Pistol Range Subarea: Two cartridge cases.

Photograph #-1: Detonation Area Near Concrete Pad Subarea: Concrete pad feature.

Photograph #-2: Detonation Area Near Concrete Pad Subarea: Concrete pad feature and surrounding area to north, detonation depression located off of northeast corner of concrete pad.

Photograph #-3: Detonation Area Near Concrete Pad Subarea: Low lying topography sampling location.

Photograph #-1: Rifle Range Subarea: View of range in far background from 500-yard firing line.

Photograph #-2: Rifle Range Subarea: Viewing area to right, earthen constructed berm in center, wooded embankment in background.

Photograph #3: Rifle Range Subarea: Rear of target carrier and toe of wooded embankment.

Photograph #-4: Rifle Range Subarea: Wooded embankment, thick woods.

Photograph #-5: Rifle Range Subarea: Hand augering, boring on earthen berm.

Photograph #-6: Rifle Range Subarea: Short-yardage range and earthen berm.

Photograph #-7: Rifle Range Subarea: 200 yard firing line.

Photograph #-8: Rifle Range Subarea: 200 yard firing line.

Photograph #-9: Rifle Range Subarea: 300 yard firing line.

Photograph #-10: Rifle Range Subarea: 300 yard firing line.

Photograph #-11: Rifle Range Subarea: View of range from lower road.

Photograph #-12: Rifle Range Subarea: 500 yard firing line.

Photograph #-13: Rifle Range Subarea: 500 yard firing line.

Photograph #-1: OB/OD Subarea: UXO Escort clearance of soil boring location.

Photograph #-2: OB/OD Subarea: View from road; flat grassy area in foreground and wooded steep area in background.

Photograph #-3: OB/OD Subarea: Typical silty loamy soil with gravel soil boring location.

B-5 SOIL BACKGROUND CONCENTRATIONS

Revised Final II

Summary Report for Environmental Background Concentrations of Inorganic Compounds
Naval Activity Puerto Rico
RCRA/HSWA Permit No. PR2170027203
Ceiba, Puerto Rico

Prepared for

Department of the Navy
Naval Facilities Engineering Command
Atlantic Division

Norfolk, Virginia

Contract No. N62470-02-D-3052
CTO-0121

July 30, 2010

Prepared by

Baker
Environmental, Inc.

CH2M HILL
Federal Group, Inc.

CDM
Federal Programs Corp.

TABLE 2-4

Revised: February 29, 2008

DESCRIPTIVE STATISTICS - SURFACE SOIL BACKGROUND
SUMMARY REPORT FOR ENVIRONMENTAL BACKGROUND CONCENTRATIONS
CTO-0121
NAVAL ACTIVITY PUERTO RICO, CEIBA, PR

			W-Test Results			Arithmetic	Standard	Coefficient	Upper Limit	Outlier
	FOD	n	Normal Dist	Lognormal Dist	Assumed Dist	Mean (x)	Deviation (s)	of Variation (CV)	of Means (x + 2s)	Removed?
Metals (mg/kg)										
Antimony	C	2	--	--	--	2.60	0.28	0.109	3.17	
Arsenic	D	21	YES	YES	NORMAL	1.16	0.75	0.645	2.65	
Barium	D	20	YES	YES	NORMAL	95	52	0.547	199	Yes
Beryllium	D	19	YES	NO	NORMAL	0.287	0.152	0.528	0.590	Yes
Cadmium	C	7	--	--	--	0.397	0.311	0.782	1.02	
Chromium	D	21	YES	NO	NORMAL	24.9	12.4	0.499	49.8	
Cobalt	D	19	NO	YES	LOGNORMAL	22.8	11.7	0.512	46.2	Yes
Copper	D	19	YES	YES	NORMAL	77.2	45.4	0.589	168	Yes
Lead	D	19	NO	NO	NORMAL	8.4	6.8	0.81	22.0	Yes
Mercury	D	21	YES	NO	NORMAL	0.0509	0.0290	0.570	0.109	
Nickel	D	20	NO	YES	LOGNORMAL	10.3	5.22	0.508	20.7	
Selenium	C	5	--	--	--	0.760	0.36	0.474	1.48	
Thallium	B	20	--	--	--	--	--	--	--	
Tin	D	20	YES	NO	NORMAL	1.66	1.05	0.631	3.76	
Vanadium	D	18	YES	YES	NORMAL	142	58.8	0.415	259	
Zinc	D	19	YES	YES	NORMAL	51.6	31.6	0.613	115	Yes
Conventionals (mg/kg)										
Cyanide	B	20	--	--	--	--	--	--	--	
Sulfide	C	4	--	--	--	35.4	--	--	--	

TABLE 3-4

Revised: September 15, 2006

DESCRIPTIVE STATISTICS - SUBSURFACE SOIL BACKGROUND, CLAY
SUMMARY REPORT FOR ENVIRONMENTAL BACKGROUND CONCENTRATIONS
CTO-0121
NAVAL ACTIVITY PUERTO RICO, CEIBA, PR

			W-Test Results									
	FOD	n	Normal Dist	Lognormal Dist	Assumed Dist	Arithmetic Mean (x)	Standard Deviation (s)	Lognormal Arithmetic Mean (x)	Lognormal Standard Deviation (s)	Coefficient of Variation (CV)	Upper Limit of Means (x + 2s)	Outlier Removed?
Metals (mg/kg)												
Antimony	B	9	--	--	--	--	--	--	--	--	--	
Arsenic	D	19	NO	YES	LOGNORMAL	0.73	0.43	--	--	0.585	1.59	Yes
Barium	D	20	NO	YES	LOGNORMAL	67	76	--	--	1.146	220	
Beryllium	D	18	YES	YES	NORMAL	0.259	0.169	--	--	0.651	0.596	Yes
Cadmium	C	20	YES	NO	NORMAL	0.240	0.149	--	--	0.622	0.54	
Chromium	D	18	NO	YES	LOGNORMAL	37.3	38.6	--	--	1.034	114.5	
Cobalt	D	18	NO	YES	LOGNORMAL	9.1	8.9	--	--	0.976	26.9	Yes
Copper	D	17	YES	YES	NORMAL	105.0	70.5	--	--	0.672	246	
Lead	D	19	YES	NO	NORMAL	3.1	1.6	--	--	0.52	6.3	
Mercury	C	20	NO	NO	NORMAL	0.0308	0.0386	--	--	1.253	0.108	
Nickel	D	18	NO	YES	LOGNORMAL	7.9	8.39	--	--	1.063	24.7	Yes
Selenium	C	20	NO	YES	LOGNORMAL	--	--	0.51	2.72	5.377	5.94	
Silver	B	20	--	--	--	--	--	--	--	--	--	
Thallium	C	19	NO	NO	NORMAL	0.30	0.31	--	--	1.036	0.92	
Tin	D	19	YES	NO	NORMAL	2	0.9	--	--	0.475	4	
Vanadium	D	19	YES	YES	NORMAL	208.6	112.7	--	--	0.541	434	
Zinc	D	19	YES	YES	NORMAL	37.4	25.4	--	--	0.679	88	
Conventionals (mg/kg)												
Sulfide	B	13	--	--	--	--	--	--	--	--	--	

TABLE 3-7

Revised: September 15, 2006

DESCRIPTIVE STATISTICS - SUBSURFACE SOIL BACKGROUND, FINE SAND/SILT
SUMMARY REPORT FOR ENVIRONMENTAL BACKGROUND CONCENTRATIONS
CTO-0121
NAVAL ACTIVITY PUERTO RICO, CEIBA, PR

	FOD	n	W-Test Results			Arithmetic Mean (x)	Standard Deviation (s)	Lognormal Arithmetic Mean (x)	Lognormal Standard Deviation (s)	Coefficient of Variation (CV)	Upper Limit of Means (x + 2s)	Outlier Removed?
			Normal Dist	Lognormal Dist	Assumed Dist							
Metals (mg/kg)												
Antimony	C	13	NO	YES	LOGNORMAL	--	--	1.28	3.08	2.407	7.44	
Arsenic	C	15	NO	YES	LOGNORMAL	--	--	0.62	3.02	4.846	6.66	
Barium	D	14	YES	YES	NORMAL	95	56	--	--	0.587	207	Yes
Beryllium	D	14	NO	NO	NORMAL	0.319	0.307	--	--	0.963	0.933	
Cadmium	C	15	YES	YES	NORMAL	0.234	0.170	--	--	0.727	0.57	
Chromium	D	15	YES	YES	NORMAL	21.6	13.1	--	--	0.607	47.9	
Cobalt	D	14	NO	YES	LOGNORMAL	24.9	19.1	--	--	0.768	63.1	
Copper	D	13	YES	YES	NORMAL	59.1	30.6	--	--	0.517	120	Yes
Lead	D	14	NO	YES	LOGNORMAL	2.1	2.0	--	--	0.94	6.2	Yes
Mercury	C	15	NO	NO	NORMAL	0.0210	0.0231	--	--	1.100	0.067	
Nickel	D	14	YES	NO	NORMAL	13.1	6.66	--	--	0.507	26.5	
Selenium	C	13	YES	YES	NORMAL	0.491	0.35	--	--	0.714	1.19	
Silver	B	15	--	--	--	--	--	--	--	--	--	
Tin	D	14	YES	NO	NORMAL	1.42	1.03	--	--	0.725	3.47	
Vanadium	D	14	YES	YES	NORMAL	126	65.2	--	--	0.519	256	
Zinc	D	12	NO	YES	LOGNORMAL	43.8	24.2	--	--	0.552	92	

TABLE 3-10

DESCRIPTIVE STATISTICS - SUBSURFACE SOIL BACKGROUND, WEATHERED BEDROCK
SUMMARY REPORT FOR ENVIRONMENTAL BACKGROUND CONCENTRATIONS
CTO-0121
NAVAL ACTIVITY PUERTO RICO, CEIBA, PR

			W-Test Results			Arithmetic	Standard	Coefficient	Upper Limit
	FOD	n	Normal Dist	Lognormal Dist	Assumed Dist	Mean (x)	Deviation (s)	of Variation (CV)	of Means (x + 2s)
Metals (mg/kg)									
Barium	D	3	YES	YES	Normal	65.33	38.73	0.593	142.80
Beryllium	D	3	YES	YES	Normal	0.22	0.12	0.524	0.45
Cadmium	B	3	--	--	--	--	--	--	--
Chromium	D	3	YES	YES	Normal	14.600	11.793	0.808	38.186
Cobalt	D	3	YES	YES	Normal	24.333	7.024	0.289	38.38
Copper	D	3	YES	YES	Normal	140.7	61.7	0.438	264.0
Lead	D	3	YES	YES	Normal	1.3	0.6	0.498	2.5
Nickel	D	3	YES	YES	Normal	14.3	3.2	0.224	21
Selenium	B	3	--	--	--	--	--	--	--
Tin	D	3	YES	YES	Normal	2.5333	1.0504	0.415	4.634
Vanadium	D	3	YES	YES	Normal	166.7	32.15	0.193	231.0
Zinc	D	3	YES	YES	Normal	64.000	24.76	0.387	113.52

B-6 CHEMICAL REFERENCE LIMITS AND EVALUATION TABLES

HUMAN HEALTH

Analyte	CAS Number	EPA Regional Sceening Levels Residential Soil (mg/kg) (1)	Adjusted EPA Regional Screening Level Residentional Soil (mg/kg) (2)	EPA Soil Screening Level, Migration to Groundwater DAF=1 (mg/kg) (1, 3)	Lowest Human Health Criterion	Lowest Human Health Criterion Reference
1,1,1-Trichloroethane	71-55-6	8700 N	870 N	2.6	2.6	RBSSL
1,1,1,2-Tetrachloroethane	630-20-6	1.9 C	1.9 C	0.00019	0.00019	RBSSL
1,1,2,2-Tetrachloroethane	79-34-5	0.56 C	0.56 C	0.000026	0.000026	RBSSL
1,1,2-Trichloroethane	79-00-5	1.6 N(4)	0.16 N(4)	0.000077	0.000077	RBSSL
1,1-Dichloroethane	75-34-3	3.3 C	3.3 C	0.00068	0.00068	RBSSL
1,1-Dichloroethene	75-35-4	240 N	24 N	0.093	0.093	RBSSL
1,2,3-Trichloropropane	96-18-4	0.005 C	0.005 C	0.00000028	0.00000028	RBSSL
1,2,4-Trichlorobenzene	120-82-1	62 N (4)	6.2 N (4)	0.0029	0.0029	RBSSL
1,2-Dibromo-3-chloropropane	96-12-8	0.0054 C	0.0054 C	0.00000014	0.00000014	RBSSL
1,2-Dibromethane	106-93-4	0.034 C	0.034 C	0.0000018	0.0000018	RBSSL
1,2-Dichlorobenzene	95-50-1	1900 N	190 N	0.27	0.27	RBSSL
1,2-Dichloroethane	107-06-2	0.43 C	0.43 C	0.000042	0.000042	RBSSL
1,2-Dichloropropane	78-87-5	0.94 C	0.94 C	0.00013	0.00013	RBSSL
1,3-Dichlorobenzene	541-73-1	2.4 C (5)	2.4 C (5)	0.0004 (5)	0.0004	RBSSL
1,4-Dichlorobenzene	106-46-7	2.4 C	2.4 C	0.0004	0.0004	RBSSL
2-Butanone	78-93-3	28000 N	2800 N	1	1	RBSSL
2-Hexanone	591-78-6	210 N	21 N	0.0079	0.0079	RBSSL
4-Methyl-2-pentanone	108-10-1	5300 N	530 N	0.23	0.23	RBSSL
Acetone	67-64-1	61000 N	6100 N	2.4	2.4	RBSSL
Acrylonitrile	107-13-1	0.24 C	0.24 C	0.0000098	0.0000098	RBSSL
Acrolein	107-02-8	0.15 N	0.015 N	0.0000084	0.0000084	RBSSL
Acetonitrile	75-05-8	870 N	87 N	0.026	0.026	RBSSL
Allyl Chloride	107-05-1	1.8 N	0.18 N	0.0002	0.0002	RBSSL
Benzene	71-43-2	1.1 C	1.1 C	0.0002	0.0002	RBSSL
Bromodichloromethane	75-27-4	0.27 C	0.27 C	0.000032	0.000032	RBSSL
Bromoform	75-25-2	62 C	62 C	0.0021	0.0021	RBSSL
Bromomethane	74-83-9	7.3 N	0.73 N	0.0018	0.0018	RBSSL
Carbon Disulfide	75-15-0	820 N	82 N	0.21	0.21	RBSSL
Carbon Tetrachloride	56-23-5	0.61 C	0.61 C	0.00015	0.00015	RBSSL
Chlorobenzene	108-90-7	290 N	29 N	0.049	0.049	RBSSL
Chloroethane	75-00-3	15000 N	1500 N	0.0021	0.0021	RBSSL
Chloroform	67-66-3	0.29 C	0.29 C	0.000053	0.000053	RBSSL
Chloromethane	74-87-3	120 N	12 N	0.049	0.049	RBSSL
Chloroprene	126-99-8	0.0094 C	0.0094 C	0.0000085	0.0000085	RBSSL
cis-1,3-Dichloropropene	542-75-6	1.7 C (6)	1.7 C (6)	0.00015 (6)	0.00015	RBSSL
Dibromomethane	74-95-3	25 N	2.5 N	0.0019	0.0019	RBSSL
Dibromochloromethane	124-48-1	0.68 C	0.68 C	0.000039	0.000039	RBSSL
Dichlorodifluoromethane	75-71-8	94 N	9.4 N	0.3	0.3	RBSSL
Ethylbenzene	100-41-4	5.4 C	5.4 C	0.0015	0.0015	RBSSL
Isobutyl alcohol	78-83-1	18000 N	1800 N	0.95	0.95	RBSSL
Methyl Iodide	74-88-4	NC	NC	NC	NC	NA

Analyte	CAS Number	EPA Regional Sceening Levels Residential Soil (mg/kg) (1)	Adjusted EPA Regional Screening Level Residentional Soil (mg/kg) (2)	EPA Soil Screening Level, Migration to Groundwater DAF=1 (mg/kg) (1, 3)	Lowest Human Health Criterion	Lowest Human Health Criterion Reference
Methacrylonitrile	126-98-7	3.2 N	0.32 N	0.00017	0.00017	RBSSL
Methylene Chloride	75-09-2	56 C	11 C	0.0025	0.0025	RBSSL
Propionitrile	107-12-0	NC	NC	NC	NC	NA
Styrene	100-42-5	6300 N	630 N	1.2	1.2	RBSSL
Tetrachloroethene	127-18-4	22 C	22 C	0.0044	0.0044	RBSSL
Toluene	108-88-3	5000 N	500 N	0.59	0.59	RBSSL
trans-1,2-Dichloroethene	156-60-5	150 N	15 N	0.025	0.025	RBSSL
trans-1,3-Dichloropropene	542-75-6	1.7 C (6)	1.7 C (6)	0.00015 (6)	0.00015	RBSSL
trans-1,4-Dichloro-2-butene	110-57-6	0.0069 C	0.0069 C	0.00000054	0.00000054	RBSSL
Trichloroethene	79-01-6	4.4 N(4)	0.44 N(4)	0.00016	0.00016	RBSSL
Trichlorofluoromethane	75-69-4	790 N	79 N	0.69	0.69	RBSSL
Vinyl Acetate	108-05-4	970 N	97 N	0.087	0.087	RBSSL
Vinyl Chloride	75-01-4	0.06 C	0.06 C	0.0000053	0.0000053	RBSSL
Xylenes (Total)	1330-20-7	630 N	63 N	0.19	0.19	RBSSL
Ethyl Methacrylate	97-63-2	1500 N	150 N	0.099	0.099	RBSSL
Methyl Methacrylate	80-62-6	4800 N	480 N	0.3	0.3	RBSSL
Methylene Bromide (dibromomethane)	74-95-3	25 N	2.5 N	0.0019	0.0019	RBSSL
Pentachloroethane	76-01-7	5.4 C	5.4 C	0.00027	0.00027	RBSSL

Notes:

1 - The residential direct contact (R-RSL) and risk-based migration to groundwater soil screening levels (RBSSL) from the USEPA Regional Screening Levels for Chemical Contaminants at Superfund Sites, May, 2012, available online at http://epa-prgs.ornl.gov/chemicals/index.shtml. The risk-based screening levels are based on a target hazard quotient (HQ) of 1 for noncarcinogens (denoted with a "N" flag) or an incremental lifetime cancer risk (ILCR) of 1E-6 for carcinogens (denoted with a "C" flag).

2 - The USEPA RSL (May, 2012) residential soil screening level for noncarcinogens adjusted by dividing by 10, equivalent to a HQ of 0.1. The residential soil screening level for carcinogens (not adjusted) is equivalent to an ILCR of 1E-6.

3 - A dilution attentuation factor of 1 has been applied to EPA soil screening levels, migration to groundwater values.

4 - One tenth the noncarcinogenic value is less than the carinogenic value; therefore, the noncarcinogenic value is presented.

5 - Value is for 1,4-dichlorobenzene.

6 - Value is for 1,3-dichloropropene.

Abbreviations:

NA - Not available or not applicable

NC - No criteria

N - Noncarcinogen

C - Carcinogen

DAF - Dilution Attenuation Factor

Analyte	CAS Number	EPA Regional Sceening Levels Residential Soil (mg/kg) (1)	Adjusted EPA Regional Screening Level Residentional Soil (mg/kg) (2)	EPA Soil Screening Level, Migration to Groundwater DAF=1 (mg/kg) (1,3)	Lowest Human Health Criterion	Lowest Human Health Criterion Reference
1,4-Naphthoquinone	130-15-4	NC	NC	NC	NC	NA
1,2,4,5-Tetrachlorobenzene	95-94-3	18 N	1.8 N	0.0058	0.0058	RBSSL
1,4-Dioxane	123-91-1	4.9 C	4.9 C	0.00014	0.00014	RBSSL
2,3,4,6-Tetrachlorophenol	58-90-2	1800 N	180 N	1.1	1.1	RBSSL
2,4,5-Trichlorophenol	95-95-4	6100 N	610 N	3.3	3.3	RBSSL
2,4,6-Trichlorophenol	88-06-2	61 N (4)	6.1 N (4)	0.013	0.013	RBSSL
2,4-Dichlorophenol	120-83-2	180 N	18 N	0.041	0.041	RBSSL
2,4-Dimethylphenol	105-67-9	1200 N	120 N	0.32	0.32	RBSSL
2,4-Dinitrophenol	51-28-5	120 N	12 N	0.034	0.034	RBSSL
2,4-Dinitrotoluene	121-14-2	1.6 C	1.6 C	0.00028	0.00028	RBSSL
2,6-Dinitrotoluene	606-20-2	61 N	6.1 N	0.02	0.02	RBSSL
2,6-Dichlorophenol	87-65-0	NC	NC	NC	NC	NA
2-Chloronapthalene	91-58-7	6300 N	630 N	2.9	2.9	RBSSL
2-Chlorophenol	95-57-8	390 N	39 N	0.057	0.057	RBSSL
2-Methylnaphthalene	91-57-6	230 N	23 N	0.14	0.14	RBSSL
2-Methylphenol	95-48-7	6100 N	610 N	1.1	1.1	RBSSL
2-Nitroaniline	88-74-4	610 N	61 N	0.062	0.062	RBSSL
2-Nitrophenol	88-75-5	NC	NC	NC	NC	NA
3,3'-Dichlorobenzidine	91-94-1	1.1 C	1.1 C	0.00071	0.00071	RBSSL
3-Nitroaniline	99-09-2	NC	NC	NC	NC	NA
4,6-Dinitro-2-methylphenol	534-52-1	4.9 N	0.49 N	0.002	0.002	RBSSL
4-Bromophenyl-phenylether	101-55-3	NC	NC	NC	NC	NA
4-Chloro-3-methylphenol	59-50-7	6100 N	610 N	1.3	1.3	RBSSL
4-Chloroaniline	106-47-8	2.4 C	2.4 C	0.00013	0.00013	RBSSL
4-Chlorophenyl-phenylether	7005-72-3	NC	NC	NC	NC	NA
4-Methylphenol	106-44-5	6100 N	610 N	1.1	1.1	RBSSL
4-Nitroaniline	100-01-6	24 C	24 C	0.0014	0.0014	RBSSL
4-Nitrophenol	100-02-7	NC	NC	NC	NC	NA
Acenaphthene	83-32-9	3400 N	340 N	4.1	4.1	RBSSL
Acenaphthylene	208-96-8	3400 N (5)	340 N (5)	4.1 (5)	4.1	RBSSL
Acetophenone	98-86-2	7800 N	780 N	0.45	0.45	RBSSL
Anthracene	120-12-7	17000 N	1700 N	20	20	RBSSL
Benzo(a)anthracene	56-55-3	0.15 C	0.15 C	0.01	0.01	RBSSL
Benzo(a)pyrene	50-32-8	0.015 C	0.015 C	0.0035	0.0035	RBSSL
Benzo(b)fluoranthene	205-99-2	0.15 C	0.15 C	0.035	0.035	RBSSL
Benzo(g,h,i)perylene	191-24-2	1700 N (6)	170 N (6)	9.5 (6)	9.5	RBSSL
Benzo(k)fluoranthene	207-08-9	1.5 C	1.5 C	0.35	0.35	RBSSL
bis(2-Chloroethoxy) methane	111-91-1	180 N	18 N	0.011	0.011	RBSSL
bis(2-Chloroethyl) ether	111-44-4	0.21 C	0.21 C	0.0000031	0.0000031	RBSSL
bis(2-Chloro-1-methylethyl)ether	108-60-1	4.6 C	4.6 C	0.00011	0.00011	RBSSL
bis-(2-Ethylhexyl)phthalate	117-81-7	35 C	35 C	0.017	0.017	RBSSL
Butylbenzylphthalate	85-68-7	260 C	260 C	0.2	0.2	RBSSL
Chrysene	218-01-9	15 C	15 C	1.1	1.1	RBSSL
Dibenzo(a,h)anthracene	53-70-3	0.015 C	0.015 C	0.011	0.011	RBSSL

Analyte	CAS Number	EPA Regional Sceening Levels Residential Soil (mg/kg) (1)	Adjusted EPA Regional Screening Level Residentional Soil (mg/kg) (2)	EPA Soil Screening Level, Migration to Groundwater DAF=1 (mg/kg) (1,3)	Lowest Human Health Criterion	Lowest Human Health Criterion Reference
Dibenzofuran	132-64-9	78 N	7.8 N	0.11	0.11	RBSSL
Diethylphthalate	84-66-2	49000 N	4900 N	4.7	4.7	RBSSL
Dimethylphthalate	131-11-3	NC	NC	NC	NC	NA
Dinoseb	88-85-7	61 N	6.1 N	0.098	0.098	RBSSL
Di-n-butylphthalate	84-74-2	6100 N	610 N	0.000039	0.000039	RBSSL
Di-n-octylphthalate	117-84-0	NC	NC	NC	NC	NA
Fluoranthene	206-44-0	2300 N	230 N	70	70	RBSSL
Fluorene	86-73-7	2300 N	230 N	0.14	0.14	RBSSL
Hexachlorobenzene	118-74-1	0.3 C	0.3 C	0.00053	0.00053	RBSSL
Hexachlorobutadiene	87-68-3	61 N (4)	6.1 N (4)	0.0005	0.0005	RBSSL
Hexachlorocyclopentadiene	77-47-4	370 N	37 N	0.07	0.07	RBSSL
Hexachloroethane	67-72-1	43 N (4)	4.3 N (4)	0.00048	0.00048	RBSSL
Hexachlorophene	70-30-4	18 N	1.8 N	6.3	1.8	R-RSL
Indeno(1,2,3-cd)pyrene	193-39-5	0.15 C	0.15 C	0.12	0.12	RBSSL
Isophorone	78-59-1	510 C	510 C	0.022	0.022	RBSSL
Naphthalene	91-20-3	3.6 C	3.6 C	0.00047	0.00047	RBSSL
Nitrobenzene	98-95-3	4.8 C	4.8 C	0.000079	0.000079	RBSSL
N-Nitroso-di-n-propylamine	621-64-7	0.069 C	0.069 C	0.000007	0.000007	RBSSL
N-Nitrosodiphenylamine	86-30-6	99 C	99 C	0.057	0.057	RBSSL
Pentachlorophenol	87-86-5	0.89 C	0.89 C	0.0017	0.0017	RBSSL
Phenanthrene	85-01-8	1700 N (6)	170 N (6)	9.5 (6)	9.5	RBSSL
Phenol	108-95-2	18000 N	1800 N	2.6	2.6	RBSSL
Pyrene	129-00-0	1700 N	170 N	9.5	9.5	RBSSL
Pyridine	110-86-1	78 N	7.8 N	0.0053	0.0053	RBSSL
Safrole	94-59-7	0.52 C	0.52 C	0.000038	0.000038	RBSSL
o-Toluidine	95-53-4	NC	NC	NC	NC	NA
O,O,O-Triethylphosphorothioate	126-68-1	NC	NC	NC	NC	NA
1,3,5-trinitrobenzene	99-35-4	2200 N	220 N	1.7	1.7	RBSSL
1,3 Dinitrobenzene	99-65-0	6.1 N	0.61 N	0.0014	0.0014	RBSSL
1-Naphthylamine	134-32-7	NC	NC	NC	NC	NA
2-Acetylaminofluorene	53-96-3	0.13 C	0.13 C	0.000065	0.000065	RBSSL
2-Naphthylamine	91-59-8	0.27 C	0.27 C	0.00017	0.00017	RBSSL
2-Picoline	109-06-8	NC	NC	NC	NC	NA
3-methylphenol	108-39-4	6100 N	610 N	1.1	1.1	RBSSL
3,3'-dimethylbenzidine	119-93-7	0.044 C	0.044 C	0.000037	0.000037	RBSSL
3-Methylcholanthrene	56-49-5	0.0052 C	0.0052 C	0.0019	0.0019	RBSSL
4-Aminobiphenyl	92-67-1	0.023 C	0.023 C	0.000013	0.000013	RBSSL
4-Nitroquinoline-1-Oxide	56-575	NC	NC	NC	NC	NA
5-Nitro-O-Toluidine	99-55-8	54 C	54 C	0.0039	0.0039	RBSSL
7,12-Dimethylbenz(a)Anthracene	57-97-6	0.00043 C	0.00043 C	0.000085	0.000085	RBSSL
a,a-Dimethylphenethylamine	122-09-8	NC	NC	NC	NC	NA
Aniline	62-53-3	430 N(4)	43 N(4)	0.0039	0.0039	RBSSL
Aramite	140-57-8	19 C	19 C	0.03	0.03	RBSSL
Benzyl Alcohol	100-51-6	6100N	610 N	0.37	0.37	RBSSL

Analyte	CAS Number	EPA Regional Sceening Levels Residential Soil (mg/kg) (1)	Adjusted EPA Regional Screening Level Residentional Soil (mg/kg) (2)	EPA Soil Screening Level, Migration to Groundwater DAF=1 (mg/kg) (1,3)	Lowest Human Health Criterion	Lowest Human Health Criterion Reference
Chlorobenzilate	510-15-6	4.4 C	4.4 C	0.00088	0.00088	RBSSL
Diallate	2303-16-4	8 C	8 C	0.00068	0.00068	RBSSL
Diphenylamine	122-39-4	1500 N	150 N	0.44	0.44	RBSSL
Ethyl Methanesulfonate	62-50-5	NC	NC	NC	NC	NA
Hexachloropropene	1888-71-7	NC	NC	NC	NC	NA
Isodrin	465-73-6	NC	NC	NC	NC	NA
Isosafrole	120-58-1	NC	NC	NC	NC	NA
Methapyrilene	91-80-5	NC	NC	NC	NC	NA
Methyl Methanesulfonate	66-27-3	4.9 C	4.9 C	0.00014	0.00014	RBSSL
N-Nitrosodiethylamine	55-18-5	0.00077 C	0.00077 C	5.00E-08	0.00000005	RBSSL
N-Nitrosodimethylamine	62-75-9	0.0023 C	0.0023 C	1.00E-07	0.0000001	RBSSL
N-Nitroso-Di-n-Butylamine	924-16-3	0.087 C	0.087 C	4.80E-06	0.0000048	RBSSL
N-Nitrosomethylethylamine	10595-95-6	0.022 C	0.022 C	8.70E-07	0.00000087	RBSSL
N-Nitrosomorpholine	59-89-2	0.073 C	0.073 C	2.50E-06	0.0000025	RBSSL
N-Nitrosopiperidine	100-75-4	0.052 C	0.052 C	7.60E-05	0.000076	RBSSL
N-Nitrosopyrrolidine	930-55-2	0.23 C	0.23 C	0.000012	0.000012	RBSSL
p-Dimethylaminoazobenzene	60-11-7	0.11 C	0.11 C	0.000018	0.000018	RBSSL
Pentachlorobenzene	608-93-5	49 N	4.9 N	0.017	0.017	RBSSL
Pentachloronitrobenzene	82-68-8	1.9 C	1.9 C	0.0013	0.0013	RBSSL
Phenacetin	62-44-2	220 C	220 C	0.0083	0.0083	RBSSL
p-Phenylenediamine	106-50-3	12000 N	1200 N	0.79	0.79	RBSSL
Pronamide	23950-58-5	4600 N	460 N	0.91	0.91	RBSSL

Notes:

1 - The residential direct contact (R-RSL) and risk-based migration to groundwater soil screening levels (RBSSL) from the USEPA Regional Screening Levels for Chemical Contaminants at Superfund Sites, May, 2012, available online at http://epa-prgs.ornl.gov/chemicals/index.shtml. The risk-based screening levels are based on a target hazard quotient (HQ) of 1 for noncarcinogens (denoted with a "N" flag) or an incremental lifetime cancer risk (ILCR) of 1E-6 for carcinogens (denoted with a "C" flag).

2 - The USEPA RSL (May, 2012) residential soil screening level for noncarcinogens adjusted by dividing by 10, equivalent to a HQ of 0.1. The residential soil screening level for carcinogens (not adjusted) is equivalent to an ILCR of 1E-6.

3 - A dilution attentuation factor of 1 has been applied to EPA soil screening levels, migration to groundwater values.

4 - One tenth the noncarcinogenic value is less than the carinogenic value; therefore, the noncarcinogenic value is presented.

5 - Value is for acenaphthene.

6 - Value is for pyrene.

Abbreviations:

NA - Not available or not applicable

NC - No criteria

N - Noncarcinogen

C - Carcinogen

DAF - Dilution attenuation factor

Human Health Screening Criteria

Analyte	CAS Number	EPA Regional Sceening Levels Residential Soil (mg/kg) (1)	Adjusted EPA Regional Screening Level Residentional Soil (mg/kg) (2)	EPA Soil Screening Level, Migration to Groundwater DAF=1 (mg/kg) (1, 3)	Lowest Human Health Criterion	Lowest Human Health Criterion Reference
Aroclor-1016	12674-11-2	3.9 N	0.39 N	0.092	0.092	RBSSL
Aroclor-1221	11104-28-2	0.14 C	0.14 C	0.000074	0.000074	RBSSL
Aroclor-1232	11141-16-5	0.14 C	0.14 C	0.000074	0.000074	RBSSL
Aroclor-1242	53469-21-9	0.22 C	0.22 C	0.0053	0.0053	RBSSL
Aroclor-1248	12672-29-6	0.22 C	0.22 C	0.0052	0.0052	RBSSL
Aroclor-1254	11097-69-1	1.1 N (4)	0.11 N (4)	0.0088	0.0088	RBSSL
Aroclor-1260	11096-82-5	0.22 N	0.22 N	0.024	0.024	RBSSL

Notes:

1 - The residential direct contact (R-RSL) and risk-based migration to groundwater soil screening levels (RBSSL) from the USEPA Regional Screening Levels for Chemical Contaminants at Superfund Sites, May, 2012, available online at http://epa-prgs.ornl.gov/chemicals/index.shtml. The risk-based screening levels are based on a target hazard quotient (HQ) of 1 for noncarcinogens (denoted with a "N" flag) or an incremental lifetime cancer risk (ILCR) of 1E-6 for carcinogens (denoted with a "C" flag).

2 - The USEPA RSL (May, 2012) residential soil screening level for noncarcinogens adjusted by dividing by 10, equivalent to a HQ of 0.1. The residential soil screening level for carcinogens (not adjusted) is equivalent to an ILCR of 1E-6.

3 - A dilution attentuation factor of 1 has been applied to EPA soil screening levels, migration to groundwater values.

4 - One tenth the noncarcinogenic value is less than the carinogenic value; therefore, the noncarcinogenic value is presented.

Abbreviations:

N - Noncarcinogen

C - Carcinogen

DAF - Dilution Attenuation Factor

Human Health Screening Criteria

Analyte	CAS Number	EPA Regional Sceening Levels Residential Soil (mg/kg) [1]	Adjusted EPA Regional Screening Level Residentional Soil (mg/kg) [2]	EPA Soil Screening Level, Migration to Groundwater DAF=1 (mg/kg) [1, 3]	Lowest Human Health Criterion	Lowest Human Health Criterion Reference
Antimony	7440-36-0	31 N	3.1 N	0.27	0.27	RBSSL
Arsenic	7440-38-2	0.39 C	0.39 C	0.0013	0.0013	RBSSL
Barium	7440-39-9	15000 N	1500 N	120	120	RBSSL
Beryllium	7440-41-7	160 N	16 N	13	13	RBSSL
Cadmium	7440-43-9	70 N	7 N	0.52	0.52	RBSSL
Chromium (total)	77440-47-3	NC	NC	NC	NC	NA
Cobalt	7440-48-4	23 N	2.3 N	0.21	0.21	RBSSL
Copper	7440-50-8	3100 N	310 N	22	22	RBSSL
Lead	7439-92-1	400	400	14 [4]	14	RBSSL
Mercury	7439-97-6	23 N [5]	2.3 N [5]	0.033	0.033	RBSSL
Nickel	7440-02-0	1500 N	150 N	20	20	RBSSL
Selenium	7782-49-2	390 N	3.9 N	0.4	0.4	RBSSL
Silver	7440-22-4	390 N	3.9 N	0.6	0.6	RBSSL
Thallium	7440-28-0	0.78 N	0.078 N	0.011	0.011	RBSSL
Tin	7440-31-5	47000 N	4700 N	2300	2300	RBSSL
Vanadium	7440-62-2	390 N	39 N	78	39	R-RSL
Zinc	7440-66-6	23000 N	2300 N	290	290	RBSSL
Cyanide	57-12-5	47 N	4.7 N	0.094	0.094	RBSSL
Sulfide	18496-25-8	NC	NC	NC	NC	NA

Notes:

1 - The residential direct contact (R-RSL) and risk-based migration to groundwater soil screening levels (RBSSL) from the USEPA Regional Screening Levels for Chemical Contaminants at Superfund Sites, May, 2012, available online at http://epa-prgs.ornl.gov/chemicals/index.shtml. The risk-based screening levels are based on a target hazard quotient (HQ) of 1 for noncarcinogens (denoted with a "N" flag) or an incremental lifetime cancer risk (ILCR) of 1E-6 for carcinogens (denoted with a "C" flag).

2 - The USEPA RSL (May, 2012) residential soil screening level for noncarcinogens adjusted by dividing by 10, equivalent to a HQ of 0.1. The residential soil screening level for carcinogens (not adjusted) is equivalent to an ILCR of 1E-6.

3 - A dilution attentuation factor of 1 has been applied to EPA soil screening levels, migration to groundwater values.

4 - Calculated from the EPA website (http://epa-prgs.ornl.gov/cgi-bin/chemicals/csl_search).

5 - Value is for mercuric chloride (and other mercury salts).

Abbreviations:

NA - Not available or not applicable

NC - No criteria

N - Noncarcinogen

C - Carcinogen

DAF - Dilution Attenuation Factor

Human Health Screening Criteria

Analyte	CAS Number	EPA Regional Sceening Levels Residential Soil (mg/kg) [1]	Adjusted EPA Regional Screening Level Residentional Soil (mg/kg) [2]	EPA Soil Screening Level, Migration to Groundwater DAF=1 (mg/kg) [1, 3]	Lowest Human Health Criterion	Lowest Human Health Criterion Reference
Aldrin	309-00-2	0.029 C	0.029 C	0.000034	0.000034	RBSSL
alpha-BHC	319-84-6	0.077 C	0.077 C	0.000036	0.000036	RBSSL
beta-BHC	319-85-7	0.27 C	0.27 C	0.00013	0.00013	RBSSL
delta-BHC	319-86-8	0.077 C [4]	0.077 C [4]	0.000036 [4]	0.000036	RBSSL
gamma-BHC	58-89-9	0.52 C	0.52 C	0.00021	0.00021	RBSSL
Chlordane	12789-03-6	1.6 C	1.6 C	0.0018	0.0018	RBSSL
4,4'-DDD	72-54-8	2 C	2 C	0.066	0.066	RBSSL
4,4'-DDE	72-55-9	1.4 C	1.4 C	0.046	0.046	RBSSL
4,4'-DDT	50-29-3	1.7 C	1.7 C	0.067	0.067	RBSSL
Dieldrin	60-57-1	0.03 C	0.03 C	0.000061	0.000061	RBSSL
Endosulfan I	115-29-7	370 N [5]	37 N [5]	1.1 [5]	1.1	RBSSL
Endosulfan II	33213-65-9	370 N [5]	37 N [5]	1.1 [5]	1.1	RBSSL
Endosulfan sulfate	1031-07-8	370 N [5]	37 N [5]	1.1 [5]	1.1	RBSSL
Endrin	72-20-8	18 N	1.8 N	0.068	0.068	RBSSL
Endrin aldehyde	7421-93-4	18 N [6]	1.8 N [6]	0.068 [6]	0.068	RBSSL
Heptachlor	76-44-8	0.11 C	0.11 C	0.00014	0.00014	RBSSL
Heptachlor epoxide	1024-57-3	0.053 C	0.053 C	0.000068	0.000068	RBSSL
Kepone	143-50-0	0.049 C	0.049 C	0.00011	0.00011	RBSSL
Methoxychlor	72-43-5	310 N	31 N	1.5	1.5	RBSSL
Toxaphene	8001-35-2	0.44 C	0.44 C	0.0021	0.0021	RBSSL

Notes:

1 - The residential direct contact (R-RSL) and risk-based migration to groundwater soil screening levels (RBSSL) from the USEPA Regional Screening Levels for Chemical Contaminants at Superfund Sites, May, 2012, available online at http://epa-prgs.ornl.gov/chemicals/index.shtml. The risk-based screening levels are based on a target hazard quotient (HQ) of 1 for noncarcinogens (denoted with a "N" flag) or an incremental lifetime cancer risk (ILCR) of 1E-6 for carcinogens (denoted with a "C" flag).

2 - The USEPA RSL (May, 2012) residential soil screening level for noncarcinogens adjusted by dividing by 10, equivalent to a HQ of 0.1. The residential soil screening level for carcinogens (not adjusted) is equivalent to an ILCR of 1E-6.

3 - A dilution attentuation factor of 1 has been applied to EPA soil screening levels, migration to groundwater values.

4 - Value is for alpha-BHC.

5 - Value is for Endosulfan.

6 - Value is for Endrin.

Abbreviations:

NA - Not available or not applicable

NC - No criteria

N - Noncarcinogen

C - Carcinogen

DAF - Dilution attenuation factor

Analyte	CAS Number	EPA Regional Sceening Levels Residential Soil (mg/kg) [1]	Adjusted EPA Regional Screening Level Residentional Soil (mg/kg) [2]	EPA Soil Screening Level, Migration to Groundwater DAF=1 (mg/kg) [1, 3]	Lowest Human Health Criterion	Lowest Human Health Criterion Reference
Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)	2691-41-0	3800 N	380 N	0.99	0.99	RBSSL
Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX)	121-82-4	5.6 C	5.6 C	0.00023	0.00023	RBSSL
1,3,5-Trinitrobenzene	99-35-4	2200 N	220 N	1.7	1.7	RBSSL
1,3-Dinitrobenzene	99-65-0	6.1 N	0.61 N	0.0014	0.0014	RBSSL
Methyl-2,4,6-trinitrophenylnitramine (Tetryl)	479-45-8	240 N	24 N	0.59	0.59	RBSSL
Nitrobenzene	98-95-3	4.8 C	4.8 C	0.000079	0.000079	RBSSL
2,4,6-Trinitrotoluene	118-96-7	36 N [4]	3.6 N [4]	0.013	0.013	RBSSL
4-Amino-2,6-dinitrotoluene	19406-51-0	150 N	15 N	0.023	0.023	RBSSL
2-Amino-4,6-dinitrotoluene	35572-78-2	150 N	15 N	0.023	0.023	RBSSL
2,4-Dinitrotoluene	121-14-2	1.6 C	1.6 C	0.00028	0.00028	RBSSL
2,6-Dinitrotoluene	606-20-2	61 N	6.1 N	0.02	0.02	RBSSL
2-Nitrotoluene	88-72-2	2.9 C	2.9 C	0.00025	0.00025	RBSSL
3-Nitrotoluene	99-08-1	6.1 N	0.61 N	0.0012	0.0012	RBSSL
4-Nitrotoluene	99-99-0	240 N [4]	24 N [4]	0.0034	0.0034	RBSSL
Nitroglycerin	55-63-0	6.1 N	0.61 N	0.00066	0.00066	RBSSL

Notes:

1 - The residential direct contact (R-RSL) and risk-based migration to groundwater soil screening levels (RBSSL) from the USEPA Regional Screening Levels for Chemical Contaminants at Superfund Sites, May, 2012, available online at http://epa-prgs.ornl.gov/chemicals/index.shtml. The risk-based screening levels are based on a target hazard quotient (HQ) of 1 for noncarcinogens (denoted with a "N" flag) or an incremental lifetime cancer risk (ILCR) of 1E-6 for carcinogens (denoted with a "C" flag).

2 - The USEPA RSL (May, 2012) residential soil screening level for noncarcinogens adjusted by dividing by 10, equivalent to a HQ of 0.1. The residential soil screening level for carcinogens (not adjusted) is equivalent to an ILCR of 1E-6.

3 - A dilution attentuation factor of 1 has been applied to EPA soil screening levels, migration to groundwater values.

4 - One tenth the noncarcinogenic value is less than the carcinogenic value; therefore, the noncarcinogenic value is presented.

Abbreviations:

NA - Not available or not applicable

NC - No criteria

N - Noncarcinogen

C - carcinogen

DAF - Dilution attenuation factor

Analyte	CAS Number	EPA Regional Sceening Levels Residential Soil (mg/kg) (1)	Adjusted EPA Regional Screening Level Residentional Soil (mg/kg) (2)	EPA Soil Screening Level, Migration to Groundwater DAF=1 (mg/kg) (1, 3)	Lowest Human Health Criterion	Lowest Human Health Criterion Reference
Herbicides						
2,4-D	94-75-7	690 N	69 N	0.035	0.035	RBSSL
Silvex (2,4,5-TP)	93-72-1	490 N	49 N	0.046	0.046	RBSSL
2,4,5-T	93-76-5	610 N	61 N	0.052	0.052	RBSSL
Orthophosphate						
Thionazin (O,O-diethyl phosphorothioate)	297-97-2	NC	NC	NC	NA	NC
Dimethoate	60-51-5	12 N	1.2 N	0.0007	0.0007	RBSSL
Disulfoton	298-04-4	2.4 N	0.24 N	0.00071	0.00071	RBSSL
Famphur	52-85-7	NC	NC	NC	NA	NC
Methyl parathion	298-00-0	15 N	1.5 N	0.0057	0.0057	RBSSL
Ethyl parathion (parathion)	56-38-2	370 N	37 N	0.33	0.33	RBSSL
Phorate	298-02-2	12 N	1.2 N	0.0026	0.0026	RBSSL
Sulfotepp (tetraethyl dithiopyrophosphate)	3689-24-5	31 N	3.1 N	0.0039	0.0039	RBSSL

Notes:

1 - The residential direct contact (R-RSL) and risk-based migration to groundwater soil screening levels (RBSSL) from the USEPA Regional Screening Levels for Chemical Contaminants at Superfund Sites, May, 2012, available online at http://epa-prgs.ornl.gov/chemicals/index.shtml. The risk-based screening levels are based on a target hazard quotient (HQ) of 1 for noncarcinogens (denoted with a "N" flag) or an incremental lifetime cancer risk (ILCR) of 1E-6 for carcinogens (denoted with a "C" flag).

2 - The USEPA RSL (May, 2012) residential soil screening level for noncarcinogens adjusted by dividing by 10, equivalent to a HQ of 0.1. The residential soil screening level for carcinogens (not adjusted) is equivalent to an ILCR of 1E-6.

3 - A dilution attentuation factor of 1 has been applied to EPA soil screening levels, migration to groundwater values.

Abbreviations:

NA - Not available or not applicable

NC - No criteria

N - Noncarcinogen

C - Carcinogen

DAF - Dilution attenuation factor

ECOLOGICAL

Ecological Screening Criteria

Analyte	CAS Number	Minimum Eco SSL[1] (mg/kg)	Region 5 SSL[2] (mg/kg)	Minimum LANL ESL[3] (mg/kg)	Final Ecological Criterion[4] (mg/kg)	Final Ecological Criterion Reference
1,1,1-Trichloroethane	71-55-6	NA	29.8	400	29.8	Region 5 SSL
1,1,1,2-Tetrachloroethane	630-20-6	NA	225	NA	225	Region 5 SSL
1,1,2,2-Tetrachloroethane	79-34-5	NA	0.127	NA	0.127	Region 5 SSL
1,1,2-Trichloroethane	79-00-5	NA	28.6	NA	28.6	Region 5 SSL
1,1-Dichloroethane	75-34-3	NA	20.1	210	20.1	Region 5 SSL
1,1-Dichloroethene	75-35-4	NA	8.28	14	8.28	Region 5 SSL
1,2,3-Trichloropropane	96-18-4	NA	3.36	NA	3.36	Region 5 SSL
1,2,4-Trichlorobenzene	120-82-1	NA	11.1	0.51	0.51	LANL ESL
1,2-Dibromo-3-chloropropane	96-12-8	NA	0.0352	NA	0.0352	Region 5 SSL
1,2-Dibromethane	106-93-4	NA	1.23	NA	1.23	Region 5 SSL
1,2-Dichlorobenzene	95-50-1	NA	2.96	1.5	1.5	LANL ESL
1,2-Dichloroethane	107-06-2	NA	21.2	0.85	0.85	LANL ESL
1,2-Dichloropropane	78-87-5	NA	32.7	NA	32.7	Region 5 SSL
1,3-Dichlorobenzene	541-73-1	NA	37.7	1.3	1.3	LANL ESL
1,4-Dichlorobenzene	106-46-7	NA	0.546	1.2	0.546	Region 5 SSL
2-Butanone	78-93-3	NA	89.6	360	89.6	Region 5 SSL
2-Hexanone	591-78-6	NA	12.6	0.36	0.36	LANL ESL
4-Methyl-2-pentanone	108-10-1	NA	443	9.8	9.8	LANL ESL
Acetone	67-64-1	NA	2.5	1.2	1.2	LANL ESL
Acrylonitrile	107-13-1	NA	0.0239	NA	0.0239	Region 5 SSL
Acrolein	107-02-8	NA	5.27	NA	5.27	Region 5 SSL
Acetonitrile	75-05-8	NA	1.37	NA	1.37	Region 5 SSL
Allyl Chloride	107-05-1	NA	0.0134	NA	0.0134	Region 5 SSL
Benzene	71-43-2	NA	0.255	24	0.255	Region 5 SSL
Bromodichloromethane	75-27-4	NA	0.54	NA	0.54	Region 5 SSL
Bromoform	75-25-2	NA	15.9	NA	15.9	Region 5 SSL
Bromomethane	74-83-9	NA	0.235	NA	0.235	Region 5 SSL
Carbon Disulfide	75-15-0	NA	0.0941	0.82	0.0941	Region 5 SSL
Carbon Tetrachloride	56-23-5	NA	2.98	NA	2.98	Region 5 SSL
Chlorobenzene	108-90-7	NA	13.1	2.4	2.4	LANL ESL
Chloroethane	75-00-3	NA	NA	NA	NA	NA
Chloroform	67-66-3	NA	1.19	8	1.19	Region 5 SSL
Chloromethane	74-87-3	NA	10.4	NA	10.4	Region 5 SSL
Chloroprene	126-99-8	NA	0.0029	NA	0.0029	Region 5 SSL

cis-1,3-Dichloropropene	542-75-6	NA	0.398	NA	0.398	Region 5 SSL
Dibromomethane	74-95-3	NA	65	NA	65	Region 5 SSL
Dibromochloromethane	124-48-1	NA	2.05	NA	2.05	Region 5 SSL
Dichlorodifluoromethane	75-71-8	NA	39.5	NA	39.5	Region 5 SSL
Ethylbenzene	100-41-4	NA	5.16	NA	5.16	Region 5 SSL
Isobutyl alcohol	78-83-1	NA	20.8	NA	20.8	Region 5 SSL
Methyl Iodide	74-88-4	NA	1.23	0.038	0.038	LANL ESL
Methacrylonitrile	126-98-7	NA	0.057	NA	0.057	Region 5 SSL
Methylene Chloride	75-09-2	NA	4.05	2.6	2.6	LANL ESL
Propionitrile	107-12-0	NA	0.0498	NA	0.0498	Region 5 SSL
Styrene	100-42-5	NA	4.69	1.2	1.2	LANL ESL
Tetrachloroethene	127-18-4	NA	9.92	0.36	0.36	LANL ESL
Toluene	108-88-3	NA	5.45	25	5.45	Region 5 SSL
trans-1,2-Dichloroethene	156-60-5	NA	0.784	25	0.784	Region 5 SSL
trans-1,3-Dichloropropene	542-75-6	NA	0.398	NA	0.398	Region 5 SSL
trans-1,4-Dichloro-2-butene	110-57-6	NA	NA	NA	NA	NA
Trichloroethene	79-01-6	NA	12.4	55	12.4	Region 5 SSL
Trichlorofluoromethane	75-69-4	NA	16.4	98	16.4	Region 5 SSL
Vinyl Acetate	108-05-4	NA	12.7	NA	12.7	Region 5 SSL
Vinyl Chloride	75-01-4	NA	0.646	0.13	0.13	LANL ESL
Xylenes (Total)	1330-20-7	NA	10	2	2	LANL ESL
Ethyl Methacrylate	97-63-2	NA	30	NA	30	Region 5 SSL
Methyl Methacrylate	80-62-6	NA	984	NA	984	Region 5 SSL
Methylene Bromide (dibromomethane)	74-95-3	NA	65	NA	65	Region 5 SSL
Pentachloroethane	76-01-7	NA	10.7	NA	10.7	Region 5 SSL

Notes:

1 - USEPA Ecological Soil Screening Levels (Eco SSLs) available online: http://www.epa.gov/ecotox/ecossl/. Minimum of plant, invertebrate, avian, and herbivorous mammalian screening value presented.

2 - USEPA Region 5 Ecological Soil Screening Levels (Region 5 SSLs) (USEPA, August 2003).

3 - Los Alamos National Laboratory Ecological Screening Levels (LANL ESLs), Ecorisk Database release 3.0, October 2011. Minimum of plant, earthworm, avian, and mammalian (Desert Cottontail and Deer Mouse) screening value presented.

4 - Final Ecological Screen Criterion was selected in the following order of preference:

a. USEPA Eco SSL.

b. Lower of Region 5 SSL or LANL ESL.

NA - Not available

Analyte	CAS Number	Minimum Eco SSL[1] (mg/kg)	Region 5 SSL[2] (mg/kg)	Minimum LANL ESL[3] (mg/kg)	Final Ecological Criterion[4] (mg/kg)	Final Ecological Criterion Reference
1,4-Naphthoquinone	130-15-4	NA	1.67	NA	1.67	Region 5 SSL
1,2,4,5-Tetrachlorobenzene	95-94-3	NA	2.02	NA	2.02	Region 5 SSL
1,4-Dioxane	123-91-1	NA	2.05	NA	2.05	Region 5 SSL
2,3,4,6-Tetrachlorophenol	58-90-2	NA	0.199	NA	0.199	Region 5 SSL
2,4,5-Trichlorophenol	95-95-4	NA	14.1	NA	14.1	Region 5 SSL
2,4,6-Trichlorophenol	88-06-2	NA	9.94	NA	9.94	Region 5 SSL
2,4-Dichlorophenol	120-83-2	NA	87.5	NA	87.5	Region 5 SSL
2,4-Dimethylphenol	105-67-9	NA	0.01	NA	0.01	Region 5 SSL
2,4-Dinitrophenol	51-28-5	NA	0.0609	NA	0.0609	Region 5 SSL
2,4-Dinitrotoluene	121-14-2	NA	1.28	2.5	1.28	Region 5 SSL
2,6-Dinitrotoluene	606-20-2	NA	0.0328	1.8	0.0328	Region 5 SSL
2,6-Dichlorophenol	87-65-0	NA	1.17	NA	1.17	Region 5 SSL
2-Chloronapthalene	91-58-7	NA	0.0122	NA	0.0122	Region 5 SSL
2-Chlorophenol	95-57-8	NA	0.243	0.39	0.243	Region 5 SSL
2-Methylnaphthalene	91-57-6	29	3.24	24	29	Eco SSL
2-Methylphenol	95-48-7	NA	40.4	0.67	0.67	LANL ESL
2-Nitroaniline	88-74-4	NA	74.1	5.4	5.4	LANL ESL
2-Nitrophenol	88-75-5	NA	1.6	NA	1.6	Region 5 SSL
3,3'-Dichlorobenzidine	91-94-1	NA	0.646	NA	0.646	Region 5 SSL
3-Nitroaniline	99-09-2	NA	3.16	NA	3.16	Region 5 SSL
4,6-Dinitro-2-methylphenol	534-52-1	NA	0.144	NA	0.144	Region 5 SSL
4-Bromophenyl-phenylether	101-55-3	NA	NA	NA	NA	NA
4-Chloro-3-methylphenol	59-50-7	NA	7.95	NA	7.95	Region 5 SSL
4-Chloroaniline	106-47-8	NA	1.1	1	1	LANL ESL
4-Chlorophenyl-phenylether	7005-72-3	NA	NA	NA	NA	NA
4-Methylphenol	106-44-5	NA	163	NA	163	Region 5 SSL
4-Nitroaniline	100-01-6	NA	21.9	NA	21.9	Region 5 SSL
4-Nitrophenol	100-02-7	NA	5.12	NA	5.12	Region 5 SSL
Acenaphthene	83-32-9	29	682	0.25	29	Eco SSL
Acenaphthylene	208-96-8	29	682	160	29	Eco SSL
Acetophenone	98-86-2	NA	300	NA	300	Region 5 SSL
Anthracene	120-12-7	29	1480	6.8	29	Eco SSL
Benzo(a)anthracene	56-55-3	18	5.21	0.8	18	Eco SSL
Benzo(a)pyrene	50-32-8	18	1.52	85	18	Eco SSL
Benzo(b)fluoranthene	205-99-2	18	59.8	18	18	Eco SSL
Benzo(g,h,i)perylene	191-24-2	18	119	47	18	Eco SSL
Benzo(k)fluoranthene	207-08-9	18	148	100	18	Eco SSL
bis(2-Chloroethoxy) methane	111-91-1	NA	0.302	NA	0.302	Region 5 SSL
bis(2-Chloroethyl) ether	111-44-4	NA	23.7	NA	23.7	Region 5 SSL

bis(2-Chloro-1-methylethyl)ether	108-60-1	NA	19.9	NA	19.9	Region 5 SSL
bis-(2-Ethylhexyl)phthalate	117-81-7	NA	0.925	0.02	0.02	LANL ESL
Butylbenzylphthalate	85-68-7	NA	0.239	160	0.239	Region 5 SSL
Chrysene	218-01-9	18	4.73	3.1	18	Eco SSL
Dibenzo(a,h)anthracene	53-70-3	18	18.4	22	18	Eco SSL
Dibenzofuran	132-64-9	NA	NA	6.1	6.1	LANL ESL
Diethylphthalate	84-66-2	NA	24.8	100	24.8	Region 5 SSL
Dimethylphthalate	131-11-3	NA	734	10	10	LANL ESL
Dinoseb	88-85-7	NA	0.0218	NA	0.0218	Region 5 SSL
Di-n-butylphthalate	84-74-2	NA	0.15	0.011	0.011	LANL ESL
Di-n-octylphthalate	117-84-0	NA	709	1.8	1.8	LANL ESL
Fluoranthene	206-44-0	29	122	10	29	Eco SSL
Fluorene	86-73-7	29	122	3.7	29	Eco SSL
Hexachlorobenzene	118-74-1	NA	0.199	0.079	0.079	LANL ESL
Hexachlorobutadiene	87-68-3	NA	0.0398	NA	0.0398	Region 5 SSL
Hexachlorocyclopentadiene	77-47-4	NA	0.755	NA	0.755	Region 5 SSL
Hexachloroethane	67-72-1	NA	0.596	NA	0.596	Region 5 SSL
Hexachlorophene	70-30-4	NA	0.199	NA	0.199	Region 5 SSL
Indeno(1,2,3-cd)pyrene	193-39-5	18	109	110	18	Eco SSL
Isophorone	78-59-1	NA	139	NA	139	Region 5 SSL
Naphthalene	91-20-3	29	0.0994	1	29	Eco SSL
Nitrobenzene	98-95-3	NA	1.31	2.2	1.31	Region 5 SSL
N-Nitroso-di-n-propylamine	621-64-7	NA	0.544	NA	0.544	Region 5 SSL
N-Nitrosodiphenylamine	86-30-6	NA	0.545	NA	0.545	Region 5 SSL
Pentachlorophenol	87-86-5	2.1	0.119	0.36	2.1	Eco SSL
Phenanthrene	85-01-8	29	45.7	5.5	29	Eco SSL
Phenol	108-95-2	NA	120	0.79	0.79	LANL ESL
Pyrene	129-00-0	18	78.5	10	18	Eco SSL
Pyridine	110-86-1	NA	1.03	NA	1.03	Region 5 SSL
Safrole	94-59-7	NA	0.404	NA	0.404	Region 5 SSL
o-Toluidine	95-53-4	NA	2.97	NA	2.97	Region 5 SSL
O,O,O-Triethylphosphorothioate	126-68-1	NA	0.818	NA	0.818	Region 5 SSL
1,3,5-trinitrobenzene	99-35-4	NA	0.376	6.6	0.376	Region 5 SSL
1,3 Dinitrobenzene	99-65-0	NA	0.655	0.073	0.073	LANL ESL
1-Naphthylamine	134-32-7	NA	9.34	NA	9.34	Region 5 SSL
2-Acetylaminofluorene	53-96-3	NA	0.596	NA	0.596	Region 5 SSL
2-Naphthylamine	91-59-8	NA	3.03	NA	3.03	Region 5 SSL
2-Picoline	109-06-8	NA	9.9	NA	9.9	Region 5 SSL
3-methylphenol	108-39-4	NA	NA	0.69	0.69	LANL ESL
3,3'-dimethylbenzidine	119-93-7	NA	NA	NA	NA	NA
3-Methylcholanthrene	56-49-5	NA	0.0779	NA	0.0779	Region 5 SSL
4-Aminobiphenyl	92-67-1	NA	0.00305	NA	0.00305	Region 5 SSL
4-Nitroquinoline-1-Oxide	56-57-5	NA	0.122	NA	0.122	Region 5 SSL

5-Nitro-O-Toluidine	99-55-8	NA	8.73	NA	8.73	Region 5 SSL
7,12-Dimethylbenz(a)Anthracene	57-97-6	NA	16.3	NA	16.3	Region 5 SSL
a,a-Dimethylphenethylamine	122-09-8	NA	0.3	NA	0.3	Region 5 SSL
Aniline	62-53-3	NA	0.0568	NA	0.0568	Region 5 SSL
Aramite	140-57-8	NA	166	NA	166	Region 5 SSL
Benzyl Alcohol	100-51-6	NA	65.8	120	65.8	Region 5 SSL
Chlorobenzilate	510-15-6	NA	5.05	NA	5.05	Region 5 SSL
Diallate	2303-16-4	NA	0.452	NA	0.452	Region 5 SSL
Diphenylamine	122-39-4	NA	1.01	10	1.01	Region 5 SSL
Ethyl Methanesulfonate	62-50-5	NA	NA	NA	NA	NA
Hexachloropropene	1888-71-7	NA	NA	NA	NA	NA
Isodrin	465-73-6	NA	0.00332	NA	0.00332	Region 5 SSL
Isosafrole	120-58-1	NA	9.94	NA	9.94	Region 5 SSL
Methapyrilene	91-80-5	NA	2.78	NA	2.78	Region 5 SSL
Methyl Methanesulfonate	66-27-3	NA	0.315	NA	0.315	Region 5 SSL
N-Nitrosodiethylamine	55-18-5	NA	0.0693	NA	0.0693	Region 5 SSL
N-Nitrosodimethylamine	62-75-9	NA	0.0000321	NA	0.0000321	Region 5 SSL
N-Nitroso-Di-n-Butylamine	924-16-3	NA	0.267	NA	0.267	Region 5 SSL
N-Nitrosomethylethylamine	10595-95-6	NA	0.00166	NA	0.00166	Region 5 SSL
N-Nitrosomorpholine	59-89-2	NA	0.0706	NA	0.0706	Region 5 SSL
N-Nitrosopiperidine	100-75-4	NA	0.00665	NA	0.00665	Region 5 SSL
N-Nitrosopyrrolidine	930-55-2	NA	0.0126	NA	0.0126	Region 5 SSL
p-Dimethylaminoazobenzene	60-11-7	NA	0.04	NA	0.04	Region 5 SSL
Pentachlorobenzene	608-93-5	NA	0.497	NA	0.497	Region 5 SSL
Pentachloronitrobenzene	82-68-8	NA	7.09	0.7	0.7	LANL ESL
Phenacetin	62-44-2	NA	11.7	NA	11.7	Region 5 SSL
p-Phenylenediamine	106-50-3	NA	6.16	NA	6.16	Region 5 SSL
Pronamide	23950-58-5	NA	0.0136	NA	0.0136	Region 5 SSL

Notes:

1 - USEPA Ecological Soil Screening Levels (Eco SSLs) available online: http://www.epa.gov/ecotox/ecossl/. Minimum of plant, invertebrate, avian, and herbivorous mammalian screening value presented.

2 - USEPA Region 5 Ecological Soil Screening Levels (Region 5 SSLs) (USEPA, August 2003).

3 - Los Alamos National Laboratory Ecological Screening Levels (LANL ESLs), Ecorisk Database release 3.0, October 2011. Minimum of plant, earthworm, avian, and mammalian (Desert Cottontail and Deer Mouse) screening value presented.

4 - Final Ecological Screen Criterion was selected in the following order of preference:

a. USEPA Eco SSL.

b. Lower of Region 5 SSL or LANL ESL.

NA - Not available

Ecological Screening Criteria

Analyte	CAS Number	Minimum Eco SSL[1] (mg/kg)	Region 5 SSL[2] (mg/kg)	Minimum LANL ESL[3] (mg/kg)	Final Ecological Criterion[4] (mg/kg)	Final Ecological Criterion Reference
Aroclor-1016	12674-11-2	NA	0.000332	2.1	0.000332	Region 5 SSL
Aroclor-1221	11104-28-2	NA	0.000332	NA	0.000332	Region 5 SSL
Aroclor-1232	11141-16-5	NA	0.000332	NA	0.000332	Region 5 SSL
Aroclor-1242	53469-21-9	NA	0.000332	0.041	0.000332	Region 5 SSL
Aroclor-1248	12672-29-6	NA	0.000332	0.014	0.000332	Region 5 SSL
Aroclor-1254	11097-69-1	NA	0.000332	0.041	0.000332	Region 5 SSL
Aroclor-1260	11096-82-5	NA	0.000332	0.88	0.000332	Region 5 SSL

Notes:

1 - USEPA Ecological Soil Screening Levels (Eco SSLs) available online: http://www.epa.gov/ecotox/ecossl/. Minimum of plant, invertebrate, avian, and herbivorous mammalian screening value presented.

2 - USEPA Region 5 Ecological Soil Screening Levels (Region 5 SSLs) (USEPA, August 2003).

3 - Los Alamos National Laboratory Ecological Screening Levels (LANL ESLs), Ecorisk Database release 3.0, October 2011. Minimum of plant, earthworm, avian, and mammalian (Desert Cottontail and Deer Mouse) screening value presented.

4 - Final Ecological Screen Criterion was selected in the following order of preference:

a. USEPA Eco SSL.

b. Lower of Region 5 SSL or LANL ESL.

NA - Not available

Ecological Screening Criteria

Analyte	CAS Number	Minimum Eco SSL[1] (mg/kg)	Region 5 SSL[2] (mg/kg)	Minimum LANL ESL[3] (mg/kg)	Final Ecological Criterion[4] (mg/kg)	Final Ecological Criterion Reference
Antimony	7440-36-0	10	0.142	0.05	10	Eco SSL
Arsenic	7440-38-2	18	5.7	6.8	18	Eco SSL
Barium	7440-39-9	330	1.04	110	330	Eco SSL
Beryllium	7440-41-7	21	1.06	2.5	21	Eco SSL
Cadmium	7440-43-9	0.77	0.00222	0.29	0.77	Eco SSL
Chromium (total)	77440-47-3	26 [6]	0.4 [6]	2.3	26	Eco SSL
Cobalt	7440-48-4	13	0.14	13	13	Eco SSL
Copper	7440-50-8	28	5.4	15	28	Eco SSL
Lead	7439-92-1	11	0.0537	14	11	Eco SSL
Mercury	7439-97-6	NA	0.1	0.013 [7]	0.013	LANL ESL
Nickel	7440-02-0	38	13.6	20	38	Eco SSL
Selenium	7782-49-2	0.52	0.0276	0.52	0.52	Eco SSL
Silver	7440-22-4	4.2	4.04	2.6	4.2	Eco SSL
Thallium	7440-28-0	NA	0.0569	0.068	0.0569	Region 5 SSL
Tin	7440-31-5	NA	7.62	NA	7.62	Region 5 SSL
Vanadium	7440-62-2	7.8	1.59	0.025	7.8	Eco SSL
Zinc	7440-66-6	46	6.62	48	46	Eco SSL
Cyanide	57-12-5	NA	1.33	0.1	0.1	LANL ESL
Sulfide	18496-25-8	NA	0.00358	NA	0.00358	Region 5 SSL

Notes:

1 - USEPA Ecological Soil Screening Levels (Eco SSLs) available online: http://www.epa.gov/ecotox/ecossl/. Minimum of plant, invertebrate, avian, and herbivorous mammalian screening value presented.

2 - USEPA Region 5 Ecological Soil Screening Levels (Region 5 SSLs) (USEPA, August 2003).

3 - Los Alamos National Laboratory Ecological Screening Levels (LANL ESLs), Ecorisk Database release 3.0, October 2011. Minimum of plant, earthworm, avian, and mammalian (Desert Cottontail and Deer Mouse) screening value presented.

4 - Final Ecological Screen Criterion was selected in the following order of preference:

a. USEPA Eco SSL.

b. Lower of Region 5 SSL or LANL ESL.

5 - Value for total chromium.

6 - Value for trivalent chromium.

7 - Value for inorganic mercury.

NA - Not available

Ecological Screening Criteria

Analyte		CAS Number	Minimum Eco SSL[1] (mg/kg)	Region 5 SSL[2] (mg/kg)	Minimum LANL ESL[3] (mg/kg)	Final Ecological Criterion[4] (mg/kg)	Final Ecological Criterion Reference
Aldrin	309-00-2	309-00-2	NA	0.00332	0.075	0.00332	Region 5 SSL
alpha-BHC	319-84-6	319-84-6	NA	0.0994	100	0.0994	Region 5 SSL
beta-BHC	319-85-7	319-85-7	NA	0.00398	0.46	0.00398	Region 5 SSL
delta-BHC	319-86-8	319-86-8	NA	9.94	NA	9.94	Region 5 SSL
gamma-BHC	58-89-9	58-89-9	NA	0.005	0.016	0.005	Region 5 SSL
Chlordane	12789-03-6	12789-03-6	NA	0.224	0.28 [5]	0.224	Region 5 SSL
4,4'-DDD	72-54-8	72-54-8	0.093	0.758	0.0063	0.093	Eco SSL
4,4'-DDE	72-55-9	72-55-9	0.093	0.596	0.11	0.093	Eco SSL
4,4'-DDT	50-29-3	50-29-3	0.093	0.0035	0.089	0.093	Eco SSL
Dieldrin	60-57-1	60-57-1	0.022	0.00238	0.0088	0.022	Eco SSL
Endosulfan I	115-29-7	115-29-7	NA	0.119	0.64	0.119	Region 5 SSL
Endosulfan II	33213-65-9	33213-65-9	NA	0.119	NA	0.119	Region 5 SSL
Endosulfan sulfate	1031-07-8	1031-07-8	NA	0.0358	NA	0.0358	Region 5 SSL
Endrin	72-20-8	72-20-8	NA	0.0101	0.0014	0.0014	LANL ESL
Endrin aldehyde	7421-93-4	7421-93-4	NA	0.0105	NA	0.0105	Region 5 SSL
Heptachlor	76-44-8	76-44-8	NA	0.00598	0.11	0.00598	Region 5 SSL
Heptachlor epoxide	1024-57-3	1024-57-3	NA	0.152	NA	0.152	Region 5 SSL
Kepone	143-50-0	143-50-0	NA	0.03272	0.043	0.03272	Region 5 SSL
Methoxychlor	72-43-5	72-43-5	NA	0.0199	9.1	0.0199	Region 5 SSL
Toxaphene	8001-35-2	8001-35-2	NA	0.119	4.1	0.119	Region 5 SSL

Notes:

1 - USEPA Ecological Soil Screening Levels (Eco SSLs) available online: http://www.epa.gov/ecotox/ecossl/. Minimum of plant, invertebrate, avian, and herbivorous mammalian screening value presented.

2 - USEPA Region 5 Ecological Soil Screening Levels (Region 5 SSLs) (USEPA, August 2003).

3 - Los Alamos National Laboratory Ecological Screening Levels (LANL ESLs), Ecorisk Database release 3.0, October 2011. Minimum of plant, earthworm, avian, and mammalian (Desert Cottontail and Deer Mouse) screening value presented.

4 - Final Ecological Screen Criterion was selected in the following order of preference:

a. USEPA Eco SSL.

b. Lower of Region 5 SSL or LANL ESL.

5 - Value for alpha-chlordane.

NA - Not available

Ecological Screening Criteria

Analyte	CAS Number	Minimum Eco SSL[1] (mg/kg)	Region 5 SSL[2] (mg/kg)	Minimum LANL ESL[3] (mg/kg)	Final Ecological Criterion[4] (mg/kg)	Final Ecological Criterion Reference
Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)	2691-41-0	NA	NA	27	27	LANL ESL
Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX)	121-82-4	NA	NA	7.5	7.5	LANL ESL
1,3,5-Trinitrobenzene	99-35-4	NA	0.376	6.6	0.376	Region 5 SSL
1,3-Dinitrobenzene	99-65-0	NA	0.655	0.073	0.073	LANL ESL
Methyl-2,4,6-trinitrophenylnitramine (Tetryl)	479-45-8	NA	NA	0.99	0.99	LANL ESL
Nitrobenzene	98-95-3	NA	1.31	2.2	1.31	Region 5 SSL
2,4,6-Trinitrotoluene	118-96-7	NA	NA	6.4	6.4	LANL ESL
4-Amino-2,6-dinitrotoluene	19406-51-0	NA	NA	3.6	3.6	LANL ESL
2-Amino-4,6-dinitrotoluene	35572-78-2	NA	NA	10	10	LANL ESL
2,4-Dinitrotoluene	121-14-2	NA	1.28	2.5	1.28	Region 5 SSL
2,6-Dinitrotoluene	606-20-2	NA	0.0328	1.8	0.0328	Region 5 SSL
2-Nitrotoluene	88-72-2	NA	NA	9.9	9.9	LANL ESL
3-Nitrotoluene	99-08-1	NA	NA	12	12	LANL ESL
4-Nitrotoluene	99-99-0	NA	NA	22	22	LANL ESL
Nitroglycerin	55-63-0	NA	NA	71	71	LANL ESL

Notes:

1 - USEPA Ecological Soil Screening Levels (Eco SSLs) available online: http://www.epa.gov/ecotox/ecossl/. Minimum of plant, invertebrate, avian, and herbivorous mammalian screening value presented.

2 - USEPA Region 5 Ecological Soil Screening Levels (Region 5 SSLs) (USEPA, August 2003).

3 - Los Alamos National Laboratory Ecological Screening Levels (LANL ESLs), Ecorisk Database release 3.0, October 2011. Minimum of plant, earthworm, avian, and mammalian (Desert Cottontail and Deer Mouse) screening value presented.

4 - Final Ecological Screen Criterion was selected in the following order of preference:

a. USEPA Eco SSL.

b. Lower of Region 5 SSL or LANL ESL.

NA - Not available

Ecological Screening Criteria

Analyte	CAS Number	Minimum Eco SSL[1] (mg/kg)	Region 5 SSL[2] (mg/kg)	Minimum LANL ESL[3] (mg/kg)		Final Ecological Criterion[4] (mg/kg)	Final Ecological Criterion Reference
Herbicides							
2,4-D		NA	0.0272	NA		0.0272	Region 5 SSL
Silvex		NA	0.109	NA		0.109	Region 5 SSL
2,4,5-T		NA	0.596	NA		0.596	Region 5 SSL
Orthophosphate							
Thionazin (O,O-diethyl phosphorothioate)		NA	0.799	NA		0.799	Region 5 SSL
Dimethoate		NA	0.218	NA		0.218	Region 5 SSL
Disulfoton		NA	0.0199	NA		0.0199	Region 5 SSL
Famphur		NA	0.0497	NA		0.0497	Region 5 SSL
Methyl parathion		NA	0.000292	NA		0.000292	Region 5 SSL
Ethyl parathion (parathion)		NA	0.00034	NA		0.00034	Region 5 SSL
Phorate		NA	0.000496	NA		0.000496	Region 5 SSL
Sulfotepp (tetraethyl dithiopyrophosphate)		NA	0.596	NA		0.596	Region 5 SSL

Notes:

1 - USEPA Ecological Soil Screening Levels (Eco SSLs) available online: http://www.epa.gov/ecotox/ecossl/. Minimum of plant, invertebrate, avian, and herbivorous mammalian screening value presented.

2 - USEPA Region 5 Ecological Soil Screening Levels (Region 5 SSLs) (USEPA, August 2003).

3 - Los Alamos National Laboratory Ecological Screening Levels (LANL ESLs), Ecorisk Database release 3.0, October 2011. Minimum of plant, earthworm, avian, and mammalian (Desert Cottontail and Deer Mouse) screening value presented.

4 - Final Ecological Screen Criterion was selected in the following order of preference:

a. USEPA Eco SSL.

b. Lower of Region 5 SSL or LANL ESL.

NA - Not available

APPENDIX C

MC FIELD STANDARD OPERATING PROCEDURES

APPENDIX C

MC FIELD STANDARD OPERATING PROCEDURES

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STANDARD OPERATING PROCEDURE
SOP-01

SAMPLE CUSTODY AND DOCUMENTATION OF FIELD ACTIVITIES

1.0 PURPOSE

This Standard Operating Procedure (SOP) establishes the procedures for sample custody and documentation of field sampling and field analyses activities at the Naval Activity Puerto Rico, Ceiba, Puerto Rico.

2.0 REQUIRED FIELD FORMS AND EQUIPMENT

The following logbooks, forms, labels, and equipment are required.

Writing utensil (preferably black pen with indelible ink)
Site logbook
Field logbook
Sample label
Chain-of-Custody Form
Custody seals
Equipment calibration log
Soil and Sediment Sample Log Sheet
Groundwater Sample Log Sheet

3.0 PROCEDURES

This section describes custody and documentation procedures. All entries made into the logbooks, custody documents, logs, and log sheets described in this SOP must be made in indelible ink (black is preferred). No erasures are permitted. If an incorrect entry is made, the entry will be crossed out with a single strike mark, initialed, and dated. In addition to the field forms presented in this SOP, other required field forms for specific tasks are presented in the appropriate SOPs in this UFP SAP and shall be completed as described.

3.1 Site Logbook

The site logbook is a hard-bound, paginated, controlled-distribution record book in which all major on-site activities are documented. At a minimum, the following activities and events will be recorded (daily) in the site logbook:

- All field personnel present
- Arrival/departure of site visitors
- Arrival/departure of equipment
- Start or completion of sampling activities
- Daily on-site activities performed each day
- Sample pickup information
- Health and safety issues
- Weather conditions

The site logbook is initiated at the start of the first on-site activity (e.g., site visit or initial reconnaissance survey). Entries are to be made for every day that on-site activities take place.

The following information must be recorded on the cover of each site logbook:

- Project name
- Project number
- Book number
- Start date
- End date

Information recorded daily in the site logbook need not be duplicated in other field notebooks but must summarize the contents of these other notebooks and refer to specific page locations in these notebooks for detailed information (where applicable). At the completion of each day's entries, the site logbook must be signed and dated by the field operations leader (FOL).

3.2 Field Logbooks

The field logbook is a separate dedicated notebook used by field personnel to document his or her activities in the field. This notebook is hardbound and paginated.

3.3 Sample Labels

Adhesive sample container labels must be completed and applied to every sample container. Information on the label includes the project name, location, sample number, date, time, preservative, analysis, matrix, sampler's initials, and the name of the laboratory performing the analysis additional guidance provided by SOP-02.

3.4 Chain-of-Custody Form

The Chain-of-Custody Form (COC) is a multi-part form that is initiated as samples are acquired and accompanies a sample (or group of samples) as it is transferred from person to person. Each COC is numbered. This form must accompany any samples collected for laboratory chemical analysis. A copy of a blank COC form is attached at the end of this SOP.

The FOL must include the name of the laboratory in the upper right hand corner section to ensure that the samples are forwarded to the correct location. If more than one COC is necessary for any cooler, the FOL will indicate "Page __ of __" on each COC. The original (top) signed copy of the COC will be placed inside a sealable polyethylene bag and taped inside the lid of the shipping cooler. Once the samples are received at the laboratory, the sample custodian checks the contents of the cooler(s) against the enclosed COC(s). Any problems are noted on the enclosed COC Form (bottle breakage, discrepancies between the sample labels, COC form, etc.) and will be resolved through communication between the laboratory point-of-contact and the Project Manager (PM). The COC form is signed and retained by the laboratory and becomes part of the sample's corresponding analytical data package.

3.5 Custody Seal

The custody seal is an adhesive-backed label, and it is part of the chain-of-custody process and is used to prevent tampering with samples after they have been collected in the field and sealed in coolers for transit to the laboratory. The custody seals are signed and dated by the samplers and affixed across the opening edges of each cooler (two seals per cooler) containing environmental samples. The laboratory sample custodian will examine the custody seal for evidence of tampering and will notify the Tetra Tech PM if evidence of tampering is observed.

3.6 Equipment Calibration Log

The Equipment Calibration Log is used to document calibration of measuring equipment used in the field. The Equipment Calibration Log documents that the manufacturer's instructions were followed for calibration of the equipment, including frequency and type of standard or calibration device. An Equipment Calibration Log must be maintained for each electronic measuring device requiring calibration. Entries must be made for each day the equipment is used.

3.7 Sample Log Sheets

The Soil and Sediment Sample Log Sheets are used to document the sampling of soils for additional guidance regarding soil sampling see SOPs-04, -05, and -06.

4.0 ATTACHMENTS

1. Chain-of-Custody Record
2. Equipment Calibration Log
3. Soil and Sediment Sample Log Sheet

ATTACHMENT 1
CHAIN-OF-CUSTODY RECORD

CHAIN OF CUSTODY | NUMBER | PAGE ____ OF _____

PROJECT NO:	SITE NAME:	PROJECT MANAGER AND PHONE NUMBER	LABORATORY NAME AND CONTACT:
SAMPLERS (SIGNATURE)		FIELD OPERATIONS LEADER AND PHONE NUMBER	ADDRESS
		CARRIER/WAYBILL NUMBER	CITY, STATE

STANDARD TAT ☐
RUSH TAT ☐
☐ 24 hr. ☐ 48 hr. ☐ 72 hr. ☐ 7 day ☐ 14 day

DATE YEAR ____	TIME	SAMPLE ID	MATRIX	GRAB (G) COMP (C)	No. OF CONTAINERS	CONTAINER TYPE PLASTIC (P) or GLASS (G) / PRESERVATIVE USED / TYPE OF ANALYSIS								COMMENTS

1. RELINQUISHED BY	DATE	TIME	1. RECEIVED BY	DATE	TIME
2. RELINQUISHED BY	DATE	TIME	2. RECEIVED BY	DATE	TIME
3. RELINQUISHED BY	DATE	TIME	3. RECEIVED BY	DATE	TIME
COMMENTS					

DISTRIBUTION: WHITE (ACCOMPANIES SAMPLE) YELLOW (FIELD COPY) PINK (FILE COPY)

3/99
FORM NO. TtNUS-001

ATTACHMENT 2

EQUIPMENT CALIBRATION LOG

Tetra Tech NUS, Inc.

EQUIPMENT CALIBRATION LOG

PROJECT NAME : _____ INSTRUMENT NAME/MODEL: _____

SITE NAME: _____ MANUFACTURER: _____

PROJECT No.: _____ SERIAL NUMBER: _____

Date of Calibration	Instrument I.D. Number	Person Performing Calibration	Instrument Settings		Instrument Readings		Calibration Standard (Lot No.)	Remarks and Comments
			Pre-calibration	Post-calibration	Pre-calibration	Post-calibration		

ATTACHMENT 3

SOIL AND SEDIMENT SAMPLE LOG SHEET

SOIL & SEDIMENT SAMPLE LOG SHEET

Page___ of ___

Project Site Name: _____
Project No.: _____

[] Surface Soil
[] Subsurface Soil
[] Sediment
[] Other: _____
[] QA Sample Type: _____

Sample ID No.: _____
Sample Location: _____
Sampled By: _____
C.O.C. No.: _____

Type of Sample:
[] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

Date:	Depth Interval	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Time:			
Method:			
Monitor Reading (ppm):			

COMPOSITE SAMPLE DATA:

Date:	Time	Depth Interval	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other

OBSERVATIONS / NOTES:

MAP:

Circle if Applicable:

MS/MSD	Duplicate ID No.:

Signature(s):

STANDARD OPERATING PROCEDURE
SOP-02

SAMPLE LABELING

1.0 PURPOSE

This Standard Operating Procedure (SOP) describes the procedures to be used for labeling sample containers. Sample labels are used to document the sample ID, date, time, analysis to be performed, preservative, matrix, sampler, and the analytical laboratory. A sample label will be attached to each sample container. The label for each container will contain identical information.

2.0 REQUIRED FIELD FORMS AND EQUIPMENT

Writing utensil (indelible ink black pen)
Disposable medical-grade gloves (e.g. latex, nitrile)
Required sample containers: All sample containers for analysis by fix-based laboratories will be supplied and deemed certified clean by the laboratory.
Preprinted sample labels
Sealable polyethylene bags

3.0 PROCEDURES

3.1 The following information will be electronically printed on each sample label prior to the field activities.

- Contract Task Order number
- Project location
- Sample location
- Preservative
- Analysis to be performed
- Matrix type
- Laboratory name

3.2 Complete the label by filling in the sample ID and time of collection during the sample collection event.

3.3 Select the containers that are appropriate for a given sample. Complete the associated sample label and affix to the sample container.

3.4 Fill the appropriate containers with sample material. Securely close the container lids without overtightening.

3.5 Check to determine if the information printed on the label is correct.

3.6 Place the sample container in a Ziplock plastic bag and place in a cooler containing ice.

Example of a sample label is attached at the end of this SOP.

4.0 ATTACHMENTS

1. Sample Label

ATTACHMENT 1
SAMPLE LABEL

Tetra Tech NUS, Inc. 661 Andersen Drive Pittsburgh, 15220 (412)921-7090	Project: Location: CTO:	
Sample No:		Matrix:
Date:	Time:	Preserve:
Analysis:		
Sampled by:	Laboratory	

STANDARD OPERATING PROCEDURE
SOP-03

SAMPLE PRESERVATION, PACKAGING, AND SHIPPING

1.0 PURPOSE

This Standard Operating Procedure (SOP) describes the procedures for sample preservation, packaging, and shipping to be used in handling soil, sediment, and aqueous samples at the Naval Activity Puerto Rico, Ceiba, Puerto Rico.

2.0 REQUIRED FIELD FORMS AND EQUIPMENT

Shipping labels
Custody seals
Chain-of-custody (COC) form(s)
Sample containers with preservatives: All sample containers for analysis by fixed-base laboratories will be supplied, with preservatives added (if required) and deemed certified clean by the laboratory.
Field Preservation Kit for Perchlorate Analytical Parameter: Sterile syringe, sterile 0.2um filter, and sterile plastic sample container, and a plastic unpreserved container, all deemed certified clean by the laboratory.
Plastic surgical gloves
Sample shipping containers (coolers): All sample shipping containers are supplied by the laboratory.
Packaging material: Bubble wrap, sealable polyethylene bags, strapping tape, etc.

3.0 PROCEDURES FOR SAMPLE PRESERVATION, PACKAGING, AND SHIPPING

3.1 The laboratory provides sample containers with preservative already included (as required) for the analytical parameter for which the sample is to be analyzed. All samples will be held, stored, and shipped at 4°C. This will be accomplished through refrigeration (used to hold samples prior to shipment) and/or ice. See Section 4.0 for specific procedures for the perchlorate preservation. The perchlorate sample, once preservation is completed, will be package and shipped in the same manner as described herein Section 3.0

3.2 The sampler shall maintain custody of the samples until the samples are relinquished to another custodian or to the common carrier.

3.3 Check that each sample container is properly labeled, the container lid is securely fastened, and the container is sealed in a polyethylene bag.

3.4 If the container is glass, place the sample container into a bubble-out shipping bag and seal the bag using the self-sealing, pressure sensitive tape supplied with the bag.

3.5 Inspect the insulated shipping cooler. Check for any cracks, holes, broken handles, etc. If the cooler has a drain plug, make certain it is sealed shut, both inside and outside of the cooler. If the cooler is questionable for shipping, the cooler must be discarded.

3.6 Line the cooler with large plastic bag, and line the bottom of the cooler with a layer of bubble wrap. Place the sample containers into the shipping cooler in an upright position (containers will be upright, with the exception of any 40-ml vials). Continue filling the cooler with ice until the cooler is nearly full and the movement of the sample containers is limited.

3.7 Wrap the large plastic bag closed and secure with tape.

3.8 Place the original (top) signed copy of the COC form inside a sealable polyethylene bag. Tape the bag to the inside of the lid of the shipping cooler.

3.9 Close the cooler and seal the cooler with approximately four wraps of strapping tape at each end of the cooler. Prior to wrapping the last wrap of strapping tape, apply a signed and dated custody seal to each side of the cooler (one per side). Cover the custody seal with the last wrap of tape. This will provide a tamper evident custody seal system for the sample shipment.

3.10 Affix shipping labels to each of the coolers, ensuring all of the shipping information is filled in properly. Overnight (e.g., FedEx Priority Overnight) courier services will be used for all sample shipments.

3.11 All samples will be shipped to the laboratory in an appropriate time frame after collection in order to prevent exceedances of the sample hold times.

4.0 PROCEDURES FOR FIELD PRESERVATION OF THE PERCHLORATE GROUNDWATER SAMPLE

4.1 Fill an unpreserved HDPE container provided by the Laboratory with groundwater directly from the sampling pump discharge. Pre-filtering with a 0.45uM may be required if the turbidity is high i.e. noticeable cloudy.

4.2 Extract about 100 mL from the container using the sterile syringe (without the filter) by withdrawing the plunger. Or remove the plunger from the syringe and fill it with the groundwater by pouring from the container in to the syringe.

4.3 With the sterile syringe full of groundwater carefully attach the sterile in-line 0.2um filter to the output of the syringe.

4.4 Push the syringe plunger to force the water through the filter into the sterile plastic container provided by the laboratory.

4.5 Repeat Steps 4.2 through 4.4 to obtain about 200 mL volume in the 250 mL sterile container with required head space.

STANDARD OPERATING PROCEDURE
SOP-04

SAMPLE IDENTIFICATION NOMENCLATURE

1.0 PURPOSE

The purpose of this Standard Operating Procedure (SOP) is to establish a consistent sample nomenclature system that will facilitate subsequent data management at the Naval Activity Puerto Rico, Ceiba, Puerto Rico. The sample nomenclature system has been devised such that the following objectives can be attained.

- Sorting of data by site, location, or matrix
- Maintenance of consistency (field, laboratory, and database sample numbers)
- Accommodation of all project-specific requirements
- Accommodation of laboratory sample number length constraints
- Ease of sample identification

The NAPR Environmental Quality Board must approve any deviations from this procedure.

2.0 REQUIRED FIELD FORMS AND EQUIPMENT

Writing utensil (preferably black pen with indelible ink)
Sample container labels

3.0 SAMPLE IDENTIFICATION NOMENCLATURE

All samples will be properly labeled with a sample label affixed to the sample container. Each sample will be assigned a unique sample tracking number.

3.1 Sample Numbering Scheme

Use a sample tracking number consisting of a three-segment alpha-numeric code that identifies the sample's associated site, sample type, location, and for aqueous samples, where applicable, whether a sample is filtered.

The alphanumeric coding to be used is explained in the following diagram and subsequent definitions:

NN	AA (Soils only)		AA	NNNA or NNN		NNNN
SWMU Number	Subarea Abbreviation	-	Matrix	Sample Location Number, and for soil Grab or Composite	-	Depth Interval for soil.

Character Type:

A = Alpha

N = Numeric

SWMU Number (NN):

77

Subareas (AA):

RR = Rifle Range

OB = Potential OB/OD

MT = Potential Munitions Trench

DA = Detonation Area Near Concrete Pad

PR = Pistol Range

FP = Former Pistol Range

Matrix Code (AA):

SS = Surface Soil Sample

SB = Subsurface Soil Sample

Location Number (NNNA):

Sequential numbering, sample location identifier defined in this UFP-SAP. It is followed by a letter (A) indicating grab (G) or composite (C) for soil samples.

Depth or Date (NNNN / mmyy) Interval:

For soil this depth code is used to note the depth below ground surface (bgs) at which a soil sample is collected. The first two numbers of the four-number code specify the top interval, and the third and fourth specify the bottom interval in feet bgs of the sample. The interval from 0 to 6 inches will be designated "00.5". Depths greater than 0.5 feet will be noted in whole numbers only; further detail, if needed, will be recorded on the sample log sheet, boring log, logbook, etc.

3.1.1 Examples of Sample Nomenclature

A grab surface soil sample collected from the Pistol Range, sampling location 77PRSB037, at a depth of 0.5 feet would be labeled as "77PR-SS037G-00.5". A background grab surface soil sample collected at location 77BGSB001 would be labeled as "77BG-SS001G-00.5".

3.2 Field Quality Assurance/Quality Control (QA/QC) Sample Nomenclature

Field QA/QC samples are described in this UFP SAP. They will be designated using a different coding system than the one used for regular field samples.

3.2.1 QC and IDW Sample Numbering

Use the QC and IDW code consisting of a three-segment alpha-numeric code that identifies the sample QC type, the date the sample was collected, and the number of this type of QC sample collected on a particular date.

NN		**AA (Soils only)**	**AA or AAA**	**NNNNNN**		**NN**
SWMU Number	-	Subarea Abbreviation	QC Type or IDW	Date	-	Sequence Number

Character Type:

A = Alpha

N = Numeric

QC Types:

RB = Equipment Rinsate

FD = Field Duplicate

IDW = Investigation Derived Waste

TB = Trip Blank

Record the time of sampling on the Chain-of-Custody Form, and the labels for field duplicate samples with 5 minutes added to the parent sample collection time so that the samples are "blind" to the laboratory. Record notes detailing the sample number, time, date, and type on the sample log sheets and document the location of the duplicate sample (sample log sheets are not provided to the laboratory).

3.2.2 Examples of Field QA/QC Sample Nomenclature

The first project duplicate taken at the Pistol Range for subsurface soil sample collected on March 3, 2012 would be designated as 77PR-FD030312-01. The second project duplicate taken at the Rifle Range for subsurface soil collected March 10, 2012 would be designated as 77RR-FD031012-02

The first IDW sample collected on March 10, 2012 would be designated as 77-IDW031012-01, second IDW sample collected the same day would be designated as 77-IDW031012-02.

The first rinsate blank associated with samples collected March 3, 2012 would be designated as 77-RB030312-01, the second rinsate blank associated with samples collected March 4, 2012 would be designated 77-RB030412-02.

STANDARD OPERATING PROCEDURE

SOP 05

SOIL CORING USING HAND AUGER TECHNIQUES

1.0 PURPOSE

This Standard Operating Procedure (SOP) describes the procedures for collecting surface soil cores from unconsolidated overburden materials using hand auger drilling techniques at the at the Naval Activity Puerto Rico, Ceiba, Puerto Rico.

2.0 REQUIRED FIELD FORMS AND EQUIPMENT

Disposable medical-grade gloves (e.g., latex, nitrile)
Writing utensil
Stainless Steel Auger Buckets
Stainless Steel Extension Rods
Cross Handle
Required decontamination materials

3.0 BOREHOLE ADVANCEMENT AND SOIL SAMPLING USING A HAND AUGER

Hand augers will be employed to collect the soil samples. A hand augering system generally consists of a variety of stainless steel bucket bits (i.e. cylinders 6-1/2” long and 2-3/4”, 3-1/4”, and 4” in diameter), a series of extension rods (available in 2’, 3’, 4’ and 5’ lengths), a cross handle. The hand auger can be used in a wide variety of soil conditions. It can be used to sample soil, both from the surface, or to depths in excess of 12 feet. However, the presence or rock layers and the collapse of the borehole normally contribute to its limiting factors.

3.1 Attach a properly decontaminated bucket bit into a clean extension rod and further attach the cross handle to the extension rod.

3.2 Clear the area to be sampled of any surface debris (vegetation, twigs, rocks, letter, etc.)

3.3. Begin augering (periodically removing accumulated soils from the bucket bit) and add additional rod extensions as necessary. Also, note (in a field notebook or on standardized data sheets) and changes in the color, texture or odor of the soil.

3.4 After reaching the desired depth, slowly turn the hand auger until the bucket bit is advanced approximately 6 inches for surface (twice for subsurface 1 to 2 feet interval).

3.8 Discard the top of the core (approximately 1”), which may be any loose material collected by the bucket bit before penetrating the sample material.

3.9 Remove the sample material from the bucket bit using a stainless steel spoon and place into a properly decontaminated stainless steel mixing bowl and thoroughly homogenize the sample material prior to filling the sample containers, as described in SOP-06.

3.10 Excess soil core materials will be returned to the hole and tamped. If insufficient soil is available to fill the hole to the ground surface.

3.11 Decontaminate all soil sampling equipment in accordance with SOP-07 before collecting the next sample.

STANDARD OPERATING PROCEDURE
SOP-06

SOIL SAMPLING

1.0 PURPOSE

This Standard Operating Procedure (SOP) describes the procedures for collecting surface and subsurface soil samples from unconsolidated overburden materials using hand auger techniques at the Naval Activity Puerto Rico, Ceiba, Puerto Rico. This procedure also describes the collection of samples for analysis of volatile organic compounds (VOCs) using EnCore™ samplers.

2.0 REQUIRED FIELD FORMS AND EQUIPMENT

The following field forms and equipment are required for sediment sampling.

Disposable medical-grade gloves (e.g., latex, nitrile)
Work Gloves
Indelible marker
Plastic storage bags
Sample Labels
Cooler (containing ice)
EnCore handle and samplers
Disposable plastic trowels or Stainless steel trowels
Stainless steel mixing bowls
Sample containers: Sample containers are certified clean by the laboratory supplying the containers.
Soil Sample Log Forms

3.0 SAMPLING PROCEDURES

Hand augers will be used to collect soil samples as described in SOP-05. The sampler will wear clean, disposable, medical-grade gloves and work gloves as needed.

3.1 Clear the area to be sampled of any surface debris (herbaceous vegetation, twigs, rocks, litter, etc.).

3.2 Turn the hand auger sampler into the ground to a depth of 0.5 feet. The 0- to 0.5-foot depth soil interval is considered to be the surface soil.

3.3 Log the soil core on the Boring Log Sheet (attached).

3.4 For the VOCs analysis, collect the EnCore™ sample directly from the auger bucket in the following steps 3.4.1 through 3.4.8, for all other analysis skip to step 3.5.

3.4.1 Load the Encore™ sampler into the T-handle with the plunger fully depressed.

3.4.2 Press the T-handle with encore sampler against the freshly exposed soil between the cutting teeth of the auger bucket, forcing soil into the sampler. The plunger will be forced upward as the cavity fills with soil.

3.4.3 When the sampler is full, rotate the plunger and lock it into place. If the plunger does not lock, the sampler is not full. This method ensures there is no headspace. Soft soil may require several plunges or forcing soil against a hard surface such as a sample trowel to ensure that headspace is eliminated.

3.4.4 Use a paper towel to remove soil from the side of the sampler so a tight seal can be made between the sample cap and the rubber O-ring.

3.4.5 With soil slightly piled above the rim of the sampler, force the cap on until the catches hook the side of the sampler.

3.4.6 Remove any soil from the outside of the sampler and place in the foil bag provided with the sampler. Good work hygiene practices and diligent decontamination procedures prevents the spread of contamination even on the outside of the containers.

3.4.7 Label the bag with appropriate information in accordance with SOP-02.

3.4.8 Place the full sampler inside a lined cooler with ice and cool to 4˚C ± 2 ˚C. Make sure any required trip blanks and temperature blanks are also in the cooler. Secure custody of the cooler in accordance with SOPs-01 and -03. Typically, collect four Encore™ samplers at each location and an additional 2-oz jar will be required for the moisture content analysis. Consult the SAP or laboratory to determine the required number of Encore™ samplers to be collected.

The T-handle shall be decontaminated before moving to the next interval or location in accordance with SOP-07. A complete set of instructions for the EnCore™ samplers should be provided by the laboratory.

3.5 For all other non-VOCs analysis: Place the soil aliquot in a stainless-steel mixing bowl and homogenize. Place soil sample into laboratory supplied sampling container, and affix label in accordance with SOP-02.

3.6 Place the labeled sample container into a plastic storage bag and then place the plastic storage bag holding the sample container into a cooler containing ice.

3.7 Complete required information on Soil Sample Log Sheet (copy attached at the end of this SOP). Note the location of each aliquot in the "OBSERVATIONS/NOTES" section of the Soil and Sediment Sample Log Sheet. The information will be automatically updated to the Chain-of-Custody (COC) Form.

3.8 Record the date, sampling site, site conditions, location map, and other information on the Soil and Sediment Sample Log Sheet.

3.9 For subsurface soil samples, turn the hand auger sampler into the ground to a depth of 2 feet in accordance with SOP-05. Collect the sample aliquot from the prescribed depth interval below the ground surface and follow steps 3.3 through 3.8.

4.0 ATTACHMENTS

1. Soil and Sediment Sample Log Sheet
2. Boring Log

ATTACHMENT 1

SOIL AND SEDIMENT SAMPLE LOG SHEET

SOIL & SEDIMENT SAMPLE LOG SHEET

Page___ of ___

Project Site Name: _____
Project No.: _____

[] Surface Soil
[] Subsurface Soil
[] Sediment
[] Other: _____
[] QA Sample Type: _____

Sample ID No.: _____
Sample Location: _____
Sampled By: _____
C.O.C. No.: _____

Type of Sample:
[] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

Date:	Depth Interval	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Time:			
Method:			
Monitor Reading (ppm):			

COMPOSITE SAMPLE DATA:

Date:	Time	Depth Interval	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other

OBSERVATIONS / NOTES:

MAP:

Circle if Applicable:

MS/MSD	Duplicate ID No.:

Signature(s):

ATTACHMENT 2

BORING LOG

Tetra Tech NUS, Inc.

BORING LOG

Page ___ of ___

PROJECT NAME: _____ BORING No.: _____
PROJECT NUMBER: _____ DATE: _____
DRILLING COMPANY: _____ GEOLOGIST: _____
DRILLING RIG: _____ DRILLER: _____

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	MATERIAL DESCRIPTION: Color	MATERIAL DESCRIPTION: Material Classification	USCS *	Remarks	PID/FID Reading (ppm): Sample	PID/FID Reading (ppm): Sampler BZ	PID/FID Reading (ppm): Borehole**	PID/FID Reading (ppm): Driller BZ**

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Drilling Area Background (ppm): ____

Remarks: _____

Converted to Well: Yes _____ No _____ Well I.D. #: _____

STANDARD OPERATING PROCEDURE
SOP 07

DECONTAMINATION OF FIELD SAMPLING EQUIPMENT

1.0 PURPOSE

This Standard Operating Procedure (SOP) establishes the procedures to be followed when decontaminating non-dedicated field sampling equipment during the field investigations at the Naval Activity Puerto Rico, Ceiba, Puerto Rico.

2.0 REQUIRED FIELD FORMS AND EQUIPMENT

Waterproof pens
Non-latex rubber or plastic gloves
Field logbook
Potable water
Deionized water
LiquiNox or Alconox detergent
Brushes, spray bottles, paper towels, etc.
Wash buckets or bins
55-gallon drum or other container to collect and transport used decontamination fluids

3.0 DECONTAMINATION PROCEDURES

3.1 Don non-latex nitrile plastic gloves.

3.2 Rinse the equipment with potable water. Rinsing may be conducted by spraying with water from a spray bottle or by dipping equipment in to bucket of potable.

3.3 Wash the equipment with a solution of LiquiNox or Alconox detergent. Prepare the detergent wash solution in accordance with the instructions on the detergent container. Use brushes or sprays as appropriate for the equipment.

3.4 Rinse the equipment with potable water. Rinsing may be conducted by spraying with water from a spray bottle or by dipping.

3.5 Rinse the equipment with deionized water. Rinsing may be conducted by spraying with water from a spray bottle or by dipping.

3.6 Remove excess water by air drying, shaking, or by wiping with paper towels as necessary.

3.7 Document decontamination by recording it in the field logbook.

3.8 Containerized used decontamination solutions in accordance with the procedures described in SOP-08 and this UFP-SAP.

Note: Equipment rinsate blanks will be collected following a field decontamination event.

STANDARD OPERATING PROCEDURE

SOP 08

MANAGEMENT OF INVESTIGATION-DERIVED WASTE

1.0 PURPOSE

This Standard Operating Procedure (SOP) describes how investigation-derived waste (IDW) will be collected, segregated, classified, and managed during the field investigations at the Naval Activity Puerto Rico, Ceiba, Puerto Rico. The following types of IDW will be generated during this investigation:

- Excess soil materials remaining from sampling activities
- Decontamination solutions
- Personal protective equipment and clothing (PPE)
- Miscellaneous trash and incidental items

2.0 REQUIRED FIELD FORMS AND EQUIPMENT

Health and safety equipment (with PPE)
Decontamination equipment
Field logbook and indelible ink pen
Plastic sheeting and/or tarps
55-gallon drums with sealable lids
IDW labels for drums
Wastewater container tanks
Plastic garbage bags

3.0 PROCEDURES

Management of IDW includes the collection, segregation, temporary storage, classification, final disposal, and documentation of the waste-handling activities.

3.1 Liquid Wastes

Liquid wastes that will be generated during the site activities include decontamination solutions from sampling equipment. As they are collected from individual sites, these wastewaters will be containerized

at the site. Then at the completion of the field activities the containers will be marshaled at a central location determined by NAPR personnel.

Each drum will be labeled with the following information.

- The quantity of water from each source
- The date the wastewater was generated
- The NAPR POC name and phone number

3.2 Soil Borings

Cuttings from the soil borings will be placed back into the boring from which they came. In the event that grossly-contaminated soils are encountered, soils will be drummed. If soils are containerized, at the completion of the field activities the containers will be marshaled at a central location determined by NAPR personnel.

Each drum will be labeled with the following information.

- The quantity of soil from each source
- The date the soil collection started
- The NAPR POC name and phone number

3.3 PPE, Pump Discharge Tubing, and Incidental Trash

All PPE wastes, and incidental trash materials (e.g., wrapping or packing materials from supply cartons, waste paper) will be decontaminated (if contaminated), double bagged, securely tied shut, and placed in a designated waste receptacle at NAPR.

STANDARD OPERATING PROCEDURE
SOP-09
GLOBAL POSITIONING SYSTEM

1.0 OVERVIEW

The primary purpose of this Standard Operating Procedure (SOP) is to provide the Field Technicians with basic instructions for operating a handheld Global Positioning System (GPS) unit allowing them to set GPS parameters in the receiver, record GPS positions on the field device, and transfer the data for integration into existing Geographic Information System (GIS) figures.

This SOP is specific to GIS quality data collection for Trimble-specific hardware and software.

If possible, the Trimble GeoXT or XH Operators Manual should be downloaded onto the operator's personal computer for reference before or while in the field. The manual can be downloaded at the following website:
http://trl.trimble.com/docushare/dsweb/Get/Document-311749/TerraSyncReferenceManual.pdf

Unless the operator is proficient in the setup and operation of the GPS unit, the Project Manager (or designee) should have the GPS unit shipped to the project-specific contact listed below in the Pittsburgh, Pennsylvania office at least five working days prior to field mobilization so project-specific data files (i.e. shape files), background images, data dictionaries, and correct coordinate systems can be uploaded into the unit.

Tetra Tech NUS
Attn: Ralph Basinski
661 Anderson Drive, Bldg #7
Pittsburgh, PA 15220

The SOP also describes how field collected data is to be transferred through the use of the MRP Website. (http://www.ttnus.com/MRPRepository/). This website serves as a centralized portal to facilitate data exchange for field personnel, GIS staff, and project managers. The website contains a "Reference" page that will contain the latest version of this SOP and other valuable documentation.

For general questions about this SOP, technical questions regarding operation of the GPS units and data collection, please contact Kevin Moore (kevin.moore@tetratech.com). For use of the MRP website, please contact Doug Schloer (douglas.schloer@tetratech.com).

2.0 REQUIRED EQUIPMENT

The following hardware and software should be utilized for locating and establishing GPS points in the field:

2.1 GPS Hardware & Equipment

- Hand-held GPS Unit capable of sub-meter accuracy. This includes the docking cradle, a/c adapter, stylus, and USB cable for data transfer. Two models, the GeoXH and GeoXT, are acceptable for use. The XH yields higher accuracy (in both real-time and post-processed) and **should always be requested** when highly precise data is required.

- An external antenna will yield better satellite reception, especially in heavy tree canopy. Associated accessories include a range pole and hardware clamp, for mounting the GPS unit to the pole.

- Indelible marker.

- Non-metallic pin flags for temporary marking of positions.

2.2 GPS Software

The following software is required to transfer data from the handheld GPS unit to a personal computer:

- Trimble TerraSync version 2.6 or later (pre-loaded onto GPS unit from vendor)

- Microsoft ActiveSync version 4.5 or later. Download to personal computer from:
  http://www.microsoft.com/windowsmobile/en-us/downloads/microsoft/activesync-download.mspx

  Note: Windows Vista and Windows 7 users should download Windows Mobile Device Center version 6.1 or later from the following site, if it is not already loaded on the machine:
  http://www.microsoft.com/windowsmobile/en-us/downloads/microsoft/device-center-download.mspx

- Trimble Data Transfer Utility (freeware version 2.1 or later). Download to personal computer from:
  http://www.trimble.com/datatransfer.shtml

3.0 START-UP PROCEDURES

Prior to utilizing the GPS in the field, ensure the unit is fully charged. The unit may come charged from the vendor, but an overnight charge is recommended prior to fieldwork.

The Geo-series GPS units require a docking cradle for both charging and data transfer. The Geo-series GPS unit is docked in the cradle by first inserting the far domed end in the top of the cradled, then gently seating the contact end into the latch. The power charger is then connected to the cradle at the back end using the twist-lock connector. Attach a USB cable as needed between the cradle (B end) and the laptop/PC (A end).

It is recommended that the user also be familiar and check various Windows Mobile settings. One critical setting is the Power Options. The backlight should be set as needed to conserve power when not in use.

3.1 Initial Start Up

1) Power on the GPS unit by pushing the small green button located on the lower right front of the unit.

2) Utilizing the stylus that came with the GPS unit, launch **TerraSync** from the Windows Operating System by tapping on the start icon located in the upper left hand corner of the screen and then tap on **TerraSync** from the drop-down list.

3) If the unit does not default to the Setup screen, tap the Main Menu (uppermost left tab, just below the Windows icon) and select Setup.

4) If the unit was previously shipped to the Pittsburgh office for setup, you can skip directly to Section 4.0. However, to confirm or change settings, continue on to Section 3.1.

3.2 Confirm Setup Settings

Use the Setup section to confirm the TerraSync software settings. To open the Setup section, tap the Main Menu and select Setup. (Note that if the unit was shipped from the Pittsburgh office, these settings should have been set for your specific project. Feel free to contact Pittsburgh staff with any questions.)

1) Tap on the Coordinate System.
2) Verify the project specs are correct for your specific project by scrolling through the various settings. Edit as needed and then tap OK; otherwise, tap Cancel to return to Setup Menu. **Note:** It is always best to utilize the Cancel tab rather than the OK tab if no changes are made since configurations are easily changed by mistake.
3) Tap on the Units.

4) Verify the user preferences are correct for your specific project by scrolling through the various settings. Edit as needed and then tap OK; otherwise, tap Cancel to return to Setup Menu.
5) Tap Real-time Settings.
6) Verify the Real-time Settings are correct for your specific project by scrolling through the various settings. Edit as needed and then tap OK; otherwise, tap Cancel to return to Setup Menu.
7) The GPS unit is now configured correctly for your specific project.

3.3 Antenna Connection

1) If a connection has been properly made with the internal antenna, a satellite icon along with the number of usable satellites will appear at the top of the screen next to the battery icon. If no connection is made (e.g.: no satellite icon), tap on the GPS tab to connect antenna.
2) At this point the GPS unit is ready to begin collecting data.

3.4 Loading a Background file

This section provides instructions on pulling in a pre-loaded background file. These files are helpful in visualizing your current location.

1) From the Main Menu select Map, then tap on Layers, select the background file from drop down list.
2) Select the project-specific background file from the list of available files.
3) Once the selected background file appears, the operator can manipulate the screen utilizing the +/- and <-/-> functions at the bottom of the screen.
4) In operating mode, the operator's location will show up on the background file as a floating "x".

4.0 FIELD DATA COLLECTION

For MRP data collection activities, a new GPS file should be created **every day** and transferred **nightly** using the MRP website (see Section 9.0). This is to insure the timely transfer of data, file organization in the database, and allow for next-day GIS mapping. Also, individual GPS data files should be **unique to a particular site** or unit (typically a UXO number). If multiple sites are visited in a single data, multiple files should be created.

4.1 Creating a Data File

1) From the Main Menu select Data.
2) From the Sub Menu (located below the Data tab) select New which will bring up the New Data File menu.

3) An auto-generated filename appears and should be edited for your specific project. For example, the following naming convention should be followed as closely as possible: **IH-UXO4-01012010-TeamA**, where "IH" is the installation abbreviation (Indian Head), "UXO04" is the site, and "01012010" is the data in MMDDYYYY format. If multiple teams are being deployed across an individual site on the same day, it is important to specify the field team name at the end of the file name ("TeamA"). If the integral keyboard does not appear, tap the small keyboard icon at the bottom of the screen.
4) Select the data dictionary that will be used to collect features. The data dictionary provides predefined fields and drop-down menus to facilitate data collection as it relates to specific MRP data types. The MRP data dictionary is entitled "**MRP Data Collection**" and should appear in the data dictionary drop-down list. This should have been pre-loaded into the GPS prior to use. The data dictionary file is available on the MRP website under the "Reference" section.
5) After entering the file name and selecting the data dictionary, tap Create to create the new file.
6) Confirm antenna height if screen appears. Antenna height is the height that the GPS unit will be held from the ground surface (Typically 3 to 4 feet)
7) The Choose Feature screen appears.

4.2 Collecting Features

1) If not already open, the Collect Feature screen can be opened by tapping the Main Menu and selecting Data. The Sub Menu should default to Collect.
2) **<u>Do not</u> begin the data logging process until you are at the specific location for which you intend to log the data.**
3) A known reference or two should be shot at the beginning and at the end of each day in which the GPS unit is being used. This allows for greater accuracy during post-processing of the data.
4) Upon arriving at the specific location, select the proper feature type from the data dictionary list (MEP Object, Transect End Point, GPS QC Point, or General Point).
5) Tap Create to begin data logging.
6) As the GPS is collecting positions, enter the feature attributes, starting with the Item ID. This field is required and will not allow the user to continue or save the position without entering a value. Enter any additional notes or feature descriptions in the appropriate fields.
7) Data logging can be confirmed by viewing the writing pencil icon in the upper part of the screen. Also, the logging counter will begin. As a Rule of Thumb, accumulate a minimum of 20 readings on the counter, per point, as indicated by the logging counter before saving the GPS data.
8) Once the counter has reached a minimum number of counts (i.e. 20), tap on OK to save the data point to the GPS unit. Confirm the feature. All data points are automatically saved within the GPS unit.
9) Repeat steps 2 through 8, giving each data point a unique name or number.

Note: If the small satellite icon or the pencil icon is blinking, this is an indication the GPS unit is not collecting data. A possible problem may be too few satellites. While still in data

collection mode, tap on Main Menu in upper left hand corner of the screen and select Status. Skyplot will display as the default showing the number of available satellites. To increase productivity (number of usable satellites) use the stylus to move the pointer on the productivity and precision line to the left. This will decrease precision, but increase productivity. The precision and productivity of the GPS unit can be adjusted as the number of usable satellites changes throughout the day. To determine if GPS is correctly recording data, see Section 5.2. If the precision toggle is decreased, the user should frequently check the Skyplot display to restore the default values as soon as possible.

4.3 Navigation

This section provides instructions on navigating to saved data points in an existing file within the GPS unit.

1) From the Main Menu select Map.
2) Using the Select tool, pick the point on the map to where you want to navigate.
3) The location you select will have a box placed around the point.
4) From the Options menu, choose the Set Nav Target (aka set navigation target).
5) The location will now have double blue flags indicating this point is you navigation target.
6) From the Main Menu select Navigation.
7) The dial and data on this page will indicate what distance and direction you need to travel to reach the desired target.
8) Follow the navigation guide until you reach the point you select.
9) Repeat as needed for any map point by going back to Step 1.

4.4 Data Quality Control

Quality control checks should be performed each day of data collection and/or data navigation. QC checks are important both to understand real-time accuracy while in the field, and also to provide control data needed during post-processing.

1) Known survey benchmarks, surveyed monitoring wells, or other established and documented control points should be identified
2) GPS equipment should be placed on known control points and positions recorded
3) For data collection tasks - QC check data should be collected at least at the start and completion of the fieldwork for the day of data collection. Additional occupation and collection of control point data should occur as possible during the work day, and should increase in frequency as the number of data points increase and the need for accurate data collection increases
4) For navigation tasks such as stake placement for planned sample locations, QC data checks should be done at least at the start and completion of the fieldwork for each day. Known visible targets should be occupied and observed by the user, while the GPS satellite status and other user interface data is reviewed. The user should assess whether

the real-time accuracy settings on the GPS are within the tolerance of the observed visual reference points.

4.5 Viewing Data or Entering Additional Data Points to the Current File

1) To view the stored data points in the current file, tap on the Main Menu and select Map. Stored data points for that particular file will appear. Use the +/- and <-/-> icons in lower left hand corner of screen to zoom in/out and to manipulate current view.
2) To return to data collection, tap on the Main Menu and select Data. You are now ready to continue to collect additional data points.

4.6 Viewing Data or Entering Data Points from an Existing File

1) To view data points from a previous file, tap on Main Menu and select Data, then select File Manager from the Sub Menu.
2) Highlight the file you want to view and select Map from the Main Menu.
3) To add data points to this file, tap on Main Menu and select Data. Continue to collect additional data points.

4.7 Shutting Down

This section provides instruction for properly shutting down the GPS unit.

1) When shutting down the GPS unit for the day, first click on the "X" in the upper right hand corner.
2) You will be prompted to ensure you want to exit TerraSync. Select Yes.
3) Power off the GPS unit by pushing the small green button located on the bottom face of the unit.
4) Place the GPS unit in its cradle to recharge the battery overnight. Ensure the green charge light is visible on the charging cradle.

5.0 DATA TRANSFER

This section describes how data should be downloaded from the GPS units and uploaded to a central website for post-processing and integration into GIS datasets. GPS data collected on a given day should be transferred **that night** for post-processing by GIS staff the next morning. Once post-processed, the GPS data will be plotted on a map and be immediately provided to the project team for review. Data upload, download, and review will be facilitated through a secure MRP website: http://www.ttnus.com/MRPRepository/

5.1 Load Data from the GPS Unit to Your Computer

1) Install the Data Transfer and ActiveSync software installed on your PC (see section 2.2)
2) Connect the GeoXH/XT to your PC via an A/B USB cable (blade end and square end type "HP printer" style)
3) ActiveSync should auto-detect the connection and recognize the data collector
4) Make sure the data file desired is CLOSED in TerraSync prior to transfer
5) Connect via ActiveSync as a guest (not a partnership)
6) Run the Trimble Data Transfer Utility program on your PC
7) Select "***GIS Datalogger on Windows CE***" or similar selection
8) Hit the green connect icon to the right - the far right area should say "***Connected to ....***" if successful
9) Select the "***Receive***" data tab (under device)
10) Select "***Data***" from file types on the right
11) Find the file(s) needed for data transfer. You can sort the data files by clicking on the date/time header
12) Select or browse to a C-drive folder you can put this file for upload
13) When the file appears on the list, hit the "***Transfer All***". Once complete, a packet of multiple data files will appear on your computer in the specified folder.

5.2 Gain Access to MRP Website

1) Confirm that your computer has internet access
2) Click on the following link: http://www.ttnus.com/MRPRepository/
3) To register for the website, click on the "Register here" link. Enter your information and click "Submit." NOTE: Requests for registration are sent to Ralph Basinski, Program Manager, for approval. Please contact doug.schloer@tetratech.com if you experience any access issues.
4) Enter your username (Tetra Tech email address) and password to log in.

5.3 Upload GPS Data from Your Computer to the MRP Website

1) From the main page, select "Upload" from the menu at left.
2) Select the type of data you are uploading, typically "GPS Field Data"
3) Select the appropriate Installation and Site. Remember that GPS files should be unique for each site, even if multiple sites are visited in one day. If collected data is not associated with a site, select "Other."
4) Select "browse" to navigate to the appropriate *.SSF file on your computer. When you use the Trimble download utility to grab data from the GPS unit, multiple files will appear on your computer. You only need to the upload the *.SSF file.
5) Populate the "Comments" field to describe the dataset and any other pertinent information. This information will be provided to the GIS analyst who will be integrating the dataset, so be sure to be as descriptive as possible especially if there are any issues with the data. (For example, if you were to sample 16 points and for some reason you believe only 15 were logged, it is helpful to share this information.)
7) Select "Upload." Users will be notified if the files were uploaded successfully.

5.4 Download Data from the MRP Website to Your Computer

The download utility on the MRP website will serve different user types. **Field staff** will use the utility to download GIS figures (in PDF format) and view the previous day(s) field data on aerial photographs, checking for any discrepancies or missing data elements. **Project Managers** will also have the ability to download and view these figures, to visualize the data and track project progress. This utility will also allow **GIS Analysts** to download the *.SSF files posted by field staff for post-processing and map plotting.

To download GIS Figures:

1) From the main page, select "Download" from the menu at left.
2) Select an Installation and Site
3) Users can view Figures for a particular date or by a range of dates, by selecting the ` appropriate options. To search all dates, leave all of these fields as the default.
4) Select "Search"
5) A table will appear showing the files available for download. Simply click on the link to the file and you will be prompted to save it to your computer.

TABLE 1

Related Field Forms

Form Number	Frequency	Form Name
MRP FF.3	Daily	Daily Equipment Checklist

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1.0 GENERAL

This Standard Operating Procedure (SOP) was prepared in accordance with applicable U.S. Army Corps of Engineers procedures and policies governing field activities where Munitions and Explosives of Concern [MEC], Material Potentially Presenting an Explosive Hazard [MPPEH] and/or Chemical Warfare Material (CWM) could be encountered. All personnel conducting operations under this SOP must read and understand applicable parts of references listed in section 9.1 below prior to commencing any work described within this SOP. Other documents supporting this SOP include project-specific Work Plans and Health and Safety Plans which are prepared for the purpose of accomplishing work that contain a Munitions and Explosives of Concern [MEC] or CWM component [MEC includes Unexploded Ordnance (UXO), Discarded Military Munitions (DMM) and Munitions Constituents (MC)].

2.0 PURPOSE

This SOP applies to all operations involving MEC and/or CWM support during field operations at various sites where Tetra Tech NUS (TtNUS) personnel are present. It provides procedural requirements for any activity involving MEC and CWM, as well as detailed procedures for the location, identification, documentation, and emergency response actions pertaining to MEC/CWM activities.

3.0 APPLICABILITY

This SOP applies to persons who may visit any site where TtNUS is performing work that involve some MEC or CWM component. Compliance with the content of this SOP is mandatory for all TtNUS personnel, subcontractors, and visitors to any site where MEC/CWM activities are in progress.

4.0 RESPONSIBILITIES

Project Manager

Effective implementation of this SOP at the project level will be the ultimate responsibility of the assigned TtNUS Project Manager. The Project Manager is responsible for ensuring that all applicable rules and regulations are complied with, and that all necessary safety precautions are taken to conduct operations in accordance with this SOP. To fulfill this responsibility, the assigned Project Manager is required to ensure that appropriately-qualified technical staff are involved in all stages of project planning and field work, as well as for ensuring that appropriate resources are marshaled and used on his/her assigned projects. For projects involving MEC and/or CWM, this will involve ensuring that a suitably qualified and experienced UXO Technician and a site Health and Safety Officer are part of the project team. In some cases, the assigned UXO Technician may also serve as the project site Health and Safety Officer.

It is also the responsibility of the Project Manager to ensure that all personnel conducting field activities in accordance with this SOP have proper training (including hazard control briefings) and, if required, the proper certifications for the job being performed.

UXO Technician

A suitably qualified and experienced UXO Technician will be included as part of the project team where these types of concern are known or suspected to exist. The UXO Technician will be primarily responsible for advising the Project Manager on all MEC/CWM matters, including the measures that will be necessary to effectively implement and adhere to this SOP. Other specific duties will include:

- Providing technical expertise and input into project planning activities and documents such as the project-specific Work Plan and Health and Safety Plan
- Assessing worksite areas for MEC/CWM concerns prior to the initiation of any other onsite activities

- Participating in the development and conductance of site specific training sessions and daily tailgate meetings to communicate MEC/CWM matters to the field personnel
- Maintaining a sound familiarity with the contents of this SOP, the contents of the references listed in section 9.1, and keeping current with new information and technology pertinent to MEC/CWM matters

Site Health and Safety Officer

A suitably qualified and experienced health and safety professional will be assigned to all projects that involve fieldwork. Project-specific responsibilities will include:

- Effectively implementing the requirements and restrictions specified in the project-specific Health and Safety Plan
- Ensuring that all personnel participating in onsite activities have satisfied all appropriate medical and training qualifications prior to participating in any onsite activities.
- Conduct initial site-specific health and safety training for all personnel participating in onsite activities.
- Conduct tail-gate safety briefings prior to the initiation of all tasks, but not less than daily.
- On certain projects, these duties may be assigned to the UXO Technician. This would be considered acceptable on field projects where the predominant concern is contact with MEC and/or CWM, and minimal health concerns or requirements (e.g., chemical exposures or monitoring) exist.

Corporate Health and Safety Manager

Perform periodic project audits and evaluations to determine the ongoing effectiveness of this SOP to address MEC/CWM concerns, and review and evaluate this SOP to determine any revisions that are appropriate.

5.0 LOCATION OF OPERATIONS

MEC and/or CWM concerns may exist at TtNUS project sites throughout the continental United States and abroad. Wherever the installation/site is located, it will be necessary to ensure that project planning activities include collecting available historical information that may be pertinent to these issues, as well as identifying and addressing contract/client-specific requirements and any location-specific requirements (e.g., State, local-level, or host-nation requirements). A detailed site description, discussion of known and/or suspected contamination sources, and results of previous studies will be provided to field personnel as part of their field mobilization and initial site-specific training activities.

The initial project evaluation must involve the performance of a preliminary risk assessment, including the investigation of probable contaminants, potential transport pathways, the identification of potential receptors, and a preliminary evaluation of human health and environmental concerns. Preliminary identification of applicable or relevant and appropriate requirements (ARARs) will also be made available to field personnel conducting activities at the installation.

6.0 PERSONNEL QUALIFICATIONS AND REQUIREMENTS

6.1 Personnel Qualifications: Qualifications of those personnel actively involved in MEC/CWM operations shall be as follows:

a. UXO personnel shall be graduates of a military EOD School of the United States. Graduate of a military EOD school of Canada, Great Britain, Germany, or Australia. Graduate of a formal training course of instruction or EOD assistant course as stated in DDESB TP-18.

b. The Senior UXO Supervisor (SUXOS) will have at least 10 years in military EOD/UXO Experience, of which more than 5 years will be in a supervisory position.

c. UXO personnel are responsible for maintaining current status with training and medical surveillance requirements, as specified in the project-specifc Health and Safety Plans and OSHA 29 CFR 1010.120, paragraphs (e) and (f).

6.2 Personnel Requirements: During any activity where the possibility that MEC and/or CWM may be encountered (no matter how remote), the following requirements will be met:

a. One UXO-qualified technician will be required to support each field team engaged in operations in areas that might contain MEC/CWM.

b. One UXO-qualified technician will be present at the site during all activities to provide MEC/CWM support in the event their services are required.

7.0 PERSONNEL LIMITS

The activities to be conducted under most contracts will not normally be conducted in areas requiring maximum personnel limitations except for intrusive MEC activities. Work will not be permitted unless at least two persons are present in the work area. The provisions of 29 CFR 1910.120 concerning personnel qualifications and requirements will be followed while working on-site. Any additional personnel limitation requirements specified by the client or the project work location (e.g., state, local ordnance, host nation, etc.) will also be identified and adhered to at all times.

7.1 Personnel Limits for MEC Operations:

a. MEC Avoidance Operations – One UXO Technician (UXO Technician III or UXO Technician II)

b. MEC Intrusive Operations - Two UXO Technicians (one UXO Technician III and one UXO Technician II or I)

8.0 MATERIAL LIMITS

The properties and configurations of specific explosive materials are not addressed in this SOP. That level of detail is required to be addressed in project-specific Work Plans and Health and Safety Plans. This SOP must be maintained onsite along with these project-specific documents to aid in appropriate communication and implementation activities. Bulk liquids to be used for decontamination of equipment will be maintained in 2-gallon containers or less. Material Safety Data Sheets (MSDSs) will be kept on file in the TtNUS Command Post for any chemical substances brought to the project site by TtNUS and TtNUS subcontractor personnel. This is addressed in greater detail in section 5. of the TtNUS Health and Safety Guidance Manual.

9.0 SAFETY REQUIREMENTS

9.1 Referenced Safety Requirements: The safety requirements that apply to the MEC/CWM operations covered under this SOP are:

a. OSHA 29 CFR 1910.120 and 1926.65 – Hazardous Waste Operations and Emergency Response (HAZWOPER). Available online at: http://www.osha.gov/pls/oshaweb/owasrch.search_form?p_doc_type=STANDARDS&p_toc_level=0&p_keyvalue=OSHA_Std_toc.html

b. US Army Corps of Engineers Engineering Regulation 385-1-92, *Safety and Occupational Health Document Requirements for Hazardous, Toxic and Radioactive Waste (HTRW) and Ordnance and Explosive Waste (OE) Activities.* Available online at: http://www.usace.army.mil/inet/usace-docs/eng-regs/er385-1-92/entire.pdf

c. US Army Corps of Engineers Engineering Pamphlet (EP) 385-1-95a, *Basic Safety Concepts and Consideration for OE Operations.* Available online at: http://www.usace.army.mil/inet/usace-docs/eng-pamphlets/ep385-1-95a/entire.pdf

d. US Army Corps of Engineers Engineering Manual (EM) 385-1-1, *Safety and Health Requirements.* Available on line at: http://www.usace.army.mil/publications/eng-manuals/em385-1-1/toc.htm.

e. US Army Corps of Engineers Data Item Description OE – 025.02, *Personnel/Work Standards* Available on line at: http://www.hnd.usace.army.mil/oew/policy/dids/FY04DIDs/OExxx/oe025_02.pdf

f. US Army Corps of Engineers Engineering Pamphlet (EP) 1110-1-18, *Ordnance and Explosive (OE) Response*. Available on line at: http://www.usace.army.mil/inet/usace-docs/eng-pamphlets/ep1110-1-18/entire.pdf

g. US Army Corps of Engineers Engineering Pamphlet (EP) 75-1-2, *Unexploded Ordnance Support for Hazardous, Toxic and Radioactive Waste and Construction Activities.* Available on line at: http://www.usace.army.mil/inet/usace-docs/eng-pamphlets/ep75-1-2/entire.pdf

h. US Army Corps of Engineers Engineering Pamphlet (EP) 75-1-3, *Recovered Chemical Warfare Material (RCWM) Response Process.* Available on line at: http://www.usace.army.mil/usace-docs/eng-pamphlets/ep75-1-3/entire.pdf

i. US Army Technical Manual 9-1300-206 (TM 9-1300-206), *Ammunition and Explosive Hazards.*

j. Technical Manual 60A-1-1-31, *Explosive Ordnance Disposal Procedures, General Information on EOD Disposal Procedures.*

9.2 Specific Safety Requirements:

a. All site operations will be suspended if any site worker encounters an item of suspected MEC/CWM. Site work will remain suspended until the item is inspected and cleared by the UXO Technician.

b. All site operations will be suspended if so ordered by an authorized client representative (i.e., Installation Range Control and/or Safety Office).

c. Buddy System –
   i. Escort/Avoidance - A minimum of two personnel, at least one a UXO-qualified technician will be present all sites where MEC is suspected or present.
   ii. Intrusive – A minimum of two UXO – qualified personnel [One Technician III and one Technician II or I] will conduct intrusive removal operations, with third person observing from a safe area to contact emergency support, if required.

d. Standard work practices as outlined in project-specific Health and Safety Plans and/or Work Plans will be observed.

9.3 Inherent MEC/CWM Hazards: MEC/CWM operations have inherent safety and health risks associated with the various field activities conducted. All planned activities will be conducted in accordance with the requirements of the references listed in Section 9.1 above, as safety is the primary consideration in all MEC/CWM activities. Every effort should be made to determine all hazards associated with the site through a thorough research of archives, past site/range uses, and any other available information. Some of the hazards to consider are:

a. Propellant, Explosives, and Pyrotechnics (PEP)
b. Depleted Uranium (DU)
c. White Phosphorus (WP)
d. Corrosive chemicals (acids and bases) and decontamination agents
e. Toxic gases, liquids and solids
f. Corroded and damaged containers, munitions bodies, drums, etc.
g. Fuze conditions
h. Etiological agents

10.0 PERSONAL PROTECTIVE EQUIPMENT (PPE)

Task-specific PPE will be identified in project-specific Health and Safety Plans. Typical PPE for project sites where the principle concern is for MEC/CWM will include the items listed below. Items marked with an asterisk (*) will be available and will be used as specified in the Health and Safety Plan and/or as determined by the TtNUS Site Health and Safety Officer.

a. Safety glasses

b. Safety shoes (and protective over boots or steel-toed rubber boots). NOTE: During geophysical survey operations, the UXO technicians will not wear steel-toed boots as they interfere with the magnetometer survey; however, around heavy equipment and activities where foot and overhead hazards may exist, steel-toed boots and hard hats will be worn.

c. Cotton clothing (with protective coveralls*)

d. Gloves (type to be specified for each project task in the Health and Safety Plan and/or by the site Health and Safety Officer)

e. Respiratory protection equipment* (29CFR1910.134)

f. Hearing protection*

g. Hard hats*

11.0 EMERGENCY RESPONSE AND CONTINGENCY PLANS

11. Emergency Contacts: The identification of (and means to communicate with) appropriate local emergency response agencies must be identified as part of project planning/mobilization activities, and these agencies must be contacted prior to the initiation of any onsite work. These initial communications must determine the capabilitities of these agencies to respond to foreseeable emergency situations, their willingness to respond, and their locations/driving directions/phone numbers. These details must be specified in the project-specific Health and Safety Plan and posted in the site Command Center/Field office.

At a minimum, the names and means of communication (phone number, radio frequency, etc.) of the following parties must be included in the project-specific Emergency Contacts procedure:

a. Local Emergency Fire Response that will respond (i.e., local Fire Department)

b. Emergency Medical Assistance (Hospital, Emergency Room, and ambulance service that will respond)

c. Installation Safety Office or other client safety/emergency response contact

d. Installation EOD Office/Detachment

e. Installation Environmental Office

The senior TtNUS managing employee onsite (Project Manager, Site Manager, Site Supervisor, Field Operations Leader) is responsible for initiating these calls in the event of an emergency where such support is needed. If the Project Manager is not onsite at the time of an emergency event, he/she must be added to the above list of contacts.

In the event of an emergency, all site personnel will be evacuated to a predetermined location away from the work place. Emergency Response Planning will be addressed in the project-specific Health and Safety Plan and will be in accordance with either 29 CFR 1910.38(a) or 1910.120(l). TtNUS will utilize the Installations Base Fire Protection and Emergency Services in emergencies or potential emergencies.

11.2 Contingency Plans: The following contingency plans will be implemented:

a. Pre-Planning – Upon arrival at the site/installation, the TtNUS Field Operations Leader (FOL) and/or the Site Safety Officer will meet with the Base or local Fire Protection Department, Base Security Personnel or local Police Department, and onsite and/or offsite Emergency services to notify them of the activities that are to be undertaken, when, and where. All site personnel will be required to follow established base/local emergency procedures and will rely on base/local services to handle emergency calls when needed.

b. Emergency Escape Procedures and Assignments – Upon notification of a site emergency that requires evacuation, all site personnel will proceed to predetermined locations based on emergency location and wind direction. An alternate assembly point will be designated in case personnel cannot reach these locations without danger to their lives and health. These primary and alternate escape routes and meeting places will be designated during the daily hazard control briefing. Personnel will be trained to remain at the assembly points until directed to either resume work or to leave the site.

c. Procedures to Account for Site Personnel – The site work force is typically small enough that accounting for personnel will not be a problem via visual head counting. On projects with larger field team sizes, roll calls will be taken using the daily sign in logs, logbook entries, or the tail-gate briefing sheets. Accounting for personnel will be the Field Operations Leader's responsibility.

d. Rescue and Medical Duties – TtNUS personnel will not be authorized to participate in emergency rescue operations. Typical first aid response equipment that is to be on hand at a project site includes suitable first aid kit, an emergency eye wash station, and at least one Five lbs Class ABC fire extinguisher.

e. Activation of Emergency Response Procedures - Should an emergency occur which requires the support of outside services, the appropriate contacts will be made by the senior TtNUS managing employee onsite (Project Manager, Site Manager, Site Supervisor, Field Operations

Leader). A list of appropriate contacts will be posted at the Command Post. Cellular phones, land-line phones, or hand-held radios will be the primary means of communication.

f. Airborne Chemical Release Contingency Plan –

(1) Chemical Release Monitoring – every member of the site team will be responsible for observing and reporting any gross chemical releases or conditions that could lead to releases. Air monitoring will be performed as described in the project-specific Work Plans and Health and Safety Plans.

(2) Responses to Measured Airborne Chemical Releases – the readings on monitoring instrumentation will be compared to the action levels specified in the project-specific Work Plans and Health and Safety Plans. The primary purpose of appropriate real-time monitoring instruments will be monitor worker breathing zone areas for the protection of employee health. The project-specific Health and Safety Plan will specify actions that are to be taken in the event that monitoring instrument readings indicate that detected concentrations may represent a health threat to onsite workers. Area and perimeter monitoring as well as sample screening activities may also be called for in the Work Plan or Health and Safety Plan, but these are *secondary* purposes for the use of these instruments.

Unless otherwise specified in a project-specific Health and Safety Plan, the following monitoring instrument action levels and response measures will be observed on MEC/CWA sites:

Parameter	Action Level
Total Organic Vapors	Any sustained level above background
Airborne particulates	Readings >2.5 mg/m^3
Flammable Vapors	10% of the Lower Explosive Limit (LEL)

If such levels are noted at site perimeters or adjacent to neighboring residential or commercial property, the TtNUS Field Operations Leader and/or the Site Safety Officer will notify the appropriate client or base contacts.

g. Liquid Release Monitoring – All field team members will be responsible for observing and reporting any liquid chemical releases or conditions that could lead to a release. If field operations on site result in a release of liquid chemicals in the absence of vapors, field personnel will attempt to contain the liquid by means of berms constructed with available equipment. If the work team cannot control the spill, they will leave the area for the assembly point quickly, without panic. The TtNUS Field Operations Leader and/or the Site Safety Officer will notify the appropriate client/base contact. This is not considered to be a significant probability during operations. However, in the unlikely instance that it should occur, field personnel may effect these types of defensive efforts, providing that such a response does not appear to present a chemical overexposure or other personal health or safety threat.

12.0 TYPICAL CLIENT/FACILITY SAFETY POINTS OF CONTACT

The following positions are typically encountered on MEC/CWA projects. Communication and coordination with these positions should be implemented and maintained throughout all project activities (from pre-field operations planning through to project close-out).

a. Installation Safety Management Office

b. Installation Ordnance Officer and/or EOD Officer

c. Installation Radiation Officer

d. Installation Environmental Office

13.0 TOOLS AND EQUIPMENT

Tools and equipment necessary to safely and effectively accomplish the objectives of a project will be detailed in the project-specific Work Plans and Health and Safety Plans. Items commonly required for MEC/CWM operations are presented below:

13.1 Personal Protective Equipment

a. Respiratory Protective Equipment (i.e., air purifying or air supplied devices)

b. Dermal (chemical resistant) protective equipment (e.g., coveralls, gloves, eye and face protection)

c. Physical safety PPE (hard hats, hearing protection, safety glasses, safety shoes, etc.)

13.2 Air Monitoring Equipment

a. Explosive/O_2 Meter (Combustible Gas Indicator)

b. Direct reading Organic Vapor Analyzer (PID or FID)

c. Direct reading particulate meter

d. Radiation Survey Meters and TLD Badges

13.3 Geophysical/Hydrology Survey Instrumentation

a. Magnetometers (Cesium Vapor, Schonstedt)

b. Electromagnetic Terrain Conductivity Meter (EM-31)

c. Time-Domain Electromagnetic All-Metals Detector (EM-61)

d. Water Level Indicator/Recorder

e. pH/Temperature/Conductivity Meter for water samples (Horiba, etc.

f. Survey Equipment (transit, tripod, level, etc.) as required

13.4 Support Equipment

a. Schonstedt Magnetic Locators (GA-52Cx or equivalent passive instrument) will be used for anomaly detection MEC activities. The GA-52Cx detects the magnetic field of any ferromagnetic object.

b. Schonstedt MG-220 Magnetic Gradiometer (Down-Hole Magnetometer or equivalent) will be used to conduct down hole anomaly checks. The MG-220 detects the magnetic field of any ferromagnetic object as it is lowered into a borehole.

c. Marking tape, pin flags, stakes, utility spray paints, etc.

13.5 CWM Support Equipment

a. Suitable monitoring equipment capable of detecting agents of concern

13.6 Decontamination Equipment

As required by the level of protection for each site. See Site Health and Safety Plan for specifics.

13.7 Hand Tools/ Miscellaneous Equipment

As may be required.

14.0 ENVIRONMENTAL CONCERNS

The field operations covered by this SOP will be performed in such a manner as to minimize the effects of pollution of air, water, or land and to control noise and dust emissions within reasonable limits.

Every effort will be made to:

a. Protect the land areas and to preserve them in their existing condition.

b. Protect water resources, including measures for run-off or run-off controls if applicable.

c. Implement sediment control measures, where warranted. These measures will also be implemented to control erosion.

Usually, field operations will generate solid and liquid waste (Investigative Derived Waste – IDW) requiring onsite handling and possible offsite disposal. The major types of waste to be generated, their environmental concerns, and their handling and disposition are summarized below:

a. Personal and equipment decontamination containers disposed offsite following a thorough decontamination. Liquid waste will be included with well purging and development fluids.

b. Personal Protective Equipment (PPE) will be double-bagged and will be the responsibility of TtNUS to dispose of according to applicable regulations. Disposal will normally be offsite.

It is not anticipated that any chemical releases will occur during the field activities.

The MSDSs for chemicals being brought onto the installation for use in field operations will be listed on a site-specific Chemical Inventory and maintained at the TtNUS Field Command Post. Copies of these documents are to be made available to client and offsite representatives who may be called upon to respond to an emergency event.

15.0 MEC/CWM PROCEDURES FOR FIELD OPERATIONS

15.1 General – field procedures for work on any installation can include any or all of the following tasks:

a. Initial entry into suspect areas

b. CWM operations

c. Surface and subsurface sampling

d. Monitoring well installation

e. Exploratory trenching

f. Geophysical surveys

g. Other miscellaneous operations

15.2 Initial Entry – initial entry into suspect areas requires a UXO-qualified technician with a magnetometer (GA-52Cx or equivalent) to screen a path into the area. The screened area is marked with lanes using either pin flags with plastic pins or marking tape. Suspect items on the surface and subsurface magnetic anomalies will be marked, usually with a different color tape or flag, and will be avoided by team members. The site where the work is to be conducted will be thoroughly screened for MEC/CWM contamination prior to any work commencing. All personnel will stay within the cleared areas and not venture out into areas not screened. If an area that has magnetic anomalies cannot be avoided, the UXO-qualified technician will hand excavate down to the anomaly to check to see if a hazard exists. Before excavation begins, the immediate area will be cleared of non-essential personnel outside of what could be a fragmentation zone (as determined by the UXO Technician). If the excavation reveals a hazard, the emergency notification procedures in paragraph 11.0 will apply.

15.3 CWM Operations - prior to conducting CWM operations, an Emergency Response Plan as required by 29CFR1910.120 and DA Pam 50-6 will be developed and implemented. Most of the information required to develop this plan should be obtained from the installation safety office; however, as a minimum, the following elements will be addressed:

a. Pre-emergency planning and procedures for reporting incidents to appropriate government agencies for potential chemical exposure, person injuries, fire/explosions, environmental spills and releases, and discovery of radioactive materials.
b. Personnel roles, lines of authority, communications.
c. Posted instructions and list of emergency contacts: physicians, nearby notified medical facility, fire and police departments, ambulance service, state/local/federal environmental agencies, Certified Industrial Hygienist (CIH), and installation commander.
d. Emergency recognition and prevention.
e. Site topography, layout and prevailing weather conditions.
f. Criteria and procedures for site evacuation (emergency alerting procedures/employee alarm system, emergency PPE and equipment, safe distance, place of refuge (assembly area), evacuation routes, site security and control).
g. Specific procedures for decontamination and medical treatment of injured personnel.
h. Route maps to nearest pre-notified medical facility.
i. Criteria for initiating community alert program, contacts and responsibilities.
j. Critique of emergency responses and follow-up.
k. Material Safety Data Sheets (MSDS) for each hazardous substance anticipated to be encountered on site would be made accessible to site personnel at all times.

15.4 Sampling – sampling will be conducted in accordance with established protocols and methodologies. Site-specific sampling requirements will be presented in the project-specific Work Plans and/or in other project-specific documents such as Field Sampling and Analysis Plans and Quality Assurance Plans.

Prior to initiating any sampling activities, an UXO-qualified technician will screen sites potentially contaminated with MEC/CWM. A magnetometer will be used to screen entry into a suspect area as in paragraph 15.2 above. Lanes will be marked and suspect items and subsurface anomalies will be identified and avoided. The immediate sampling area will be surface-screened prior to the introduction of the sampling team into the area.

Prior to any subsurface intrusive sampling, another check with a magnetometer needs to be accomplished. A magnetometer can be used for collecting subsurface samples not greater than 1 foot. If excavation of a borehole or hand auguring hole is to exceed this depth, a MG-230 Magnetic Gradiometer (down hole magnetometer) shall be utilized with readings taken at one foot intervals.

If an anomaly is detected, the location will be marked and avoided. If appropriate and acceptable, an alternate sampling location (in a cleared area) will be designated. If the sampling location cannot be relocated them the UXO-qualified technician will hand excavate down to the anomaly to determine if it is hazardous. If it is not hazardous, the object will be set aside and the sampling event will continue. If the object has been determined to be hazardous or suspect, the sampling team will move out of the area and the emergency procedures listed in paragraph 11.0 will be implemented.

15.5 Monitoring Well Installation – the area within a radius twice the size of the largest equipment used around the borehole and access path will be screened with a magnetometer and be cleared of anomalies. Once this is accomplished, the areas around borehole sites will be marked using colored marking tape and/or pin flags. Heavy equipment such as front-end loaders, backhoes, and bulldozers will not be used to develop or establish drill sites. The following action will be followed:

a. A magnetometer will be used directly over the borehole site to check for buried items down to 1 foot. After a surface check, the UXO-qualified technician will hand auger down to a depth of one foot and check down the hole using the MG-220 magnetometer, in one foot increments.

b. Once the hand-auguring hole has been cleared, the drill rig will be positioned over the proposed borehole. Drilling will commence to a depth of one foot, the drill auger will be removed from the borehole, the drill crew chief and UXO personnel will make observations of the soil from the core barrel and the soil removed from the hole by hand auger (if needed). The drilling log and lithologic log will be maintained in accordance with standard practices, noting any metal objects that may be found.

c. The drilling derrick will be secured and drill rig moved to a position at least 20 feet from the borehole.

d. The borehole will be checked again with the MG-220 magnetometer.

e. If an anomaly is present, the borehole will be abandoned and another location selected. The new borehole should be at least six feet from the original borehole. If an anomaly is not detected and the clearance is given, the drill rig shall be positioned back over the borehole, and drilling will proceed to the next interval.

f. Repeat above steps at intervals of 1 foot, until a depth of 30 feet in impact areas or as determined in others is reached. At the maximum depth plus one foot, a magnetometer reading shall be taken with the MG-220 set on the maximum sensitivity. The instrument will detect larger objects (approaching 100 lbs.) that could be expected to penetrate to depths of 10 feet or more.

15.6 Exploratory Trenching and Excavation – at times, exploratory trenching may be required to determine the lateral extent of a landfill, burial pit, or subsurface geophysical anomaly. Trenching and excavation to uncover a subsurface area will be conducted using a backhoe, an excavator, or sometimes a front-end loader. **Any trenching or excavation activities (regardless of depth) must be done in accordance with OSHA 29 Subpart P requirements, which must be considered and addressed in the project-specific Health and Safety Plan.**

On project sites where excavation activities are within the scope of work *and* a MEC/CWM concern exists, the following additional procedures will be utilized to conduct these operations:

a. The surface of the area to be trenched or excavated will first be swept with a magnetometer. Anomalies will be hand excavated to determine if hazardous.

b. No more than 0.5 feet of surface soil will then be gingerly removed (scraped) from the area of concern.

c. The heavy equipment will be removed at least 20 feet away from the area, and the area will be checked with a magnetometer. If the area is a trench, the entire length of the trench will be checked with a magnetometer and the excavation can continue six inches at a time.

d. Anomalies will continue to be uncovered by hand excavation until the desired results are obtained and the trench/area is abandoned and refilled.

e. If excavation depths reach 4 feet, suitable means of access/egress must be provided (e.g., ladders) and atmospheric monitoring must be performed prior to any entries. To avoid entry into the excavation, the MG220 may be used. Area will be checked in 1 foot intervals. Once again after the proper depth of soil is excavated, the heavy equipment is removed from the area (>20 feet) and the area is rechecked with the magnetometer.

f. The above procedures are followed until the desired depth is reached and/or the desired results are obtained.

15.7 Geophysical Surveys – there are several instruments that can be used to conduct geophysical surveys. The GA-52Cx (Schonstedt) and the MG-220 are magnetometers and are passive instruments. The Geonics Terrain Conductivity Meter (EM-31) is an active instrument and is commonly used to measure subsurface terrain conductivity. This information can be used geophysical surveys, as well as for locating voids, discontinuities in soil structures such as boundaries of disposal pits and buried conducting objects. An Ordnance Safety Analysis of the Geonics Model EM-61 Non-Contacting Terrain Conductivity Meter was conducted by the Naval Surface Warfare Center at the request of TtNUS in April 1993. The analysis concluded, in summary, that the “Geonics EM-61 poses no ordnance safety hazard when operated in the normal survey mode, where the device is held at hip height.” However, the Geonics EM-61 should not be used with the boom on the ground if ordnance is present or suspected.

When using the magnetometer or the EM-61, a UXO-qualified technician will conduct a surface sweep of the area to be surveyed to ensure that no surface ordnance or other hazards exist. The

magnetometer is a passive instrument; therefore, no special ordnance safety precautions are required.

Manufacture recommended procedures for the EM-61 must be followed to ensure safe operation during the geophysical survey. Standard survey protocols and quality assurance methods will also be required during survey operations.

15.8 Miscellaneous Operations – A UXO Technician will be present for any and all field activities that are in areas suspected to contain MEC and/or CWM. These areas also include those areas covered with water and creeks, canals, etc.

Operations that involve the inspection, hazard classification, segregation, and final disposal of UXO, DMM, MC and related scrap will not be covered in this SOP. Demilitarization is not authorized unless specific work plans, SOPs, health and safety plans and other established procedures are written and approved addressing these operations.

16.0 HAZARD CONTROL BRIEF

A Health and Safety Hazard Control Briefing (i.e., tailgate meetings) will be conducted daily prior to the start of onsite activities. The briefing will be detailed and will cover the information in the Safe Work Permits for the anticipated tasks for the day, as well as applicable portions of this SOP. Additional briefings will be conducted as necessary for tasks that become necessary during the course of a workday, if they were not covered in the morning briefing. These briefings are in addition to (not in place of) the site-specific health and safety training that is required for all onsite personnel prior to their participation in any onsite activities.

The following information will be given during the daily briefings:

a. Overview of task(s) to be performed and review of appropriate Safe Work Permits with task participants.

b. Overview of the day's objectives, as well as general site hazards

   - Unexploded Ordnance Hazards
   - Chemical Warfare Agents and Materials
   - Physical Hazards

c. Overview of Standard Work Practices pertinent to the day's planned activities

d. Review of any worker incidents or near-miss events, including a review of corrective/preventive measures to prevent recurrence

e. Overview of Emergency Response Actions, evacuation routes and assembly points

17.0 SECURITY

Field activities under various TtNUS contracts are typically unclassified and normal security measures apply in accordance with above references (section 9.1 above). TtNUS personnel and their subcontractors will check in with the appropriate client/installation's security office and may be issued security badges for entry into certain work areas. This SOP will not cover special security requirements for projects involving MEC/CWM as most installations have established policies and procedures on reporting and securing recovered items that are MEC and/or CWM. The TtNUS Project Manager will incorporate all security procedures required by the installation into the site work plan.

APPENDIX D

ANALYTICAL LABORATORY ACCREDITATION AND CERTIFICATION INFORMATION

LABORATORY ACCREDITATION BUREAU

Certificate of Accreditation

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

Empirical Laboratories, LLC

621 Mainstream Drive, Suite 270
Nashville, TN 37228

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

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

Accreditation Granted through: November 30, 2012

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

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

Scope of Accreditation
For
Empirical Laboratories, LLC

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

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

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

Testing - Environmental

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

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/MS	EPA 8260B	1,3-Dichlorobenzene
GC/MS	EPA 8260B	1,3-Dichloropropane
GC/MS	EPA 8260B	1,4-Dichlorobenzene
GC/MS	EPA 8260B	1,4-Dioxane
GC/MS	EPA 8260B	1-Chlorohexane
GC/MS	EPA 8260B	2,2-Dichloropropane
GC/MS	EPA 8260B	2-Butanone (Methyl ethyl ketone; MEK)
GC/MS	EPA 8260B	2-Chloroethyl vinyl ether
GC/MS	EPA 8260B	2-Chlorotoluene
GC/MS	EPA 8260B	2-Hexanone (Methyl butyl ketone; MBK)
GC/MS	EPA 8260B	4-Chlorotoluene
GC/MS	EPA 8260B	4-Methyl-2-pentanone (Methyl isobutyl ketone; MIBK)
GC/MS	EPA 8260B	Acetone
GC/MS	EPA 8260B	Acetonirile
GC/MS	EPA 8260B	Acrolein
GC/MS	EPA 8260B	Acrylonitrile
GC/MS	EPA 8260B	Allyl chloride
GC/MS	EPA 8260B	Benzene
GC/MS	EPA 8260B	Bromobenzene
GC/MS	EPA 8260B	Bromochloromethane
GC/MS	EPA 8260B	Bromodichloromethane
GC/MS	EPA 8260B	Bromoform
GC/MS	EPA 8260B	Bromomethane
GC/MS	EPA 8260B	Carbon Disulfide
GC/MS	EPA 8260B	Carbon Tetrachloride
GC/MS	EPA 8260B	Chlorobenzene
GC/MS	EPA 8260B	Chloroethane
GC/MS	EPA 8260B	Chloroform
GC/MS	EPA 8260B	Chloromethane
GC/MS	EPA 8260B	Chloroprene
GC/MS	EPA 8260B	cis-1,2-Dichloroethene (cis-1,2-DCE)
GC/MS	EPA 8260B	cis-1,3-Dichloropropene
GC/MS	EPA 8260B	cis-1,4-Dichloro-2-butene

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/MS	EPA 8260B	Cyclohexane
GC/MS	EPA 8260B	Dibromochloromethane
GC/MS	EPA 8260B	Dibromomethane
GC/MS	EPA 8260B	Dichlorodifluoromethane (CFC-12)
GC/MS	EPA 8260B	Di-isopropyl ether
GC/MS	EPA 8260B	ETBE
GC/MS	EPA 8260B	Ethyl methacrylate
GC/MS	EPA 8260B	Ethylbenzene
GC/MS	EPA 8260B	Hexachlorobutadiene
GC/MS	EPA 8260B	Hexane
GC/MS	EPA 8260B	Iodomethane
GC/MS	EPA 8260B	Isobutyl alcohol
GC/MS	EPA 8260B	Isopropylbenzene (Cumene)
GC/MS	EPA 8260B	Methacrylonitrile
GC/MS	EPA 8260B	Methyl Acetate
GC/MS	EPA 8260B	Methyl methacrylate
GC/MS	EPA 8260B	Methyl Tertiary Butyl Ether (MTBE)
GC/MS	EPA 8260B	Methylcyclohexane
GC/MS	EPA 8260B	Methylene Chloride, or Dichloromethane
GC/MS	EPA 8260B	Naphthalene
GC/MS	EPA 8260B	n-Butylbenzene
GC/MS	EPA 8260B	n-Propylbenzene
GC/MS	EPA 8260B	p-Isopropyltoluene
GC/MS	EPA 8260B	Propionitrile
GC/MS	EPA 8260B	sec-Butylbenzene
GC/MS	EPA 8260B	Styrene
GC/MS	EPA 8260B	t-Butyl alcohol
GC/MS	EPA 8260B	tert-Amyl methyl ether
GC/MS	EPA 8260B	tert-Butylbenzene
GC/MS	EPA 8260B	Tetrachloroethene (PCE; PERC)
GC/MS	EPA 8260B	Tetrahydrofuran
GC/MS	EPA 8260B	Toluene
GC/MS	EPA 8260B	trans-1,2-Dichloroethene (trans-1,2-DCE)

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/MS	EPA 8260B	trans-1,3-Dichloropropene
GC/MS	EPA 8260B	trans-1,4-Dichloro-2-butene
GC/MS	EPA 8260B	Trichloroethene (TCE)
GC/MS	EPA 8260B	Trichlorofluoromethane (CFC-11)
GC/MS	EPA 8260B	Vinyl acetate
GC/MS	EPA 8260B	Vinyl Chloride (VC)
GC/MS	EPA 8260B	Xylenes (Total)
GC/MS	EPA 8270C/D	1,1'-Biphenyl
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-Dichlorobenzene
GC/MS	EPA 8270C/D	1,4-Dichlorobenzene
GC/MS	EPA 8270C/D	1,4-Dioxane
GC/MS	EPA 8270C/D	1-Methylnaphthalene
GC/MS	EPA 8270C/D	2,3,4,6-Tetrachlorophenol
GC/MS	EPA 8270C/D	2,4,5-Trichlorophenol
GC/MS	EPA 8270C/D	2,4,6-Trichlorophenol (TCP)
GC/MS	EPA 8270C/D	2,4-Dichlorophenol (DCP)
GC/MS	EPA 8270C/D	2,4-Dimethylphenol
GC/MS	EPA 8270C/D	2,4-Dinitrophenol
GC/MS	EPA 8270C/D	2,4-Dinitrotoluene (DNT)
GC/MS	EPA 8270C/D	2,6-Dichlorophenol
GC/MS	EPA 8270C/D	2,6-Dinitrotoluene
GC/MS	EPA 8270C/D	2-Chloronaphthalene
GC/MS	EPA 8270C/D	2-Chlorophenol
GC/MS	EPA 8270C/D	2-Methylnaphthalene
GC/MS	EPA 8270C/D	2-Methylphenol (o-Cresol)
GC/MS	EPA 8270C/D	2-Nitroaniline
GC/MS	EPA 8270C/D	2-Nitrophenol (ONP)
GC/MS	EPA 8270C/D	3,3'-Dichlorobenzidine (DCB)
GC/MS	EPA 8270C/D	3-Methylphenol

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/MS	EPA 8270C/D	3-Nitroaniline
GC/MS	EPA 8270C/D	4,6-Dinitro-2-methylphenol (DNOC)
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 phenyl ether
GC/MS	EPA 8270C/D	4-Methylphenol (p-Cresol)
GC/MS	EPA 8270C/D	4-Nitroaniline (PNA)
GC/MS	EPA 8270C/D	4-Nitrophenol (PNP)
GC/MS	EPA 8270C/D	7,12-Dimethylbenz(a)anthracene
GC/MS	EPA 8270C/D	Acenaphthene
GC/MS	EPA 8270C/D	Acenaphthylene
GC/MS	EPA 8270C/D	Acetaphenone
GC/MS	EPA 8270C/D	Aniline
GC/MS	EPA 8270C/D	Anthracene
GC/MS	EPA 8270C/D	Atrazine
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 (BCEE)
GC/MS	EPA 8270C/D	Bis(2-chloroisopropyl)ether, or 2,2'-oxybis (1-Chloropropane)
GC/MS	EPA 8270C/D	bis(2-Ethylhexyl)phthalate (BEHP)
GC/MS	EPA 8270C/D	Butyl benzyl phthalate (BBP)
GC/MS	EPA 8270C/D	Caprolactam
GC/MS	EPA 8270C/D	Carbazole

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/MS	EPA 8270C/D	Chrysene
GC/MS	EPA 8270C/D	Dibenz(a,h)anthracene
GC/MS	EPA 8270C/D	Dibenzofuran (DBF)
GC/MS	EPA 8270C/D	Diethyl phthalate (DEP)
GC/MS	EPA 8270C/D	Dimethyl phthalate (DMP)
GC/MS	EPA 8270C/D	Di-n-butyl phthalate (DBP)
GC/MS	EPA 8270C/D	Di-n-octyl phthalate (DNOP)
GC/MS	EPA 8270C/D	Fluoranthene
GC/MS	EPA 8270C/D	Fluorene
GC/MS	EPA 8270C/D	Hexachlorobenzene (HCB)
GC/MS	EPA 8270C/D	Hexachlorobutadiene (HCBD)
GC/MS	EPA 8270C/D	Hexachlorocyclopentadiene (HCCPD)
GC/MS	EPA 8270C/D	Hexachloroethane (HCE)
GC/MS	EPA 8270C/D	Indeno(1,2,3-cd)pyrene
GC/MS	EPA 8270C/D	Isophorone
GC/MS	EPA 8270C/D	Naphthalene
GC/MS	EPA 8270C/D	Nitrobenzene
GC/MS	EPA 8270C/D	N-Nitrosodimethylamine
GC/MS	EPA 8270C/D	N-Nitroso-di-n-propylamine (NDPA)
GC/MS	EPA 8270C/D	N-nitrosodiphenylamine (NDPHA)
GC/MS	EPA 8270C/D	Pentachlorophenol
GC/MS	EPA 8270C/D	Phenanthrene
GC/MS	EPA 8270C/D	Phenol
GC/MS	EPA 8270C/D	Pyrene
GC/MS	EPA 8270C/D	Pyridine
GC/ECD	EPA 8081A/B	4,4'-DDD
GC/ECD	EPA 8081A/B	4,4'-DDE
GC/ECD	EPA 8081A/B	4,4'-DDT
GC/ECD	EPA 8081A/B	Aldrin
GC/ECD	EPA 8081A/B	alpha-BHC (alpha-HCH)
GC/ECD	EPA 8081A/B	alpha-Chlordane
GC/ECD	EPA 8081A/B	beta-BHC (beta-HCH)
GC/ECD	EPA 8081A/B	delta-BHC (delta-HCH)

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/ECD	EPA 8081A/B	Dieldrin
GC/ECD	EPA 8081A/B	Endosulfan I
GC/ECD	EPA 8081A/B	Endosulfan II
GC/ECD	EPA 8081A/B	Endosulfan sulfate
GC/ECD	EPA 8081A/B	Endrin
GC/ECD	EPA 8081A/B	Endrin aldehyde
GC/ECD	EPA 8081A/B	Endrin ketone
GC/ECD	EPA 8081A/B	gamma-BHC (Lindane; gamma-HCH)
GC/ECD	EPA 8081A/B	gamma-Chlordane
GC/ECD	EPA 8081A/B	Heptachlor
GC/ECD	EPA 8081A/B	Heptachlor epoxide
GC/ECD	EPA 8081A/B	Methoxychlor
GC/ECD	EPA 8081A/B	Chlordane
GC/ECD	EPA 8081A/B	Toxaphene
GC/ECD	EPA 8082 /A	Aroclor-1016
GC/ECD	EPA 8082 /A	Aroclor-1221
GC/ECD	EPA 8082 /A	Aroclor-1232
GC/ECD	EPA 8082 /A	Aroclor-1242
GC/ECD	EPA 8082 /A	Aroclor-1248
GC/ECD	EPA 8082 /A	Aroclor-1254
GC/ECD	EPA 8082 /A	Aroclor-1260
GC/ECD	EPA 8082 /A	Aroclor-1262
GC/ECD	EPA 8082 /A	Aroclor-1268
GC/ECD	EPA 8151A	2,4,5-T
GC/ECD	EPA 8151A	2,4,5-TP (Silvex)
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	Dichlorprop
GC/ECD	EPA 8151A	Dinoseb
GC/ECD	EPA 8151A	MCPA
GC/ECD	EPA 8151A	MCPP (Mecoprop)

Non-Potable Water		
Technology	**Method**	**Analyte**
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-Trinitrophenylmethylnitramine (Tetryl)
HPLC/UV	EPA 8330A/B	2,4,6-Trinitrotoluene (TNT)
HPLC/UV	EPA 8330A/B	2,4-Dinitrotoluene (DNT)
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 (ONT)
HPLC/UV	EPA 8330A/B	3,5-Dinitroaniline
HPLC/UV	EPA 8330A/B	3-Nitrotoluene
HPLC/UV	EPA 8330A/B	4-Amino-2,6-dinitrotoluene
HPLC/UV	EPA 8330A/B	4-Nitrotoluene (PNT)
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/B	Nitroglycerin
HPLC/UV	EPA 8330A/B	Nitroguanidine
HPLC/UV	EPA 8330A/B	Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)
HPLC/UV	EPA 8330A/B	3,5-Dinitroaniline
HPLC/UV	EPA 8330A/B	PETN
GC/FID	FLPRO	Petroleum Range Organics
GC/FID	EPA 8015B	TPH DRO
GC/FID	EPA 8015B	TPH GRO
GC/FID	RSK-175	Methane
GC/FID	RSK-175	Ethane
GC/FID	RSK-175	Ethene
GC/ECD	EPA 8011	1,2-Dibromoethane (EDB)
GC/ECD	EPA 8011	1,2-Dibromo-3-chloropropane (DBCP)
HPLC/MS	EPA 6850	Perchlorate
ICP	EPA 6010B/C	Aluminum
ICP	EPA 6010B/C	Antimony
ICP	EPA 6010B/C	Arsenic
ICP	EPA 6010B/C	Barium
ICP	EPA 6010B/C	Beryllium

Non-Potable Water		
Technology	**Method**	**Analyte**
ICP	EPA 6010B/C	Boron
ICP	EPA 6010B/C	Cadmium
ICP	EPA 6010B/C	Calcium
ICP	EPA 6010B/C	Chromium, total
ICP	EPA 6010B/C	Cobalt
ICP	EPA 6010B/C	Copper
ICP	EPA 6010B/C	Iron
ICP	EPA 6010B/C	Lead
ICP	EPA 6010B/C	Magnesium
ICP	EPA 6010B/C	Manganese
CVAA	EPA 7470A	Mercury
ICP	EPA 6010B/C	Molybdenum
ICP	EPA 6010B/C	Nickel
ICP	EPA 6010B/C	Potassium
ICP	EPA 6010B/C	Selenium
ICP	EPA 6010B/C	Silver
ICP	EPA 6010B/C	Sodium
ICP	EPA 6010B/C	Strontium
ICP	EPA 6010B/C	Thallium
ICP	EPA 6010B/C	Tin
ICP	EPA 6010B/C	Titanium
ICP	EPA 6010B/C	Vanadium
ICP	EPA 6010B/C	Zinc
IC	EPA 300.0	Chloride
IC	EPA 300.0	Fluoride
IC	EPA 300.0	Nitrate
IC	EPA 300.0	Nitrite
IC	EPA 300.0	Sulfate
IC	EPA 9056A	Chloride
IC	EPA 9056A	Fluoride
IC	EPA 9056A	Nitrate
IC	EPA 9056A	Nitrite
IC	EPA 9056A	Sulfate

Non-Potable Water		
Technology	**Method**	**Analyte**
Titration	SM 2320B 20th/21st edition	Alkalinity
Colorimetric	SM 4500 B, G, 20th/21st edition	Ammonia
Colorimetric	EPA 410.4	COD
UV/Vis	EPA 7196A	Hexavalent Chromium
Colorimetric	EPA 353.2	Nitrocellulose
Colorimetric	EPA 353.2	Nitrate/Nitrite
Gravimetric	EPA 1664A	O&G
Titration	Chap.7, Sect. 7.3.4 Mod.	Reactive Sulfide
Titration	SM 4500 S-2CF, 20th/21st edition	Sulfide
UV/Vis	SM 4500 P B5, E, 20th/21st edition	Total Phosphorus (as P)
UV/Vis	SM 4500 PE, 20th/21st edition	Ortho-Phosphate (as P)
TOC	9060A/SM5310C, 20th/21st edition	Total Organic Carbon
Gravimetric	SM 2540C, 20th/21st edition	TDS
Gravimetric	SM 2540D, 20th/21st edition	TSS
Colorimetric	EPA 9012A/B	Cyanide
Physical	EPA 1010A	Ignitability
Physical	EPA 9095B	Paint Filter
Probe	EPA 9040B/C	pH
Preparation	**Method**	**Type**
Preparation	EPA 1311	TCLP
Preparation	EPA 3005A	Metals digestion
Preparation	EPA 3010A	Metals digestion
Preparation	EPA 3510C	Organics Liquid Extraction
Preparation	EPA 5030A/B	Purge and Trap Water

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC/MS	EPA 8260B	1,1,1-Trichloroethane (1,1,1-TCA)

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC/MS	EPA 8260B	1,1,1,2-Tetrachloroethane
GC/MS	EPA 8260B	1,1,2,2-Tetrachloroethane
GC/MS	EPA 8260B	1,1,2-Trichloro-1,2,2-trifluoroethane (CFC-113; Freon 113)
GC/MS	EPA 8260B	1,1,2-Trichloroethane
GC/MS	EPA 8260B	1,1-Dichloroethane (1,1-DCA)
GC/MS	EPA 8260B	1,1-Dichloroethene (1,1-DCE)
GC/MS	EPA 8260B	1,1-Dichloropropene
GC/MS	EPA 8260B	1,2,3-Trichlorobenzene
GC/MS	EPA 8260B	1,2,3-Trichloropropane
GC/MS	EPA 8260B	1,2,4-Trichlorobenzene
GC/MS	EPA 8260B	1,2,4-Trimethylbenzene
GC/MS	EPA 8260B	1,2-Dibromo-3-chloropropane (DBCP)
GC/MS	EPA 8260B	1,2-Dibromoethane (EDB)
GC/MS	EPA 8260B	1,2-Dichlorobenzene
GC/MS	EPA 8260B	1,2-Dichloroethane (EDC)
GC/MS	EPA 8260B	1,2-Dichloropropane
GC/MS	EPA 8260B	1,3,5-Trimethylbenzene
GC/MS	EPA 8260B	1,3-Dichlorobenzene
GC/MS	EPA 8260B	1,3-Dichloropropane
GC/MS	EPA 8260B	1,4-Dichlorobenzene
GC/MS	EPA 8260B	1,4-Dioxane
GC/MS	EPA 8260B	2,2-Dichloropropane
GC/MS	EPA 8260B	2-Butanone (Methyl ethyl ketone; MEK)
GC/MS	EPA 8260B	2-Chlorotoluene
GC/MS	EPA 8260B	2-Hexanone (Methyl butyl ketone; MBK)
GC/MS	EPA 8260B	4-Chlorotoluene
GC/MS	EPA 8260B	4-Methyl-2-pentanone (Methyl isobutyl ketone; MIBK)
GC/MS	EPA 8260B	Acetone
GC/MS	EPA 8260B	Acetonitrile
GC/MS	EPA 8260B	Acrolein
GC/MS	EPA 8260B	Acrylonitrile
GC/MS	EPA 8260B	Allyl chloride

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC/MS	EPA 8260B	Benzene
GC/MS	EPA 8260B	Bromobenzene
GC/MS	EPA 8260B	Bromochloromethane
GC/MS	EPA 8260B	Bromodichloromethane
GC/MS	EPA 8260B	Bromoform
GC/MS	EPA 8260B	Bromomethane
GC/MS	EPA 8260B	Carbon Disulfide
GC/MS	EPA 8260B	Carbon Tetrachloride
GC/MS	EPA 8260B	Chlorobenzene
GC/MS	EPA 8260B	Chloroethane
GC/MS	EPA 8260B	Chloroform
GC/MS	EPA 8260B	Chloromethane
GC/MS	EPA 8260B	Chloroprene
GC/MS	EPA 8260B	cis-1,2-Dichloroethene (cis-1,2-DCE)
GC/MS	EPA 8260B	cis-1,3-Dichloropropene
GC/MS	EPA 8260B	cis-1,4-Dichloro-2-butene
GC/MS	EPA 8260B	Cyclohexane
GC/MS	EPA 8260B	Dibromochloromethane
GC/MS	EPA 8260B	Dibromomethane
GC/MS	EPA 8260B	Dichlorodifluoromethane (CFC-12)
GC/MS	EPA 8260B	Ethyl methacrylate
GC/MS	EPA 8260B	Ethylbenzene
GC/MS	EPA 8260B	Hexachlorobutadiene
GC/MS	EPA 8260B	Hexane
GC/MS	EPA 8260B	Iodomethane
GC/MS	EPA 8260B	Isobutyl alcohol
GC/MS	EPA 8260B	Isopropylbenzene (Cumene)
GC/MS	EPA 8260B	Methacrylonitrile
GC/MS	EPA 8260B	Methyl Acetate
GC/MS	EPA 8260B	Methyl methacrylate
GC/MS	EPA 8260B	Methyl Tertiary Butyl Ether (MTBE)
GC/MS	EPA 8260B	Methylcyclohexane

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC/MS	EPA 8260B	Methylene Chloride, or Dichloromethane
GC/MS	EPA 8260B	Naphthalene
GC/MS	EPA 8260B	n-Butylbenzene
GC/MS	EPA 8260B	n-Propylbenzene
GC/MS	EPA 8260B	p-Isopropyltoluene
GC/MS	EPA 8260B	Propionitrile
GC/MS	EPA 8260B	sec-Butylbenzene
GC/MS	EPA 8260B	Styrene
GC/MS	EPA 8260B	tert-Butylbenzene
GC/MS	EPA 8260B	Tetrachloroethene (PCE; PERC)
GC/MS	EPA 8260B	Toluene
GC/MS	EPA 8260B	trans-1,2-Dichloroethene (trans-1,2-DCE)
GC/MS	EPA 8260B	trans-1,3-Dichloropropene
GC/MS	EPA 8260B	trans-1,4-Dichloro-2-butene
GC/MS	EPA 8260B	Trichloroethene (TCE)
GC/MS	EPA 8260B	Trichlorofluoromethane (CFC-11)
GC/MS	EPA 8260B	Vinyl acetate
GC/MS	EPA 8260B	Vinyl Chloride (VC)
GC/MS	EPA 8260B	Xylenes (Total)
GC/MS	EPA 8270C/D	Bis(2-chloroisopropyl)ether, or 2,2'-oxybis (1-Chloropropane)
GC/MS	EPA 8270C/D	1,1'-Biphenyl
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-Dichlorobenzene
GC/MS	EPA 8270C/D	1,4-Dichlorobenzene
GC/MS	EPA 8270C/D	1,4-Dioxane
GC/MS	EPA 8270C/D	1-Methylnaphthalene
GC/MS	EPA 8270C/D	2,3,4,6-Tetrachlorophenol
GC/MS	EPA 8270C/D	2,4,5-Trichlorophenol
GC/MS	EPA 8270C/D	2,4,6-Trichlorophenol (TCP)

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC/MS	EPA 8270C/D	2,4-Dichlorophenol (DCP)
GC/MS	EPA 8270C/D	2,4-Dimethylphenol
GC/MS	EPA 8270C/D	2,4-Dinitrophenol
GC/MS	EPA 8270C/D	2,4-Dinitrotoluene (DNT)
GC/MS	EPA 8270C/D	2,6-Dichlorophenol
GC/MS	EPA 8270C/D	2,6-Dinitrotoluene
GC/MS	EPA 8270C/D	2-Chloronaphthalene
GC/MS	EPA 8270C/D	2-Chlorophenol
GC/MS	EPA 8270C/D	2-Methylnaphthalene
GC/MS	EPA 8270C/D	2-Methylphenol (o-Cresol)
GC/MS	EPA 8270C/D	2-Nitroaniline
GC/MS	EPA 8270C/D	2-Nitrophenol (ONP)
GC/MS	EPA 8270C/D	3,3'-Dichlorobenzidine (DCB)
GC/MS	EPA 8270C/D	3-Methylphenol
GC/MS	EPA 8270C/D	3-Nitroaniline
GC/MS	EPA 8270C/D	4,6-Dinitro-2-methylphenol (DNOC)
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 phenyl ether
GC/MS	EPA 8270C/D	4-Methylphenol (p-Cresol)
GC/MS	EPA 8270C/D	4-Nitroaniline (PNA)
GC/MS	EPA 8270C/D	4-Nitrophenol (PNP)
GC/MS	EPA 8270C/D	Acenaphthene
GC/MS	EPA 8270C/D	Acenaphthylene
GC/MS	EPA 8270C/D	Acetaphenone
GC/MS	EPA 8270C/D	Aniline
GC/MS	EPA 8270C/D	Anthracene
GC/MS	EPA 8270C/D	Atrazine
GC/MS	EPA 8270C/D	Benzaldehyde
GC/MS	EPA 8270C/D	Benzidine
GC/MS	EPA 8270C/D	Benzo(a)anthracene

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
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 (BCEE)
GC/MS	EPA 8270C/D	bis(2-Ethylhexyl)phthalate (BEHP)
GC/MS	EPA 8270C/D	Butyl benzyl phthalate (BBP)
GC/MS	EPA 8270C/D	Caprolactam
GC/MS	EPA 8270C/D	Carbazole
GC/MS	EPA 8270C/D	Chrysene
GC/MS	EPA 8270C/D	Dibenz(a,h)anthracene
GC/MS	EPA 8270C/D	Dibenzofuran (DBF)
GC/MS	EPA 8270C/D	Diethyl phthalate (DEP)
GC/MS	EPA 8270C/D	Dimethyl phthalate (DMP)
GC/MS	EPA 8270C/D	Di-n-butyl phthalate (DBP)
GC/MS	EPA 8270C/D	Di-n-octyl phthalate (DNOP)
GC/MS	EPA 8270C/D	Fluoranthene
GC/MS	EPA 8270C/D	Fluorene
GC/MS	EPA 8270C/D	Hexachlorobenzene (HCB)
GC/MS	EPA 8270C/D	Hexachlorobutadiene (HCBD)
GC/MS	EPA 8270C/D	Hexachlorocyclopentadiene (HCCPD)
GC/MS	EPA 8270C/D	Hexachloroethane (HCE)
GC/MS	EPA 8270C/D	Indeno(1,2,3-cd)pyrene
GC/MS	EPA 8270C/D	Isophorone
GC/MS	EPA 8270C/D	Naphthalene
GC/MS	EPA 8270C/D	Nitrobenzene
GC/MS	EPA 8270C/D	N-Nitrosodimethylamine
GC/MS	EPA 8270C/D	N-Nitroso-di-n-propylamine (NDPA)

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC/MS	EPA 8270C/D	N-nitrosodiphenylamine (NDPHA)
GC/MS	EPA 8270C/D	Pentachlorophenol
GC/MS	EPA 8270C/D	Phenanthrene
GC/MS	EPA 8270C/D	Phenol
GC/MS	EPA 8270C/D	Pyrene
GC/MS	EPA 8270C/D	Pyridine
GC/ECD	EPA 8081A/B	4,4'-DDD
GC/ECD	EPA 8081A/B	4,4'-DDE
GC/ECD	EPA 8081A/B	4,4'-DDT
GC/ECD	EPA 8081A/B	Aldrin
GC/ECD	EPA 8081A/B	alpha-BHC (alpha-HCH)
GC/ECD	EPA 8081A/B	alpha-Chlordane
GC/ECD	EPA 8081A/B	beta-BHC (beta-HCH)
GC/ECD	EPA 8081A/B	delta-BHC (delta-HCH)
GC/ECD	EPA 8081A/B	Chlordane
GC/ECD	EPA 8081A/B	Dieldrin
GC/ECD	EPA 8081A/B	Endosulfan I
GC/ECD	EPA 8081A/B	Endosulfan II
GC/ECD	EPA 8081A/B	Endosulfan sulfate
GC/ECD	EPA 8081A/B	Endrin
GC/ECD	EPA 8081A/B	Endrin aldehyde
GC/ECD	EPA 8081A/B	Endrin ketone
GC/ECD	EPA 8081A/B	gamma-BHC (Lindane; gamma-HCH)
GC/ECD	EPA 8081A/B	gamma-Chlordane
GC/ECD	EPA 8081A/B	Heptachlor
GC/ECD	EPA 8081A/B	Heptachlor epoxide
GC/ECD	EPA 8081A/B	Methoxychlor
GC/ECD	EPA 8081A/B	Toxaphene
GC/ECD	EPA 8082 /A	Aroclor-1016
GC/ECD	EPA 8082 /A	Aroclor-1221
GC/ECD	EPA 8082 /A	Aroclor-1232
GC/ECD	EPA 8082 /A	Aroclor-1242

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC/ECD	EPA 8082 /A	Aroclor-1248
GC/ECD	EPA 8082 /A	Aroclor-1254
GC/ECD	EPA 8082 /A	Aroclor-1260
GC/ECD	EPA 8082 /A	Aroclor-1262
GC/ECD	EPA 8082 /A	Aroclor-1268
GC/ECD	EPA 8151A	2,4,5-T
GC/ECD	EPA 8151A	2,4,5-TP (Silvex)
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	Dichlorprop
GC/ECD	EPA 8151A	Dinoseb
GC/ECD	EPA 8151A	MCPA
GC/ECD	EPA 8151A	MCPP (Mecoprop)
HPLC/UV	EPA 8330A	1,3,5-Trinitrobenzene
HPLC/UV	EPA 8330A	1,3-Dinitrobenzene
HPLC/UV	EPA 8330A	2,4,6-Trinitrophenylmethylnitramine (Tetryl)
HPLC/UV	EPA 8330A	2,4,6-Trinitrotoluene (TNT)
HPLC/UV	EPA 8330A	2,4-Dinitrotoluene (DNT)
HPLC/UV	EPA 8330A	2,6-Dinitrotoluene
HPLC/UV	EPA 8330A	2-Amino-4,6-dinitrotoluene
HPLC/UV	EPA 8330A	2-Nitrotoluene (ONT)
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 (PNT)
HPLC/UV	EPA 8330A	Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX)
HPLC/UV	EPA 8330A	Nitroglycerin
HPLC/UV	EPA 8330A	Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)
HPLC/UV	EPA 8330A	Nitrobenzene
HPLC/UV	EPA 8330A	Nitroguanidine

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
HPLC/UV	EPA 8330A	PETN
HPLC/UV	EPA 8330B	1,3,5-Trinitrobenzene
HPLC/UV	EPA 8330B	1,3-Dinitrobenzene
HPLC/UV	EPA 8330B	2,4,6-Trinitrophenylmethylnitramine (Tetryl)
HPLC/UV	EPA 8330B	2,4,6-Trinitrotoluene (TNT)
HPLC/UV	EPA 8330B	2,4-Dinitrotoluene (DNT)
HPLC/UV	EPA 8330B	2,6-Dinitrotoluene
HPLC/UV	EPA 8330B	2-Amino-4,6-dinitrotoluene
HPLC/UV	EPA 8330B	2-Nitrotoluene (ONT)
HPLC/UV	EPA 8330B	3-Nitrotoluene
HPLC/UV	EPA 8330B	3,5-Dinitroaniline
HPLC/UV	EPA 8330B	4-Amino-2,6-dinitrotoluene
HPLC/UV	EPA 8330B	4-Nitrotoluene (PNT)
HPLC/UV	EPA 8330B	Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX)
HPLC/UV	EPA 8330B	Nitroglycerin
HPLC/UV	EPA 8330B	Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)
HPLC/UV	EPA 8330B	Nitrobenzene
HPLC/UV	EPA 8330B	Nitroguanidine
HPLC/UV	EPA 8330B	PETN
GC/FID	FLPRO	Petroleum Range Organics
GC/FID	EPA 8015B	TPH DRO
GC/FID	EPA 8015B	TPH GRO
HPLC/MS	EPA 6850	Perchlorate
ICP	EPA 6010B/C	Aluminum
ICP	EPA 6010B/C	Antimony
ICP	EPA 6010B/C	Arsenic
ICP	EPA 6010B/C	Barium
ICP	EPA 6010B/C	Beryllium
ICP	EPA 6010B/C	Boron
ICP	EPA 6010B/C	Cadmium
ICP	EPA 6010B/C	Calcium
ICP	EPA 6010B/C	Chromium, total

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
ICP	EPA 6010B/C	Cobalt
ICP	EPA 6010B/C	Copper
ICP	EPA 6010B/C	Iron
ICP	EPA 6010B/C	Lead
ICP	EPA 6010B/C	Magnesium
ICP	EPA 6010B/C	Manganese
CVAA	EPA 7471A/B	Mercury
ICP	EPA 6010B/C	Molybdenum
ICP	EPA 6010B/C	Nickel
ICP	EPA 6010B/C	Potassium
ICP	EPA 6010B/C	Selenium
ICP	EPA 6010B/C	Silver
ICP	EPA 6010B/C	Sodium
ICP	EPA 6010B/C	Strontium
ICP	EPA 6010B/C	Tin
ICP	EPA 6010B/C	Titanium
ICP	EPA 6010B/C	Thallium
ICP	EPA 6010B/C	Vanadium
ICP	EPA 6010B/C	Zinc
UV/Vis	EPA 7196A	Hexavalent Chromium
TOC	Lloyd Kahn	Total Organic Carbon
Colorimetric	EPA 353.2	Nitrocellulose
Colorimetric	EPA 9012A/B	Cyanide
Titration	Chap.7, Sect. 7.3.4 Mod.	Reactive Sulfide
Titration	EPA 9034	Sulfide
Probe	EPA 9045C/D	pH
Preparation	**Method**	**Type**
Preparation	EPA 1311	TCLP
Preparation	EPA 1312	SPLP
Preparation	NJ Modified 3060A	Hexavalent Chromium
Preparation	EPA 3050B	Metals Digestion
Preparation	EPA 3546	Organics Microwave Extraction

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Certificate # L2226

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
Preparation	EPA 3550B/C	Organics Sonication
Preparation	SM 2540B 20th/21st edition	Percent Solids (Percent Moisture)
Preparation	EPA 5035 /A	Purge and Trap Solid

Notes:

1) This laboratory offers commercial testing service.

Approved By: _____ Date: April 8, 2011

R. Douglas Leonard
Chief Technical Officer

Issued: 11/30/09 Revised: 2/9/10 Revised: 3/31/10 Revised: 10/8/10 Revised: 1/25/11 Revised: 4/8/11

Analysis Group Description	Method Description	Method Code
Soil Samples	Semivolatile Organic Compounds by GC/MS - Low Level	8270D_LL

Analyte Description	CAS Number	RL - Limit	MDL - Limit	Units	LCSREC - Recovery Low	LCSREC - Recovery High	LCSREC - Units	LCSRPD - Precision	LCSRPD - Units	MSREC - Recovery Low	MSREC - Recovery High	MSREC - Units	MSRPD - Precision	MSRPD - Units	SUREC - Recovery Low	SUREC - Recovery High	SUREC - Units	LOD - Limit	LOD - Units
Acetophenone	98-86-2	0.033	0.0068	mg/Kg	14	130	%	50	%	14	130	%	50	%			%	0.0068	mg/Kg
2-Acetylaminofluorene	53-96-3	0.033	0.042	mg/Kg	10	130	%	50	%	10	130	%	50	%			%	0.042	mg/Kg
alpha,alpha-Dimethyl phenethylamine	122-09-8	6.7	0.33	mg/Kg	10	130	%	50	%	10	130	%	50	%			%	0.33	mg/Kg
4-Aminobiphenyl	92-67-1	0.066	0.017	mg/Kg	10	130	%	50	%	10	130	%	50	%			%	0.017	mg/Kg
Aniline	62-53-3	0.066	0.0082	mg/Kg	10	130	%	50	%	10	130	%	50	%			%	0.0082	mg/Kg
Aramite, Total	140-57-8	0.066	0.0048	mg/Kg	10	130	%	50	%	10	130	%	50	%			%	0.0048	mg/Kg
Benzyl alcohol	100-51-6	0.033	0.0061	mg/Kg	10	130	%	50	%	10	130	%	50	%			%	0.0061	mg/Kg
Bis(2-chloroethoxy)methane	111-91-1	0.033	0.0065	mg/Kg	15	130	%	50	%	15	130	%	50	%			%	0.0065	mg/Kg
Bis(2-chloroethyl)ether	111-44-4	0.033	0.0065	mg/Kg	11	130	%	50	%	11	130	%	50	%			%	0.0065	mg/Kg
Bis(2-ethylhexyl) phthalate	117-81-7	0.066	0.006	mg/Kg	29	130	%	50	%	29	130	%	50	%			%	0.006	mg/Kg
4-Bromophenyl phenyl ether	101-55-3	0.033	0.0069	mg/Kg	13	130	%	50	%	13	130	%	50	%			%	0.0069	mg/Kg
Butyl benzyl phthalate	85-68-7	0.033	0.0055	mg/Kg	30	130	%	50	%	30	130	%	50	%			%	0.0067	mg/Kg
4-Chloroaniline	106-47-8	0.066	0.0052	mg/Kg	10	130	%	50	%	10	130	%	50	%			%	0.0052	mg/Kg
4-Chloro-3-methylphenol	59-50-7	0.033	0.007	mg/Kg	18	130	%	50	%	18	130	%	50	%			%	0.007	mg/Kg
2-Chloronaphthalene	91-58-7	0.033	0.006	mg/Kg	14	130	%	50	%	14	130	%	50	%			%	0.006	mg/Kg
2-Chlorophenol	95-57-8	0.033	0.0053	mg/Kg	10	130	%	50	%	10	130	%	50	%			%	0.0053	mg/Kg
4-Chlorophenyl phenyl ether	7005-72-3	0.033	0.0064	mg/Kg	15	130	%	50	%	15	130	%	50	%			%	0.0064	mg/Kg
Diallate	2303-16-4	0.033	0.0056	mg/Kg	10	130	%	50	%	10	130	%	50	%			%	0.0056	mg/Kg
Dibenzofuran	132-64-9	0.033	0.0067	mg/Kg	20	130	%	50	%	20	130	%	50	%			%	0.0067	mg/Kg
1,3-Dichlorobenzene	541-73-1	0.033	0.0056	mg/Kg	10	130	%	50	%	10	130	%	50	%			%	0.0056	mg/Kg
3,3'-Dichlorobenzidine	91-94-1	0.066	0.017	mg/Kg	10	200	%	50	%	10	200	%	50	%			%	0.017	mg/Kg
2,4-Dichlorophenol	120-83-2	0.033	0.0072	mg/Kg	10	130	%	50	%	10	130	%	50	%			%	0.0072	mg/Kg
2,6-Dichlorophenol	87-65-0	0.033	0.0033	mg/Kg	10	130	%	50	%	10	130	%	50	%			%	0.0033	mg/Kg
Diethyl phthalate	84-66-2	0.033	0.0074	mg/Kg	24	130	%	50	%	24	130	%	50	%			%	0.0074	mg/Kg
Dimethoate	60-51-5	0.033	0.017	mg/Kg	10	130	%	50	%	10	130	%	50	%			%	0.017	mg/Kg
7,12-Dimethylbenz(a)anthracene	57-97-6	0.033	0.017	mg/Kg	10	130	%	50	%	10	130	%	50	%			%	0.017	mg/Kg
3,3'-Dimethylbenzidine	119-93-7	0.066	0.066	mg/Kg	10	130	%	50	%	10	130	%	50	%			%	0.066	mg/Kg
2,4-Dimethylphenol	105-67-9	0.066	0.0076	mg/Kg	10	134	%	50	%	10	134	%	50	%			%	0.0076	mg/Kg
Dimethyl phthalate	131-11-3	0.033	0.0075	mg/Kg	20	130	%	50	%	20	130	%	50	%			%	0.0075	mg/Kg
Di-n-butyl phthalate	84-74-2	0.17	0.017	mg/Kg	10	130	%	50	%	10	130	%	50	%			%	0.017	mg/Kg
1,3-Dinitrobenzene	99-65-0	0.033	0.017	mg/Kg	10	130	%	50	%	10	130	%	50	%			%	0.017	mg/Kg
4,6-Dinitro-2-methylphenol	534-52-1	0.17	0.017	mg/Kg	14	130	%	50	%	14	130	%	50	%			%	0.017	mg/Kg
2,4-Dinitrophenol	51-28-5	0.33	0.017	mg/Kg	10	130	%	50	%	10	130	%	50	%			%	0.042	mg/Kg
2,4-Dinitrotoluene	121-14-2	0.033	0.0075	mg/Kg	19	130	%	50	%	19	130	%	50	%			%	0.0075	mg/Kg
2,6-Dinitrotoluene	606-20-2	0.033	0.0079	mg/Kg	18	130	%	50	%	18	130	%	50	%			%	0.0079	mg/Kg
Di-n-octyl phthalate	117-84-0	0.033	0.0036	mg/Kg	10	130	%	50	%	10	130	%	50	%			%	0.0067	mg/Kg
Dinoseb	88-85-7	0.066	0.0062	mg/Kg	10	130	%	50	%	10	130	%	50	%			%	0.0067	mg/Kg
Disulfoton	298-04-4	0.033	0.017	mg/Kg	10	130	%	50	%	10	130	%	50	%			%	0.017	mg/Kg
Ethyl methanesulfonate	62-50-0	0.066	0.0078	mg/Kg	10	130	%	50	%	10	130	%	50	%			%	0.0078	mg/Kg
Ethyl Parathion	56-38-2	0.033	0.042	mg/Kg	10	130	%	50	%	10	130	%	50	%			%	0.042	mg/Kg
Famphur	52-85-7	0.033	0.017	mg/Kg	10	130	%	50	%	10	130	%	50	%			%	0.017	mg/Kg
Hexachlorobenzene	118-74-1	0.033	0.0076	mg/Kg	12	130	%	50	%	12	130	%	50	%			%	0.0076	mg/Kg
Hexachlorobutadiene	87-68-3	0.033	0.0068	mg/Kg	10	130	%	50	%	10	130	%	50	%			%	0.0068	mg/Kg
Hexachlorocyclopentadiene	77-47-4	0.066	0.0037	mg/Kg	10	130	%	50	%	10	130	%	50	%			%	0.0037	mg/Kg
Hexachloroethane	67-72-1	0.033	0.0058	mg/Kg	10	130	%	50	%	10	130	%	50	%			%	0.0058	mg/Kg
Hexachlorophene	70-30-4	17	2.4	mg/Kg	10	130	%	50	%	10	130	%	50	%			%	2.4	mg/Kg
Hexachloropropene	1888-71-7	0.033	0.0053	mg/Kg	10	130	%	50	%	10	130	%	50	%			%	0.0053	mg/Kg
Isophorone	78-59-1	0.033	0.007	mg/Kg	14	130	%	50	%	14	130	%	50	%			%	0.007	mg/Kg
Isosafrole	120-58-1	0.033	0.0033	mg/Kg	10	130	%	50	%	10	130	%	50	%			%	0.0033	mg/Kg
Methapyrilene	91-80-5	6.7	0.033	mg/Kg	10	130	%	50	%	10	130	%	50	%			%	0.067	mg/Kg
3-Methylcholanthrene	56-49-5	0.033	0.042	mg/Kg	10	130	%	50	%	10	130	%	50	%			%	0.042	mg/Kg
Methyl methanesulfonate	66-27-3	0.033	0.0038	mg/Kg	10	130	%	50	%	10	130	%	50	%			%	0.0038	mg/Kg
Methyl parathion	298-00-0	0.033	0.017	mg/Kg	10	130	%	50	%	10	130	%	50	%			%	0.017	mg/Kg
2-Methylphenol	95-48-7	0.033	0.0063	mg/Kg	10	130	%	50	%	10	130	%	50	%			%	0.0063	mg/Kg
3 & 4 Methylphenol	15831-10-4	0.033	0.0073	mg/Kg	10	130	%	50	%	10	130	%	50	%			%	0.0073	mg/Kg
1,4-Naphthoquinone	130-15-4	0.033	0.0033	mg/Kg	10	130	%	50	%	10	130	%	50	%			%	0.0033	mg/Kg
1-Naphthylamine	134-32-7	0.066	0.017	mg/Kg	10	130	%	50	%	10	130	%	50	%			%	0.017	mg/Kg
2-Naphthylamine	91-59-8	0.066	0.017	mg/Kg	10	130	%	50	%	10	130	%	50	%			%	0.017	mg/Kg
2-Nitroaniline	88-74-4	0.17	0.007	mg/Kg	21	130	%	50	%	21	130	%	50	%			%	0.007	mg/Kg
3-Nitroaniline	99-09-2	0.17	0.0067	mg/Kg	10	134	%	50	%	10	134	%	50	%			%	0.0067	mg/Kg
4-Nitroaniline	100-01-6	0.17	0.0083	mg/Kg	14	143	%	50	%	14	143	%	50	%			%	0.017	mg/Kg
Nitrobenzene	98-95-3	0.033	0.0066	mg/Kg	11	130	%	50	%	11	130	%	50	%			%	0.0066	mg/Kg
2-Nitrophenol	88-75-5	0.033	0.0058	mg/Kg	10	130	%	50	%	10	130	%	50	%			%	0.0058	mg/Kg
4-Nitrophenol	100-02-7	0.17	0.073	mg/Kg	11	130	%	50	%	11	130	%	50	%			%	0.073	mg/Kg
4-Nitroquinoline-1-oxide	56-57-5	0.33	0.042	mg/Kg	10	130	%	50	%	10	130	%	50	%			%	0.042	mg/Kg
N-Nitro-o-toluidine	99-55-8	0.033	0.017	mg/Kg	10	130	%	50	%	10	130	%	50	%			%	0.017	mg/Kg
N-Nitrosodiethylamine	55-18-5	0.066	0.0033	mg/Kg	10	130	%	50	%	10	130	%	50	%			%	0.0033	mg/Kg

Analysis Group Description	Method Description	Method Code
Soil Samples	Semivolatile Organic Compounds by GC/MS - Low Level	8270D_LL

Analyte Description	CAS Number	RL - Limit	MDL - Limit	Units	LCSREC - Recovery Low	LCSREC - Recovery High	LCSREC - Units	LCSRPD - Precision	LCSRPD - Units	MSREC - Recovery Low	MSREC - Recovery High	MSREC - Units	MSRPD - Precision	MSRPD - Units	SUREC - Recovery Low	SUREC - Recovery High	SUREC - Units	LOD - Limit	LOD - Units
N-Nitrosodimethylamine	62-75-9	0.033	0.019	mg/Kg	10	130	%	50	%	10	130	%	50	%			%	0.019	mg/Kg
N-Nitrosodi-n-butylamine	924-16-3	0.033	0.017	mg/Kg	10	130	%	50	%	10	130	%	50	%			%	0.017	mg/Kg
N-Nitrosodi-n-propylamine	621-64-7	0.033	0.0075	mg/Kg	16	130	%	50	%	16	130	%	50	%			%	0.0074	mg/Kg
N-Nitrosodiphenylamine	86-30-6	0.033	0.0061	mg/Kg	22	130	%	50	%	22	130	%	50	%			%	0.0061	mg/Kg
N-Nitrosomethylethylamine	10595-95-6	0.033	0.0033	mg/Kg	10	130	%	50	%	10	130	%	50	%			%	0.0033	mg/Kg
N-Nitrosomorpholine	59-89-2	0.033	0.0045	mg/Kg	10	130	%	50	%	10	130	%	50	%			%	0.0045	mg/Kg
N-Nitrosopiperidine	100-75-4	0.033	0.0034	mg/Kg	10	130	%	50	%	10	130	%	50	%			%	0.0034	mg/Kg
N-Nitrosopyrrolidine	930-55-2	0.033	0.0036	mg/Kg	10	130	%	50	%	10	130	%	50	%			%	0.0036	mg/Kg
o,o',o"-Triethylphosphorothioate	126-68-1	0.066	0.0044	mg/Kg	10	130	%	50	%	10	130	%	50	%			%	0.0067	mg/Kg
2,2'-oxybis[1-chloropropane]	108-60-1	0.033	0.0072	mg/Kg	10	130	%	50	%	10	130	%	50	%			%	0.0072	mg/Kg
p-Dimethylamino azobenzene	60-11-7	0.033	0.017	mg/Kg	10	130	%	50	%	10	130	%	50	%			%	0.017	mg/Kg
Pentachlorobenzene	608-93-5	0.033	0.0033	mg/Kg	10	130	%	50	%	10	130	%	50	%			%	0.0033	mg/Kg
Pentachloronitrobenzene	82-68-8	0.033	0.017	mg/Kg	10	130	%	50	%	10	130	%	50	%			%	0.017	mg/Kg
Pentachlorophenol	87-86-5	0.17	0.017	mg/Kg	10	130	%	50	%	10	130	%	50	%			%	0.017	mg/Kg
Phenacetin	62-44-2	0.033	0.017	mg/Kg	10	130	%	50	%	10	130	%	50	%			%	0.017	mg/Kg
Phenol	108-95-2	0.033	0.0065	mg/Kg	10	130	%	50	%	10	130	%	50	%			%	0.0065	mg/Kg
Phorate	298-02-2	0.033	0.0059	mg/Kg	10	130	%	50	%	10	130	%	50	%			%	0.017	mg/Kg
2-Picoline	109-06-8	0.066	0.0033	mg/Kg	10	130	%	50	%	10	130	%	50	%			%	0.0033	mg/Kg
p-Phenylene diamine	106-50-3	0.83	0.36	mg/Kg	10	130	%	50	%	10	130	%	50	%			%	0.83	mg/Kg
Pronamide	23950-58-5	0.033	0.0042	mg/Kg	10	130	%	50	%	10	130	%	50	%			%	0.0042	mg/Kg
Pyridine	110-86-1	0.033	0.02	mg/Kg	10	130	%	50	%	10	130	%	50	%			%	0.02	mg/Kg
Safrole, Total	94-59-7	0.033	0.0033	mg/Kg	10	130	%	50	%	10	130	%	50	%			%	0.0033	mg/Kg
Sulfotepp	3689-24-5	0.033	0.0065	mg/Kg	10	130	%	50	%	10	130	%	50	%			%	0.017	mg/Kg
1,2,4,5-Tetrachlorobenzene	95-94-3	0.033	0.0033	mg/Kg	10	130	%	50	%	10	130	%	50	%			%	0.0033	mg/Kg
2,3,4,6-Tetrachlorophenol	58-90-2	0.033	0.0033	mg/Kg	10	130	%	50	%	10	130	%	50	%			%	0.0033	mg/Kg
Thionazin	297-97-2	0.033	0.017	mg/Kg	10	130	%	50	%	10	130	%	50	%			%	0.017	mg/Kg
2-Toluidine	95-53-4	0.033	0.0033	mg/Kg	10	130	%	50	%	10	130	%	50	%			%	0.0033	mg/Kg
2,4,5-Trichlorophenol	95-95-4	0.033	0.0076	mg/Kg	16	130	%	50	%	16	130	%	50	%			%	0.0076	mg/Kg
2,4,6-Trichlorophenol	88-06-2	0.033	0.0079	mg/Kg	15	130	%	50	%	15	130	%	50	%			%	0.0079	mg/Kg
1,3,5-Trinitrobenzene	99-35-4	0.066	0.017	mg/Kg	10	130	%	50	%	10	130	%	50	%			%	0.017	mg/Kg
2-Fluorobiphenyl	321-60-8			ug/Kg	10	130	%	50	%	10	130	%	50	%	11	130	%		ug/Kg
2-Fluorophenol (Surr)	367-12-4			ug/Kg	10	130	%	50	%	10	130	%	50	%	10	130	%		ug/Kg
Nitrobenzene-d5 (Surr)	4165-60-0			ug/Kg	10	130	%	50	%	10	130	%	50	%	18	130	%		ug/Kg
Phenol-d5 (Surr)	4165-62-2			ug/Kg	10	130	%	50	%	10	130	%	50	%	10	130	%		ug/Kg
Terphenyl-d14 (Surr)	1718-51-0			ug/Kg	10	130	%	50	%	10	130	%	50	%	27	130	%		ug/Kg
2,4,6-Tribromophenol (Surr)	118-79-6			ug/Kg	10	130	%	50	%	10	130	%	50	%	24	130	%		ug/Kg

Soil Samples	Organochlorine Pesticides and Polychlorinated Biphenyls by Gas Chromatography	8081B_8082A

Analyte Description	CAS Number	RL - Limit	MDL - Limit	Units	LCSREC - Recovery Low	LCSREC - Recovery High	LCSREC - Units	LCSRPD - Precision	LCSRPD - Units	MSREC - Recovery Low	MSREC - Recovery High	MSREC - Units	MSRPD - Precision	MSRPD - Units	SUREC - Recovery Low	SUREC - Recovery High	SUREC - Units	LOD - Limit	LOD - Units
Chlorobenzilate	510-15-6	0.017	0.017	mg/Kg	50	150	%	50	%	50	150	%	50	%			%	0.017	mg/Kg
Isodrin	465-73-6	0.0033	0.0033	mg/Kg	50	150	%	50	%	50	150	%	50	%			%	0.0033	mg/Kg
Kepone	143-50-0	0.17	0.17	mg/Kg	50	150	%	50	%	50	150	%	50	%			%	0.17	mg/Kg
DCB Decachlorobiphenyl	2051-24-3			ug/Kg			%		%			%		%	70	130	%		ug/Kg
Tetrachloro-m-xylene	877-09-8			ug/Kg			%		%			%		%	60	139	%		ug/Kg

Aqueous QC Samples	Semivolatile Organic Compounds by GC/MS - Low Level	8270D_LL

Analyte Description	CAS Number	RL - Limit	MDL - Limit	Units	LCSREC - Recovery Low	LCSREC - Recovery High	LCSREC - Units	LCSRPD - Precision	LCSRPD - Units	MSREC - Recovery Low	MSREC - Recovery High	MSREC - Units	MSRPD - Precision	MSRPD - Units	SUREC - Recovery Low	SUREC - Recovery High	SUREC - Units	LOD - Limit	LOD - Units
Acetophenone	98-86-2	0.001	0.0001	mg/L	45	130	%	50	%	45	130	%	50	%			%	0.0001	mg/L
2-Acetylaminofluorene	53-96-3	0.001	0.0001	mg/L	10	130	%	50	%	10	130	%	50	%			%	0.0002	mg/L
alpha,alpha-Dimethyl phenethylamine	122-09-8	0.01	0.0034	mg/L	10	130	%	50	%	10	130	%	50	%			%	0.0034	mg/L
4-Aminobiphenyl	92-67-1	0.005	0.00031	mg/L	10	130	%	50	%	10	130	%	50	%			%	0.00031	mg/L
Aniline	62-53-3	0.002	0.00097	mg/L	10	130	%	50	%	10	130	%	50	%			%	0.00097	mg/L
Aramite, Total	140-57-8	0.0015	0.00011	mg/L	10	130	%	50	%	10	130	%	50	%			%	0.00011	mg/L
Benzyl alcohol	100-51-6	0.001	0.00014	mg/L	34	130	%	50	%	34	130	%	50	%			%	0.0002	mg/L
Bis(2-chloroethoxy)methane	111-91-1	0.001	0.0001	mg/L	47	130	%	50	%	47	130	%	50	%			%	0.0001	mg/L
Bis(2-chloroethyl)ether	111-44-4	0.001	0.0001	mg/L	36	130	%	50	%	36	130	%	50	%			%	0.0001	mg/L
Bis(2-ethylhexyl) phthalate	117-81-7	0.002	0.00064	mg/L	10	158	%	50	%	10	158	%	50	%			%	0.00064	mg/L
4-Bromophenyl phenyl ether	101-55-3	0.001	0.00012	mg/L	44	130	%	50	%	44	130	%	50	%			%	0.00012	mg/L
Butyl benzyl phthalate	85-68-7	0.001	0.00012	mg/L	60	130	%	50	%	60	130	%	50	%			%	0.00012	mg/L
4-Chloroaniline	106-47-8	0.002	0.00036	mg/L	17	130	%	50	%	17	130	%	50	%			%	0.00036	mg/L
4-Chloro-3-methylphenol	59-50-7	0.001	0.00012	mg/L	54	130	%	50	%	54	130	%	50	%			%	0.00012	mg/L
2-Chloronaphthalene	91-58-7	0.001	0.0001	mg/L	48	130	%	50	%	48	130	%	50	%			%	0.0001	mg/L
2-Chlorophenol	95-57-8	0.001	0.00012	mg/L	45	130	%	50	%	45	130	%	50	%			%	0.00012	mg/L
4-Chlorophenyl phenyl ether	7005-72-3	0.001	0.0001	mg/L	52	130	%	50	%	52	130	%	50	%			%	0.0001	mg/L
Diallate	2303-16-4	0.001	0.0001	mg/L	10	130	%	50	%	10	130	%	50	%			%	0.0001	mg/L
Dibenzofuran	132-64-9	0.001	0.0001	mg/L	56	130	%	50	%	56	130	%	50	%			%	0.0001	mg/L
1,3-Dichlorobenzene	541-73-1	0.001	0.0001	mg/L	31	130	%	50	%	31	130	%	50	%			%	0.0001	mg/L
3,3'-Dichlorobenzidine	91-94-1	0.02	0.002	mg/L	10	158	%	50	%	10	158	%	50	%			%	0.002	mg/L
2,4-Dichlorophenol	120-83-2	0.001	0.0001	mg/L	58	130	%	50	%	58	130	%	50	%			%	0.0001	mg/L
2,6-Dichlorophenol	87-65-0	0.001	0.0001	mg/L	10	130	%	50	%	10	130	%	50	%			%	0.0001	mg/L
Diethyl phthalate	84-66-2	0.001	0.00011	mg/L	60	130	%	50	%	60	130	%	50	%			%	0.00011	mg/L
Dimethoate	60-51-5	0.002	0.00012	mg/L	10	130	%	50	%	10	130	%	50	%			%	0.0002	mg/L
7,12-Dimethylbenz(a)anthracene	57-97-6	0.001	0.0002	mg/L	10	130	%	50	%	10	130	%	50	%			%	0.0002	mg/L
3,3'-Dimethylbenzidine	119-93-7	0.02	0.005	mg/L	10	130	%	50	%	10	130	%	50	%			%	0.005	mg/L
2,4-Dimethylphenol	105-67-9	0.002	0.00069	mg/L	41	130	%	50	%	41	130	%	50	%			%	0.00069	mg/L
Dimethyl phthalate	131-11-3	0.001	0.0001	mg/L	58	130	%	50	%	58	130	%	50	%			%	0.0001	mg/L
Di-n-butyl phthalate	84-74-2	0.001	0.00039	mg/L	59	130	%	50	%	59	130	%	50	%			%	0.00039	mg/L
1,3-Dinitrobenzene	99-65-0	0.001	0.0001	mg/L	10	130	%	50	%	10	130	%	50	%			%	0.0001	mg/L
4,6-Dinitro-2-methylphenol	534-52-1	0.005	0.00013	mg/L	10	182	%	50	%	10	182	%	50	%			%	0.00013	mg/L
2,4-Dinitrophenol	51-28-5	0.01	0.0011	mg/L	10	200	%	50	%	10	200	%	50	%			%	0.0013	mg/L
2,4-Dinitrotoluene	121-14-2	0.001	0.00012	mg/L	57	130	%	50	%	57	130	%	50	%			%	0.00012	mg/L
2,6-Dinitrotoluene	606-20-2	0.001	0.00013	mg/L	53	130	%	50	%	53	130	%	50	%			%	0.00013	mg/L
Di-n-octyl phthalate	117-84-0	0.001	0.00017	mg/L	19	130	%	50	%	19	130	%	50	%			%	0.00017	mg/L
Dinoseb	88-85-7	0.002	0.00015	mg/L	10	130	%	50	%	10	130	%	50	%			%	0.0002	mg/L
Disulfoton	298-04-4	0.001	0.0001	mg/L	10	130	%	50	%	10	130	%	50	%			%	0.0002	mg/L
Ethyl methanesulfonate	62-50-0	0.002	0.0001	mg/L	10	130	%	50	%	10	130	%	50	%			%	0.0001	mg/L
Ethyl Parathion	56-38-2	0.002	0.0001	mg/L	10	130	%	50	%	10	130	%	50	%			%	0.0002	mg/L
Famphur	52-85-7	0.001	0.00016	mg/L	10	130	%	50	%	10	130	%	50	%			%	0.00016	mg/L
Hexachlorobenzene	118-74-1	0.001	0.0001	mg/L	49	130	%	50	%	49	130	%	50	%			%	0.0001	mg/L
Hexachlorobutadiene	87-68-3	0.001	0.0001	mg/L	36	130	%	50	%	36	130	%	50	%			%	0.0001	mg/L
Hexachlorocyclopentadiene	77-47-4	0.002	0.0005	mg/L	16	130	%	50	%	16	130	%	50	%			%	0.0005	mg/L
Hexachloroethane	67-72-1	0.001	0.0005	mg/L	32	130	%	50	%	32	130	%	50	%			%	0.0005	mg/L
Hexachlorophene	70-30-4	0.5	0.025	mg/L	10	130	%	50	%	10	130	%	50	%			%	0.025	mg/L
Hexachloropropene	1888-71-7	0.001	0.0001	mg/L	10	130	%	50	%	10	130	%	50	%			%	0.0001	mg/L
Isophorone	78-59-1	0.001	0.0001	mg/L	45	130	%	50	%	45	130	%	50	%			%	0.0001	mg/L
Isosafrole	120-58-1	0.001	0.0001	mg/L	10	130	%	50	%	10	130	%	50	%			%	0.0001	mg/L
Methapyrilene	91-80-5	0.2	0.0013	mg/L	10	130	%	50	%	10	130	%	50	%			%	0.0025	mg/L
3-Methylcholanthrene	56-49-5	0.001	0.0005	mg/L	10	130	%	50	%	10	130	%	50	%			%	0.0005	mg/L
Methyl methanesulfonate	66-27-3	0.002	0.0001	mg/L	10	130	%	50	%	10	130	%	50	%			%	0.0001	mg/L
Methyl parathion	298-00-0	0.001	0.00013	mg/L	10	130	%	50	%	10	130	%	50	%			%	0.0002	mg/L
2-Methylphenol	95-48-7	0.002	0.00074	mg/L	49	130	%	50	%	49	130	%	50	%			%	0.00074	mg/L
3 & 4 Methylphenol	15831-10-4	0.002	0.00066	mg/L	55	130	%	50	%	55	130	%	50	%			%	0.00066	mg/L
1,4-Naphthoquinone	130-15-4	0.001	0.0005	mg/L	10	130	%	50	%	10	130	%	50	%			%	0.0005	mg/L
1-Naphthylamine	134-32-7	0.005	0.0013	mg/L	10	130	%	50	%	10	130	%	50	%			%	0.0013	mg/L
2-Naphthylamine	91-59-8	0.005	0.0013	mg/L	10	130	%	50	%	10	130	%	50	%			%	0.0013	mg/L
2-Nitroaniline	88-74-4	0.001	0.00016	mg/L	48	130	%	50	%	48	130	%	50	%			%	0.0002	mg/L
3-Nitroaniline	99-09-2	0.005	0.00016	mg/L	18	147	%	50	%	18	147	%	50	%			%	0.0002	mg/L
4-Nitroaniline	100-01-6	0.005	0.0005	mg/L	31	147	%	50	%	31	147	%	50	%			%	0.0005	mg/L
Nitrobenzene	98-95-3	0.001	0.0001	mg/L	45	130	%	50	%	45	130	%	50	%			%	0.0001	mg/L
2-Nitrophenol	88-75-5	0.001	0.0001	mg/L	49	130	%	50	%	49	130	%	50	%			%	0.0001	mg/L
4-Nitrophenol	100-02-7	0.005	0.0005	mg/L	36	132	%	50	%	36	132	%	50	%			%	0.0005	mg/L
4-Nitroquinoline-1-oxide	56-57-5	0.002	0.0011	mg/L	10	130	%	50	%	10	130	%	50	%			%	0.0013	mg/L
N-Nitro-o-toluidine	99-55-8	0.001	0.0001	mg/L	10	130	%	50	%	10	130	%	50	%			%	0.0001	mg/L
N-Nitrosodiethylamine	55-18-5	0.001	0.0001	mg/L	10	130	%	50	%	10	130	%	50	%			%	0.0001	mg/L
N-Nitrosodimethylamine	62-75-9	0.001	0.00025	mg/L	29	130	%	50	%	29	130	%	50	%			%	0.00025	mg/L
N-Nitrosodi-n-butylamine	924-16-3	0.001	0.0001	mg/L	10	130	%	50	%	10	130	%	50	%			%	0.0001	mg/L
N-Nitrosodi-n-propylamine	621-64-7	0.001	0.00013	mg/L	42	130	%	50	%	42	130	%	50	%			%	0.00013	mg/L
N-Nitrosodiphenylamine	86-30-6	0.001	0.00037	mg/L	38	130	%	50	%	38	130	%	50	%			%	0.00037	mg/L
N-Nitrosomethylethylamine	10595-95-6	0.002	0.0001	mg/L	10	130	%	50	%	10	130	%	50	%			%	0.0002	mg/L
N-Nitrosomorpholine	59-89-2	0.001	0.0001	mg/L	10	130	%	50	%	10	130	%	50	%			%	0.0001	mg/L
N-Nitrosopiperidine	100-75-4	0.001	0.0001	mg/L	10	130	%	50	%	10	130	%	50	%			%	0.0001	mg/L
N-Nitrosopyrrolidine	930-55-2	0.001	0.0001	mg/L	10	130	%	50	%	10	130	%	50	%			%	0.0001	mg/L
o,o',o"-Triethylphosphorothioate	126-68-1	0.001	0.00013	mg/L	10	130	%	50	%	10	130	%	50	%			%	0.00013	mg/L
2,2'-oxybis[1-chloropropane]	108-60-1	0.001	0.0001	mg/L	39	130	%	50	%	39	130	%	50	%			%	0.0001	mg/L
p-Dimethylamino azobenzene	60-11-7	0.005	0.00015	mg/L	10	130	%	50	%	10	130	%	50	%			%	0.0002	mg/L
Pentachlorobenzene	608-93-5	0.001	0.0001	mg/L	10	130	%	50	%	10	130	%	50	%			%	0.0001	mg/L
Pentachloronitrobenzene	82-68-8	0.001	0.0005	mg/L	10	130	%	50	%	10	130	%	50	%			%	0.0005	mg/L
Pentachlorophenol	87-86-5	0.005	0.0004	mg/L	12	156	%	50	%	12	156	%	50	%			%	0.0004	mg/L
Phenacetin	62-44-2	0.001	0.0001	mg/L	10	130	%	50	%	10	130	%	50	%			%	0.0001	mg/L

Aqueous QC Samples	Semivolatile Organic Compounds by GC/MS - Low Level	8270D_LL

Analyte Description	CAS Number	RL - Limit	MDL - Limit	Units	LCSREC - Recovery Low	LCSREC - Recovery High	LCSREC - Units	LCSRPD - Precision	LCSRPD - Units	MSREC - Recovery Low	MSREC - Recovery High	MSREC - Units	MSRPD - Precision	MSRPD - Units	SUREC - Recovery Low	SUREC - Recovery High	SUREC - Units	LOD - Limit	LOD - Units
Phenol	108-95-2	0.001	0.00013	mg/L	44	130	%	50	%	44	130	%	50	%			%	0.00013	mg/L
Phorate	298-02-2	0.001	0.0002	mg/L	10	130	%	50	%	10	130	%	50	%			%	0.0002	mg/L
2-Picoline	109-06-8	0.002	0.00015	mg/L	10	130	%	50	%	10	130	%	50	%			%	0.0002	mg/L
p-Phenylene diamine	106-50-3	0.2	0.016	mg/L	10	130	%	50	%	10	130	%	50	%			%	0.016	mg/L
Pronamide	23950-58-5	0.001	0.00012	mg/L	10	130	%	50	%	10	130	%	50	%			%	0.00012	mg/L
Pyridine	110-86-1	0.005	0.00073	mg/L	10	130	%	50	%	10	130	%	50	%			%	0.00073	mg/L
Safrole, Total	94-59-7	0.001	0.0001	mg/L	10	130	%	50	%	10	130	%	50	%			%	0.0001	mg/L
Sulfotepp	3689-24-5	0.001	0.00014	mg/L	10	130	%	50	%	10	130	%	50	%			%	0.00014	mg/L
1,2,4,5-Tetrachlorobenzene	95-94-3	0.001	0.0001	mg/L	10	130	%	50	%	10	130	%	50	%			%	0.0001	mg/L
2,3,4,6-Tetrachlorophenol	58-90-2	0.001	0.0001	mg/L	10	130	%	50	%	10	130	%	50	%			%	0.0001	mg/L
Thionazin	297-97-2	0.001	0.0002	mg/L	10	130	%	50	%	10	130	%	50	%			%	0.0002	mg/L
2-Toluidine	95-53-4	0.001	0.00013	mg/L	10	130	%	50	%	10	130	%	50	%			%	0.00013	mg/L
2,4,5-Trichlorophenol	95-95-4	0.001	0.00012	mg/L	61	130	%	50	%	61	130	%	50	%			%	0.00012	mg/L
2,4,6-Trichlorophenol	88-06-2	0.001	0.00017	mg/L	61	130	%	50	%	61	130	%	50	%			%	0.00017	mg/L
1,3,5-Trinitrobenzene	99-35-4	0.001	0.0005	mg/L	10	130	%	50	%	10	130	%	50	%			%	0.0005	mg/L
2-Fluorobiphenyl	321-60-8			ug/L	10	130	%	50	%	10	130	%	50	%	34	130	%		ug/L
2-Fluorophenol (Surr)	367-12-4			ug/L	10	130	%	50	%	10	130	%	50	%	25	130	%		ug/L
Nitrobenzene-d5 (Surr)	4165-60-0			ug/L			%	50	%			%	50	%	32	130	%		ug/L
Phenol-d5 (Surr)	4165-62-2			ug/L			%	50	%			%	50	%	27	130	%		ug/L
Terphenyl-d14 (Surr)	1718-51-0			ug/L			%	50	%			%	50	%	36	130	%		ug/L
2,4,6-Tribromophenol (Surr)	118-79-6			ug/L	10	130	%	50	%	10	130	%	50	%	30	130	%		ug/L

Aqueous QC Samples	Organochlorine Pesticides and Polychlorinated Biphenyls by Gas Chromatography	8081B_8082A

Analyte Description	CAS Number	RL - Limit	MDL - Limit	Units	LCSREC - Recovery Low	LCSREC - Recovery High	LCSREC - Units	LCSRPD - Precision	LCSRPD - Units	MSREC - Recovery Low	MSREC - Recovery High	MSREC - Units	MSRPD - Precision	MSRPD - Units	SUREC - Recovery Low	SUREC - Recovery High	SUREC - Units	LOD - Limit	LOD - Units
Chlorobenzilate	510-15-6	0.0005	0.0005	mg/L	10	189	%	50	%	10	189	%	50	%			%	0.0005	mg/L
Isodrin	465-73-6	0.00005	0.00005	mg/L	32	130	%	50	%	32	130	%	50	%			%	0.00005	mg/L
Kepone	143-50-0	0.001	0.001	mg/L	10	133	%	50	%	10	133	%	50	%			%	0.001	mg/L
DCB Decachlorobiphenyl	2051-24-3			ug/L			%		%			%		%	40	130	%		ug/L
Tetrachloro-m-xylene	877-09-8			ug/L			%		%			%		%	36	130	%		ug/L

The American Association for Laboratory Accreditation

World Class Accreditation

Accredited DoD ELAP Laboratory

A2LA has accredited

TEST AMERICA SAVANNAH

Savannah, GA

for technical competence in the field of

Environmental Testing

In recognition of the successful completion of the A2LA evaluation process, (including an assessment of the laboratory's compliance with ISO IEC 17025:2005, the 2003 NELAC Chapter 5 Standard, and the requirements of the DoD Environmental Laboratory Accreditation Program (DoD ELAP) as detailed in the current DoD Quality Systems Manual for Environmental Laboratories); accreditation is granted to this laboratory to perform recognized EPA methods as defined on the associated A2LA Environmental Scope of Accreditation. This accreditation demonstrates technical competence for this defined scope and the operation of a laboratory quality management system (*refer to joint ISO-ILAC-IAF Communiqué dated 8 January 2009*).

Presented this 5th day of April 2011.

President & CEO
For the Accreditation Council
Certificate Number 0399.01
Valid to February 28, 2013

For the tests or types of tests to which this accreditation applies, please refer to the laboratory's Environmental Scope of Accreditation.

SCOPE OF ACCREDITATION TO ISO/IEC 17025:2005

TEST AMERICA SAVANNAH
5102 LaRoche Avenue
Savannah, GA 31404
Andrea Teal Phone: 912 354 7858

ENVIRONMENTAL

Valid To: February 28, 2013 Certificate Number: 0399.01

In recognition of the successful completion of the A2LA evaluation process, (including an assessment of the laboratory's compliance with ISO IEC 17025:2005, the 2003 NELAC Chapter 5 Standard, and the requirements of the DoD Environmental Laboratory Accreditation Program (DoD ELAP) as detailed in the current DoD Quality Systems Manual for Environmental Laboratories) accreditation is granted to this laboratory to perform recognized EPA methods using the following testing technologies and in the analyte categories identified below and for the test methods applicable to Kentucky Statute KRS 224.60-130(2)(a):

Testing Technologies

Atomic Absorption/ICP-AES Spectrometry, Gas Chromatography, Gas Chromatography/Mass Spectrometry, Gravimetry, Ion Chromatography, ICP/MS, Methylene Blue Active Substances, Misc.- Electronic Probes (pH, F^-, O_2), Oxygen Demand, Hazardous Waste Characteristics Tests, Spectrophotometry (Visible), Spectrophotometry (Automated), Titrimetry, Total Organic Carbon, Total Organic Halide, Turbidity

Parameter/Analyte	**Potable Water**	**Nonpotable Water**	**Solid Hazardous Waste**	
			Aqueous	**Solid**
Metals				
Aluminum	EPA 200.7 EPA 200.8	EPA 200.7 EPA 200.8	EPA 3005A/6010B EPA 3010A/6010B EPA 3010A/6010B SM 3030C/EPA 6010B EPA 3005A/6010C EPA 3010A/6010C SM 3030C/EPA 6010C EPA 3005A/6020 EPA 3010A/6020 SM 3030C/EPA 6020 EPA 3005A/6020A EPA 3010A/6020A SM 3030C/EPA 6020A ISM01.2 (ICP) ISM01.2 (ICPMS)	EPA 3050B/6010B EPA 3050B/6010C EPA 3050B/6020 EPA 3050B/6020A ISM01.2 (ICP)

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Parameter/Analyte	Potable Water	Nonpotable Water	Solid Hazardous Waste	
			Aqueous	Solid
Antimony	EPA 200.7 EPA 200.8	EPA 200.7 EPA 200.8	EPA 3005A/6010B EPA 3010A/6010B EPA 3010A/6010B SM 3030C/EPA 6010B EPA 3005A/6010C EPA 3010A/6010C SM 3030C/EPA 6010C EPA 3005A/6020 EPA 3010A/6020 SM 3030C/EPA 6020 EPA 3005A/6020A EPA 3010A/6020A SM 3030C/EPA 6020A ISM01.2 (ICP) ISM01.2 (ICPMS)	EPA 3050B/6010B EPA 3050B/6010C EPA 3050B/6020 EPA 3050B/6020A ISM01.2 (ICP) ISM01.2 (ICPMS)
Arsenic	EPA 200.7 EPA 200.8	EPA 200.7 EPA 200.8	EPA 3005A/6010B EPA 3010A/6010B EPA 3010A/6010B SM 3030C/EPA 6010B EPA 3005A/6010C EPA 3010A/6010C SM 3030C/EPA 6010C EPA 3005A/6020 EPA 3010A/6020 SM 3030C/EPA 6020 EPA 3005A/6020A EPA 3010A/6020A SM 3030C/EPA 6020A ISM01.2 (ICP) ISM01.2 (ICPMS)	EPA 3050B/6010B EPA 3050B/6010C EPA 3050B/6020 EPA 3050B/6020A ISM01.2 (ICP) ISM01.2 (ICPMS)
Barium	EPA 200.7 EPA 200.8	EPA 200.7 EPA 200.8	EPA 3005A/6010B EPA 3010A/6010B EPA 3010A/6010B SM 3030C/EPA 6010B EPA 3005A/6010C EPA 3010A/6010C SM 3030C/EPA 6010C EPA 3005A/6020 EPA 3010A/6020 SM 3030C/EPA 6020 EPA 3005A/6020A EPA 3010A/6020A SM 3030C/EPA 6020A ISM01.2 (ICP) ISM01.2 (ICPMS)	EPA 3050B/6010B EPA 3050B/6010C EPA 3050B/6020 EPA 3050B/6020A ISM01.2 (ICP) ISM01.2 (ICPMS)

Parameter/Analyte	Potable Water	Nonpotable Water	Solid Hazardous Waste	
			Aqueous	Solid
Beryllium	EPA 200.7 EPA 200.8	EPA 200.7 EPA 200.8	EPA 3005A/6010B EPA 3010A/6010B EPA 3010A/6010B SM 3030C/EPA 6010B EPA 3005A/6010C EPA 3010A/6010C SM 3030C/EPA 6010C EPA 3005A/6020 EPA 3010A/6020 SM 3030C/EPA 6020 EPA 3005A/6020A EPA 3010A/6020A SM 3030C/EPA 6020A ISM01.2 (ICP) ISM01.2 (ICPMS)	EPA 3050B/6010B EPA 3050B/6010C EPA 3050B/6020 EPA 3050B/6020A ISM01.2 (ICP) ISM01.2 (ICPMS)
Boron	EPA 200.7 EPA 200.8	EPA 200.7 EPA 200.8	EPA 3005A/6010B EPA 3010A/6010B EPA 3010A/6010B SM 3030C/EPA 6010B EPA 3005A/6010C EPA 3010A/6010C SM 3030C/EPA 6010C EPA 3005A/6020 EPA 3010A/6020 SM 3030C/EPA 6020 EPA 3005A/6020A EPA 3010A/6020A SM 3030C/EPA 6020A	EPA 3050B/6010B EPA 3050B/6010C EPA 3050B/6020 EPA 3050B/6020A
Cadmium	EPA 200.7 EPA 200.8	EPA 200.7 EPA 200.8	EPA 3005A/6010B EPA 3010A/6010B EPA 3010A/6010B SM 3030C/EPA 6010B EPA 3005A/6010C EPA 3010A/6010C SM 3030C/EPA 6010C EPA 3005A/6020 EPA 3010A/6020 SM 3030C/EPA 6020 EPA 3005A/6020A EPA 3010A/6020A SM 3030C/EPA 6020A ISM01.2 (ICP) ISM01.2 (ICPMS)	EPA 3050B/6010B EPA 3050B/6010C EPA 3050B/6020 EPA 3050B/6020A ISM01.2 (ICP) ISM01.2 (ICPMS)

Parameter/Analyte	Potable Water	Nonpotable Water	Solid Hazardous Waste	
			Aqueous	Solid
Calcium	EPA 200.7 EPA 200.8	EPA 200.7 EPA 200.8	EPA 3005A/6010B EPA 3010A/6010B EPA 3010A/6010B SM 3030C/EPA 6010B EPA 3005A/6010C EPA 3010A/6010C SM 3030C/EPA 6010C EPA 3005A/6020 EPA 3010A/6020 SM 3030C/EPA 6020 EPA 3005A/6020A EPA 3010A/6020A SM 3030C/EPA 6020A ISM01.2 (ICP) ISM01.2 (ICPMS)	EPA 3050B/6010B EPA 3050B/6010C EPA 3050B/6020 EPA 3050B/6020A ISM01.2 (ICP)
Chromium	EPA 200.7 EPA 200.8	EPA 200.7 EPA 200.8	EPA 3005A/6010B EPA 3010A/6010B EPA 3010A/6010B SM 3030C/EPA 6010B EPA 3005A/6010C EPA 3010A/6010C SM 3030C/EPA 6010C EPA 3005A/6020 EPA 3010A/6020 SM 3030C/EPA 6020 EPA 3005A/6020A EPA 3010A/6020A SM 3030C/EPA 6020A ISM01.2 (ICP) ISM01.2 (ICPMS)	EPA 3050B/6010B EPA 3050B/6010C EPA 3050B/6020 EPA 3050B/6020A ISM01.2 (ICP) ISM01.2 (ICPMS)
Chromium 3+	SM 3500 Cr B_01 SM3500 Cr D	EPA 7196A SM 3500 Cr B_01 SM 3500 Cr D	EPA 7196A SM 3500 Cr B_01 SM 3500 Cr D	EPA 3060A/7196A
Chromium 6+	SM 3500 Cr B_01 SM3500 Cr D	EPA 7196A SM 3500 Cr B_01 SM 3500 Cr D	EPA 7196A SM 3500 Cr B_01 SM 3500 Cr D	EPA 3060A/7196A

Parameter/Analyte	Potable Water	Nonpotable Water	Solid Hazardous Waste	
			Aqueous	Solid
Cobalt	EPA 200.7 EPA 200.8	EPA 200.7 EPA 200.8	EPA 3005A/6010B EPA 3010A/6010B EPA 3010A/6010B SM 3030C/EPA 6010B EPA 3005A/6010C EPA 3010A/6010C SM 3030C/EPA 6010C EPA 3005A/6020 EPA 3010A/6020 SM 3030C/EPA 6020 EPA 3005A/6020A EPA 3010A/6020A SM 3030C/EPA 6020A ISM01.2 (ICP) ISM01.2 (ICPMS)	EPA 3050B/6010B EPA 3050B/6010C EPA 3050B/6020 EPA 3050B/6020A ISM01.2 (ICP) ISM01.2 (ICPMS)
Copper	EPA 200.7 EPA 200.8	EPA 200.7 EPA 200.8	EPA 3005A/6010B EPA 3010A/6010B EPA 3010A/6010B SM 3030C/EPA 6010B EPA 3005A/6010C EPA 3010A/6010C SM 3030C/EPA 6010C EPA 3005A/6020 EPA 3010A/6020 SM 3030C/EPA 6020 EPA 3005A/6020A EPA 3010A/6020A SM 3030C/EPA 6020A ISM01.2 (ICP) ISM01.2 (ICPMS)	EPA 3050B/6010B EPA 3050B/6010C EPA 3050B/6020 EPA 3050B/6020A ISM01.2 (ICP) ISM01.2 (ICPMS)
Iron	EPA 200.7 EPA 200.8	EPA 200.7 EPA 200.8	EPA 3005A/6010B EPA 3010A/6010B EPA 3010A/6010B SM 3030C/EPA 6010B EPA 3005A/6010C EPA 3010A/6010C SM 3030C/EPA 6010C EPA 3005A/6020 EPA 3010A/6020 SM 3030C/EPA 6020 EPA 3005A/6020A EPA 3010A/6020A SM 3030C/EPA 6020A ISM01.2 (ICP) ISM01.2 (ICPMS)	EPA 3050B/6010B EPA 3050B/6010C EPA 3050B/6020 EPA 3050B/6020A ISM01.2 (ICP)

Parameter/Analyte	Potable Water	Nonpotable Water	Solid Hazardous Waste	
			Aqueous	Solid
Iron, Ferric	SM 3500 Fe B_97 SM3500 Fe D	SM 3500 Fe B_97 SM3500 Fe D	SM 3500 Fe B_97 SM3500 Fe D	- - - - - - - - - -
Iron, Ferrous	SM 3500 Fe B_97 SM3500 Fe D	SM 3500 Fe B_97 SM3500 Fe D	SM 3500 Fe B_97 SM3500 Fe D	- - - - - - - - - -
Lead	EPA 200.7 EPA 200.8	EPA 200.7 EPA 200.8	EPA 3005A/6010B EPA 3010A/6010B EPA 3010A/6010B SM 3030C/EPA 6010B EPA 3005A/6010C EPA 3010A/6010C SM 3030C/EPA 6010C EPA 3005A/6020 EPA 3010A/6020 SM 3030C/EPA 6020 EPA 3005A/6020A EPA 3010A/6020A SM 3030C/EPA 6020A ISM01.2 (ICP) ISM01.2 (ICPMS)	EPA 3050B/6010B EPA 3050B/6010C EPA 3050B/6020 EPA 3050B/6020A ISM01.2 (ICP) ISM01.2 (ICPMS)
Magnesium	EPA 200.7 EPA 200.8	EPA 200.7 EPA 200.8	EPA 3005A/6010B EPA 3010A/6010B EPA 3010A/6010B SM 3030C/EPA 6010B EPA 3005A/6010C EPA 3010A/6010C SM 3030C/EPA 6010C EPA 3005A/6020 EPA 3010A/6020 SM 3030C/EPA 6020 EPA 3005A/6020A EPA 3010A/6020A SM 3030C/EPA 6020A ISM01.2 (ICP) ISM01.2 (ICPMS)	EPA 3050B/6010B EPA 3050B/6010C EPA 3050B/6020 EPA 3050B/6020A ISM01.2 (ICP)

Parameter/Analyte	Potable Water	Nonpotable Water	Solid Hazardous Waste	
			Aqueous	Solid
Manganese	EPA 200.7 EPA 200.8	EPA 200.7 EPA 200.8	EPA 3005A/6010B EPA 3010A/6010B EPA 3010A/6010B SM 3030C/EPA 6010B EPA 3005A/6010C EPA 3010A/6010C SM 3030C/EPA 6010C EPA 3005A/6020 EPA 3010A/6020 SM 3030C/EPA 6020 EPA 3005A/6020A EPA 3010A/6020A SM 3030C/EPA 6020A ISM01.2 (ICP) ISM01.2 (ICPMS)	EPA 3050B/6010B EPA 3050B/6010C EPA 3050B/6020 EPA 3050B/6020A ISM01.2 (ICP) ISM01.2 (ICPMS)
Mercury	EPA 200.8 EPA 245.1	EPA 200.8 EPA 245.1 SM 3112B	EPA 3005A/6020 EPA 3010A/6020 SM 3030C/EPA 6020 EPA 3005A/6020A EPA 3010A/6020A SM 3030C/EPA 6020A EPA 7470A ISM01.2 (Hg) SM 3112B	EPA 3050B/6020 EPA 3050B/6020A EPA 7471A EPA 7471B ISM01.2 (Hg)
Molybdenum	EPA 200.7 EPA 200.8	EPA 200.7 EPA 200.8	EPA 3005A/6010B EPA 3010A/6010B EPA 3010A/6010B SM 3030C/EPA 6010B EPA 3005A/6010C EPA 3010A/6010C SM 3030C/EPA 6010C EPA 3005A/6020 EPA 3010A/6020 SM 3030C/EPA 6020 EPA 3005A/6020A EPA 3010A/6020A SM 3030C/EPA 6020A	EPA 3050B/6010B EPA 3050B/6010C EPA 3050B/6020 EPA 3050B/6020A

Parameter/Analyte	Potable Water	Nonpotable Water	Solid Hazardous Waste	
			Aqueous	Solid
Nickel	EPA 200.7 EPA 200.8	EPA 200.7 EPA 200.8	EPA 3005A/6010B EPA 3010A/6010B EPA 3010A/6010B SM 3030C/EPA 6010B EPA 3005A/6010C EPA 3010A/6010C SM 3030C/EPA 6010C EPA 3005A/6020 EPA 3010A/6020 SM 3030C/EPA 6020 EPA 3005A/6020A EPA 3010A/6020A SM 3030C/EPA 6020A ISM01.2 (ICP) ISM01.2 (ICPMS)	EPA 3050B/6010B EPA 3050B/6010C EPA 3050B/6020 EPA 3050B/6020A ISM01.2 (ICP) ISM01.2 (ICPMS)
Potassium	EPA 200.7 EPA 200.8	EPA 200.7 EPA 200.8	EPA 3005A/6010B EPA 3010A/6010B EPA 3010A/6010B SM 3030C/EPA 6010B EPA 3005A/6010C EPA 3010A/6010C SM 3030C/EPA 6010C EPA 3005A/6020 EPA 3010A/6020 SM 3030C/EPA 6020 EPA 3005A/6020A EPA 3010A/6020A SM 3030C/EPA 6020A ISM01.2 (ICP) ISM01.2 (ICPMS)	EPA 3050B/6010B EPA 3050B/6010C EPA 3050B/6020 EPA 3050B/6020A ISM01.2 (ICP)
Selenium	EPA 200.7 EPA 200.8	EPA 200.7 EPA 200.8	EPA 3005A/6010B EPA 3010A/6010B EPA 3010A/6010B SM 3030C/EPA 6010B EPA 3005A/6010C EPA 3010A/6010C SM 3030C/EPA 6010C EPA 3005A/6020 EPA 3010A/6020 SM 3030C/EPA 6020 EPA 3005A/6020A EPA 3010A/6020A SM 3030C/EPA 6020A ISM01.2 (ICP) ISM01.2 (ICPMS)	EPA 3050B/6010B EPA 3050B/6010C EPA 3050B/6020 EPA 3050B/6020A ISM01.2 (ICP) ISM01.2 (ICPMS)

Parameter/Analyte	Potable Water	Nonpotable Water	Solid Hazardous Waste	
			Aqueous	Solid
Silica	EPA 200.7	EPA 200.7	EPA 6010B EPA 6010C	- - - - - - - - - -
Silicon	EPA 200.7	EPA 200.7	EPA 6010B EPA 6010C	- - - - - - - - - -
Silver	EPA 200.7 EPA 200.8	EPA 200.7 EPA 200.8	EPA 3005A/6010B EPA 3010A/6010B EPA 3010A/6010B SM 3030C/EPA 6010B EPA 3005A/6010C EPA 3010A/6010C SM 3030C/EPA 6010C EPA 3005A/6020 EPA 3010A/6020 SM 3030C/EPA 6020 EPA 3005A/6020A EPA 3010A/6020A SM 3030C/EPA 6020A ISM01.2 (ICP) ISM01.2 (ICPMS)	EPA 3050B/6010B EPA 3050B/6010C EPA 3050B/6020 EPA 3050B/6020A ISM01.2 (ICP) ISM01.2 (ICPMS)
Sodium	EPA 200.7 EPA 200.8	EPA 200.7 EPA 200.8	EPA 3005A/6010B EPA 3010A/6010B EPA 3010A/6010B SM 3030C/EPA 6010B EPA 3005A/6010C EPA 3010A/6010C SM 3030C/EPA 6010C EPA 3005A/6020 EPA 3010A/6020 SM 3030C/EPA 6020 EPA 3005A/6020A EPA 3010A/6020A SM 3030C/EPA 6020A ISM01.2 (ICP) ISM01.2 (ICPMS)	EPA 3050B/6010B EPA 3050B/6010C EPA 3050B/6020 EPA 3050B/6020A ISM01.2 (ICP)
Sodium Adsorption Ratio	- - - - - - - - - -	USDA 20B	USDA 20B	- - - - - - - - - -

Parameter/Analyte	Potable Water	Nonpotable Water	Solid Hazardous Waste	
			Aqueous	Solid
Strontium	EPA 200.7 EPA 200.8	EPA 200.7 EPA 200.8	EPA 3005A/6010B EPA 3010A/6010B EPA 3010A/6010B SM 3030C/EPA 6010B EPA 3005A/6010C EPA 3010A/6010C SM 3030C/EPA 6010C EPA 3005A/6020 EPA 3010A/6020 SM 3030C/EPA 6020 EPA 3005A/6020A EPA 3010A/6020A SM 3030C/EPA 6020A	EPA 3050B/6010B EPA 3050B/6010C EPA 3050B/6020 EPA 3050B/6020A
Thallium	EPA 200.7 EPA 200.8	EPA 200.7 EPA 200.8	EPA 3005A/6010B EPA 3010A/6010B EPA 3010A/6010B SM 3030C/EPA 6010B EPA 3005A/6010C EPA 3010A/6010C SM 3030C/EPA 6010C EPA 3005A/6020 EPA 3010A/6020 SM 3030C/EPA 6020 EPA 3005A/6020A EPA 3010A/6020A SM 3030C/EPA 6020A ISM01.2 (ICP) ISM01.2 (ICPMS)	EPA 3050B/6010B EPA 3050B/6010C EPA 3050B/6020 EPA 3050B/6020A ISM01.2 (ICP) ISM01.2 (ICPMS)
Tin	EPA 200.7 EPA 200.8	EPA 200.7 EPA 200.8	EPA 3005A/6010B EPA 3010A/6010B EPA 3010A/6010B SM 3030C/EPA 6010B EPA 3005A/6010C EPA 3010A/6010C SM 3030C/EPA 6010C EPA 3005A/6020 EPA 3010A/6020 SM 3030C/EPA 6020 EPA 3005A/6020A EPA 3010A/6020A SM 3030C/EPA 6020A	EPA 3050B/6010B EPA 3050B/6010C EPA 3050B/6020 EPA 3050B/6020A

Parameter/Analyte	Potable Water	Nonpotable Water	Solid Hazardous Waste	
			Aqueous	Solid
Titanium	EPA 200.7 EPA 200.8	EPA 200.7 EPA 200.8	EPA 3005A/6010B EPA 3010A/6010B EPA 3010A/6010B SM 3030C/EPA 6010B EPA 3005A/6010C EPA 3010A/6010C SM 3030C/EPA 6010C EPA 3005A/6020 EPA 3010A/6020 SM 3030C/EPA 6020 EPA 3005A/6020A EPA 3010A/6020A SM 3030C/EPA 6020A	EPA 3050B/6010B EPA 3050B/6010C EPA 3050B/6020 EPA 3050B/6020A
Vanadium	EPA 200.7 EPA 200.8	EPA 200.7 EPA 200.8	EPA 3005A/6010B EPA 3010A/6010B EPA 3010A/6010B SM 3030C/EPA 6010B EPA 3005A/6010C EPA 3010A/6010C SM 3030C/EPA 6010C EPA 3005A/6020 EPA 3010A/6020 SM 3030C/EPA 6020 EPA 3005A/6020A EPA 3010A/6020A SM 3030C/EPA 6020A ISM01.2 (ICP) ISM01.2 (ICPMS)	EPA 3050B/6010B EPA 3050B/6010C EPA 3050B/6020 EPA 3050B/6020A ISM01.2 (ICP) ISM01.2 (ICPMS)
Zinc	EPA 200.7 EPA 200.8	EPA 200.7 EPA 200.8	EPA 3005A/6010B EPA 3010A/6010B EPA 3010A/6010B SM 3030C/EPA 6010B EPA 3005A/6010C EPA 3010A/6010C SM 3030C/EPA 6010C EPA 3005A/6020 EPA 3010A/6020 SM 3030C/EPA 6020 EPA 3005A/6020A EPA 3010A/6020A SM 3030C/EPA 6020A ISM01.2 (ICP) ISM01.2 (ICPMS)	EPA 3050B/6010B EPA 3050B/6010C EPA 3050B/6020 EPA 3050B/6020A ISM01.2 (ICP) ISM01.2 (ICPMS)

Parameter/Analyte	Potable Water	Nonpotable Water	Solid Hazardous Waste	
			Aqueous	Solid
Nutrients				
Ammonia (as N)	EPA 350.1 SM4500NH3_G	EPA 350.1 SM4500NH3_G	EPA 350.1 SM4500NH3_G	- - - - - - - - - -
Kjeldahl nitrogen	EPA 351.2	EPA 351.2	EPA 351.2	- - - - - - - - - -
Nitrate (as N)	EPA 300.0 EPA 353.2	EPA 300.0 EPA 353.2 EPA 9056 EPA 9056A	EPA 300.0 EPA 353.2 EPA 9056 EPA 9056A	EPA 300.0 EPA 9056 EPA 9056A
Nitrate-nitrite (as N)	EPA 300.0 EPA 353.2	EPA 300.0 EPA 353.2 EPA 9056 EPA 9056A	EPA 300.0 EPA 353.2 EPA 9056 EPA 9056A	EPA 300.0 EPA 9056 EPA 9056A
Nitrite (as N)	EPA 300.0 EPA 353.2	EPA 300.0 EPA 353.2 EPA 9056 EPA 9056A	EPA 300.0 EPA 353.2 EPA 9056 EPA 9056A	EPA 300.0 EPA 9056 EPA 9056A
Nitrate (as NO3)	EPA 300.0 EPA 353.2	EPA 300.0 EPA 353.2 EPA 9056 EPA 9056A	EPA 300.0 EPA 353.2 EPA 9056 EPA 9056A	EPA 300.0 EPA 9056 EPA 9056A
Nitrate-nitrite (as NO3-NO2)	EPA 300.0 EPA 353.2	EPA 300.0 EPA 353.2 EPA 9056 EPA 9056A	EPA 300.0 EPA 353.2 EPA 9056 EPA 9056A	EPA 300.0 EPA 9056 EPA 9056A
Nitrite (as NO2)	EPA 300.0 EPA 353.2	EPA 300.0 EPA 353.2 EPA 9056 EPA 9056A	EPA 300.0 EPA 353.2 EPA 9056 EPA 9056A	EPA 300.0 EPA 9056 EPA 9056A
Organic Nitrogen (as N)	- - - - - - - - - -	TKN minus Ammonia	TKN minus Ammonia	- - - - - - - - - -
Orthophosphate (as P)	EPA 365.1 SM4500P F	EPA 365.1 SM4500P F	EPA 365.1 SM4500P F	- - - - - - - - - -
Total Nitrogen (as N)	- - - - - - - - - -	TKN plus Nitrate-Nitrite (as N)	TKN plus Nitrate-Nitrite (as N)	- - - - - - - - - -
Total phosphorus	EPA 365.4	EPA 365.4	EPA 365.4	- - - - - - - - - -
Demands				
Adsorbable organic halides (AOX)	- - - - - - - - - -	EPA 1650	EPA 1650	- - - - - - - - - -
Biochemical oxygen demand	EPA 405.1 SM 5210 B	EPA 405.1 SM 5210 B	EPA 405.1 SM 5210 B	- - - - - - - - - -
Carbonacious BOD	SM 5210 B	SM 5210 B	SM 5210 B	- - - - - - - - - -
Chemical oxygen demand	EPA 410.4 SM 5220 D	EPA 410.4 SM 5220 D	EPA 410.4 SM 5220 D	- - - - - - - - - -

Parameter/Analyte	Potable Water	Nonpotable Water	Solid Hazardous Waste	
			Aqueous	Solid
Dissolved carbon	EPA 415.1 SM 5310B	EPA 415.1 SM 5310B EPA 9060 EPA 9060A	EPA 415.1 SM 5310B EPA 9060 EPA 9060A	- - - - - - - - - -
Dissolved inorganic carbon	EPA 415.1 SM 5310B	EPA 415.1 SM 5310B EPA 9060 EPA 9060A	EPA 415.1 SM 5310B EPA 9060 EPA 9060A	- - - - - - - - - -
Dissolved organic carbon	EPA 415.1 SM 5310B	EPA 415.1 SM 5310B EPA 9060 EPA 9060A	EPA 415.1 SM 5310B EPA 9060 EPA 9060A	- - - - - - - - - -
Extractable organic halides	- - - - - - - - - -	- - - - - - - - - -	- - - - - - - - - -	EPA 9023
Total carbon	EPA 415.1 SM 5310B	EPA 415.1 SM 5310B EPA 9060 EPA 9060A	EPA 415.1 SM 5310B EPA 9060 EPA 9060A	- - - - - - - - - -
Total inorganic carbon	EPA 415.1 SM 5310B	EPA 415.1 SM 5310B EPA 9060 EPA 9060A	EPA 415.1 SM 5310B EPA 9060 EPA 9060A	- - - - - - - - - -
Total organic carbon	EPA 415.1 SM 5310B	EPA 415.1 SM 5310B EPA 9060 EPA 9060A	EPA 415.1 SM 5310B EPA 9060 EPA 9060A	EPA 9060 EPA 9060A Lloyd Kahn
Total organic halides	EPA 9020B	EPA 450.1 EPA 9020B	EPA 9020B EPA 450.1	- - - - - - - - - -
Wet Chemistry				
Acidity	EPA 305.1 SM 2310B	EPA 305.1 SM 2310B	EPA 305.1 SM 2310B	- - - - - - - - - -
Alkalinity	EPA 310.1 SM 2320B	EPA 310.1 SM 2320B	EPA 310.1 SM 2320B	- - - - - - - - - -
Anion/Cation Balance	- - - - - - - - - -	SM 1030 F	SM 1030 F	- - - - - - - - - -
Bicarbonate alkalinity	EPA 310.1 SM 2320B	EPA 310.1 SM 2320B	EPA 310.1 SM 2320B	- - - - - - - - - -
Bromide	EPA 300.1B	EPA 300.0 EPA 9056 EPA 9056A	EPA 300.0 EPA 9056 EPA 9056A	EPA 300.0 EPA 9056 EPA 9056A
Bromate	EPA 300.1B	- - - - - - - - - -	- - - - - - - - - -	- - - - - - - - - -

Parameter/Analyte	Potable Water	Nonpotable Water	Solid Hazardous Waste	
			Aqueous	Solid
Carbon dioxide, free	EPA 310.1 SM 2320B	EPA 310.1 SM 2320B	EPA 310.1 SM 2320B	- - - - - - - - - -
Carbonate alkalinity	EPA 310.1 SM 2320B	EPA 310.1 SM 2320B SM 4500 CO2 D	EPA 310.1 SM 2320B SM 4500 CO2 D	- - - - - - - - - -
Chlorate	EPA 300.1B	- - - - - - - - - -	- - - - - - - - - -	- - - - - - - - - -
Chloride	EPA 300.0 EPA 325.2 SM 4500 Cl- E	EPA 300.0 EPA 325.2 SM4500 Cl- E EPA 9056 EPA 9056A EPA 9251	EPA 9056 EPA 9056A EPA 9251 EPA 300.0 EPA 325.2 SM4500 Cl-E	EPA 300.0 EPA 9056 EPA 9056A EPA 9251
Chloride, residual	EPA 330.3 SM 4500 Cl-B	EPA 330.3 SM4500 Cl-B	EPA 330.3 SM4500 Cl-B	- - - - - - - - - -
Chlorite	EPA 300.1B	- - - - - - - - - -	- - - - - - - - - -	- - - - - - - - - -
Color	EPA 110.2 SM 2120B	EPA 110.2 SM 2120B	EPA 110.2 SM 2120B	- - - - - - - - - -
Corrosivity-calc.carb. stability	SM 2330B	SM 2330B	SM 2330B	- - - - - - - - - -
Cyanide	EPA 335.4 SM 4500-CN-E	EPA 335.4 SM 4500 CN-E ISM01.2 (CN) EPA 9012A EPA 9012B	EPA 9012A EPA 9012B ISM01.2 (CN) EPA 335.4 SM 4500 CN-E	EPA 9012A EPA 9012B ISM01.2 (CN)
Cyanide amenable to chlorination	EPA 335.1	EPA 335.1 EPA 9013/9012A EPA 9013/9012B	EPA 9013/9012A EPA 9013/9012B EPA 335.1	EPA 9013/9012A EPA 9013/9012B
Cyanide, weak acid dissociable	- - - - - - - - - -	SM 4500-CN-I	SM 4500-CN-I	- - - - - - - - - -
Fluoride	EPA 300.0 SM 4500-F-C	EPA 300.0 EPA 9056 EPA 9056A SM 4500-F-C	EPA 300.0 EPA 9056 EPA 9056A SM 4500-F-C	EPA 300.0 EPA 9056 EPA 9056A
Hardness (as calcium carbonate)	EPA 130.2 SM 2340B SM 2340C	EPA 130.2 SM 2340B SM 2340C	EPA 130.2 SM 2340B SM 2340C	- - - - - - - - - -
Hardness, Calcium (as calcium carbonate)	SM 2340B	SM 2340B	SM 2340B	- - - - - - - - - -
Hardness, Magnesium (as calcium carbonate)	SM 2340B	SM 2340B	SM 2340B	- - - - - - - - - -

Parameter/Analyte	Potable Water	Nonpotable Water	Solid Hazardous Waste	
			Aqueous	Solid
Hydroxide alkalinity	EPA 310.1 SM 2320B	EPA 310.1 SM 2320B	EPA 310.1 SM 2320B	- - - - - - - - - -
Odor	EPA 140.1 SM 2150 B	- - - - - - - - - -	- - - - - - - - - -	- - - - - - - - - -
Oxygen, dissolved	EPA 360.2 SM 4500 O C	EPA 360.2 SM 4500 O C	EPA 360.2 SM 4500 O C	- - - - - - - - - -
Perchlorate	EPA 314.0	EPA 314.0	EPA 314.0	EPA 314.0
pH	EPA 150.1 SM 4500 H+ B	EPA 150.1 SM 4500 H+ B EPA 9040B EPA 9040C	EPA 9040B EPA 9040C EPA 150.1 SM 4500 H+ B	EPA 9045C EPA 9045D
Phenolphthalein alkalinity	EPA 310.1 SM 2320B	EPA 310.1 SM 2320B	EPA 310.1 SM 2320B	- - - - - - - - - -
MBAS (Surfactants)	EPA 425.1 SM 5540C	EPA 425.1 SM 5540C	EPA 425.1 SM 5540C	
Oil and Grease (HEM)	- - - - - - - - - -	EPA 1664A	EPA 1664A	EPA 9071B
Phenols	EPA 420.1	EPA 420.1 EPA 9065 EPA 9065A	EPA 9065 EPA 9065A EPA 420.1	EPA 9065 EPA 9065A
Filterable residue	EPA 160.1 SM 2540C	EPA 160.1 SM 2540C	EPA 160.1 SM 2540C	- - - - - - - - - -
Nonfilterable residue	EPA 160.2 SM 2540D	EPA 160.2 SM 2540D	EPA 160.2 SM 2540D	- - - - - - - - - -
Settleable Residue	EPA 160.5 SM 2540F	EPA 160.5 SM 2540F	EPA 160.5 SM 2540F	- - - - - - - - - -
Total residue	EPA 160.3 SM 2540B	EPA 160.3 SM 2540B	EPA 160.3 SM 2540B	SM2540G
Volatile dissolved residue	- - - - - - - - - -	SM 2540E	SM 2540E	- - - - - - - - - -
Total volatile suspended residue	- - - - - - - - - -	SM 2540E	SM 2540E	- - - - - - - - - -
Volatile residue	EPA 160.4 SM 2540E	EPA 160.4 SM 2540E	EPA 160.4 SM 2540E	SM2540G
Ash Content	- - - - - - - - - -	SM 2540E	SM 2540E	SM2540G
Fixed residue	- - - - - - - - - -	- - - - - - - - - -	- - - - - - - - - -	SM2540G
Percent Moisture	- - - - - - - - - -	- - - - - - - - - -	- - - - - - - - - -	SM2540G
Resistivity	EPA 120.1 SM 2510B	EPA 120.1 SM 2510B	EPA 120.1 SM 2510B	- - - - - - - - - -
Salinity	SM 2520B	SM 2520B	SM 2520B	- - - - - - - - - -
Specific conductance	EPA 120.1 SM 2510B	EPA 120.1 SM 2510B	EPA 9050A EPA 120.1 SM 2510B	EPA 9050A

Parameter/Analyte	**Potable Water**	**Nonpotable Water**	**Solid Hazardous Waste**	
			Aqueous	**Solid**
Sulfide	EPA 376.1 SM4500-S2-F	EPA 376.1 EPA 9030B/9034 SM4500 S2 F	EPA 9030B/9034 EPA 376.1 SM4500 S2 F	EPA 9030B/9034
Sulfate	EPA 300.0 EPA 375.4	EPA 300.0 EPA 375.4 EPA 9038 EPA 9056 EPA 9056A	EPA 300.0 EPA 375.4 EPA 9056 EPA 9056A EPA 9038	EPA 300.0 EPA 9056 EPA 9056A EPA 9038
Sulfite	EPA 377.1 SM4500 SO3 B	EPA 377.1 SM4500 SO3 B	EPA 377.1 SM4500-SO3-B	- - - - - - - - - -
Tannin & Lignin	- - - - - - - - - -	SM 5550 B	SM 5550 B	- - - - - - - - - -
Thiocyanate	SM 4500 CN M	SM 4500 CN M	SM 4500 CN M	- - - - - - - - - -
Total Petroleum Hydrocarbons (TPH or SGT-HEM)	- - - - - - - - - -	EPA 1664A	EPA 1664A	EPA 9071B
Turbidity	EPA 180.1 SM 2130B	EPA 180.1 SM 2130B	EPA 180.1 SM 2130B	- - - - - - - - - -
Unionized ammonia	- - - - - - - - - -	FL-DEP SOP	FL-DEP SOP	- - - - - - - - - -
UV-254	SM5910B	- - - - - - - - - -	- - - - - - - - - -	- - - - - - - - - -
Purgeable Organics (Volatiles)				
Acetone	EPA 524.2	EPA 624	EPA 5030B/8260B	EPA 5030/8260B EPA 5035A/8260B
Acetonitrile	- - - - - - - - - -	- - - - - - - - - -	EPA 5030B/8260B	EPA 5030/8260B EPA 5035A/8260B
Acrolein	- - - - - - - - - -	EPA 624	EPA 5030B/8260B	EPA 5030/8260B EPA 5035A/8260B
Acrylonitrile	- - - - - - - - - -	EPA 624	EPA 5030B/8260B	EPA 5030/8260B EPA 5035A/8260B
Amyl acetate, mixed isomers	- - - - - - - - - -	EPA 1666	EPA 1666	- - - - - - - - - -
Benzene	EPA 524.2	EPA 624	EPA 5030B/8260B	EPA 5030/8260B EPA 5035A/8260B
BTEX, Total		EPA 624	EPA 5030B/8260B	EPA 5030/8260B EPA 5035A/8260B
Bromobenzene	EPA 524.2	- - - - - - - - - -	EPA 5030B/8260B	EPA 5030/8260B EPA 5035A/8260B
Bromochloromethane	EPA 524.2	- - - - - - - - - -	EPA 5030B/8260B	EPA 5030/8260B EPA 5035A/8260B
Bromodichloromethane	EPA 524.2	EPA 624	EPA 5030B/8260B	EPA 5030/8260B EPA 5035A/8260B
Bromoform	EPA 524.2	EPA 624	EPA 5030B/8260B	EPA 5030/8260B EPA 5035A/8260B

Parameter/Analyte	Potable Water	Nonpotable Water	Solid Hazardous Waste	
			Aqueous	Solid
Bromomethane	EPA 524.2	EPA 624	EPA 5030B/8260B	EPA 5030/8260B EPA 5035A/8260B
n-Butanol	- - - - - - - - - -	- - - - - - - - - -	EPA 8015B-DAI EPA 8015C-DAI	EPA 8015B-DAI EPA 8015C-DAI
sec-Butanol	- - - - - - - - - -	- - - - - - - - - -	EPA 8015B-DAI EPA 8015C-DAI	EPA 8015B-DAI EPA 8015C-DAI
2-Butanone	EPA 524.2	EPA 624	EPA 5030B/8260B	EPA 5030/8260B EPA 5035A/8260B
2-Butoxyethanol (Butyl cellosolve)	- - - - - - - - - -	- - - - - - - - - -	EPA 8015B-DAI EPA 8015C-DAI	EPA 8015B-DAI EPA 8015C-DAI
n-Butyl acetate	- - - - - - - - - -	EPA 1666	EPA 1666 EPA 8015B-DAI EPA 8015C-DAI	EPA 8015B-DAI EPA 8015C-DAI
sec-Butyl acetate	- - - - - - - - - -	- - - - - - - - - -	EPA 8015B-DAI EPA 8015C-DAI	EPA 8015B-DAI EPA 8015C-DAI
tert-Butyl alcohol (2-methyl-2-propanol)	- - - - - - - - - -	- - - - - - - - - -	EPA 8015B-DAI EPA 8015C-DAI	EPA 8015B-DAI EPA 8015C-DAI
n-Butylbenzene	EPA 524.2	- - - - - - - - - -	EPA 5030B/8260B	EPA 5030/8260B EPA 5035A/8260B
Sec-Butylbenzene	EPA 524.2	- - - - - - - - - -	EPA 5030B/8260B	EPA 5030/8260B EPA 5035A/8260B
Tert-Butylbenzene	EPA 524.2	- - - - - - - - - -	EPA 5030B/8260B	EPA 5030/8260B EPA 5035A/8260B
Carbon disulfide	- - - - - - - - - -	EPA 624	EPA 5030B/8260B	EPA 5030/8260B EPA 5035A/8260B
Carbon tetrachloride	EPA 524.2	EPA 624	EPA 5030B/8260B	EPA 5030/8260B EPA 5035A/8260B
Cellosolve acetate	- - - - - - - - - -	- - - - - - - - - -	EPA 8015B-DAI EPA 8015C-DAI	EPA 8015B-DAI EPA 8015C-DAI
Chlorobenzene	EPA 524.2	EPA 624	EPA 5030B/8260B	EPA 5030/8260B EPA 5035A/8260B
Chloroethane	EPA 524.2	EPA 624	EPA 5030B/8260B	EPA 5030/8260B EPA 5035A/8260B
2-Chloroethyl vinyl ether	- - - - - - - - - -	EPA 624	EPA 5030B/8260B	- - - - - - - - - -
Chloroform	EPA 524.2	EPA 624	EPA 5030B/8260B	EPA 5030/8260B EPA 5035A/8260B
1-Chlorohexane	- - - - - - - - - -	- - - - - - - - - -	EPA 5030B/8260B	EPA 5030/8260B EPA 5035A/8260B
4-Isopropyltoluene	EPA 524.2	- - - - - - - - - -	EPA 5030B/8260B	EPA 5030/8260B EPA 5035A/8260B
Chloromethane	EPA 524.2	EPA 624	EPA 5030B/8260B	EPA 5030/8260B EPA 5035A/8260B
3-Chloro-1-propene	- - - - - - - - - -	- - - - - - - - - -	EPA 5030B/8260B	EPA 5030/8260B EPA 5035A/8260B

Parameter/Analyte	Potable Water	Nonpotable Water	Solid Hazardous Waste	
			Aqueous	Solid
Chloroprene	- - - - - - - - - -	- - - - - - - - - -	EPA 5030B/8260B	EPA 5030/8260B EPA 5035A/8260B
Cyclohexane	- - - - - - - - - -	- - - - - - - - - -	EPA 5030B/8260B	EPA 5030/8260B EPA 5035A/8260B
2-Chlorotoluene	EPA 524.2	- - - - - - - - - -	EPA 5030B/8260B	EPA 5030/8260B EPA 5035A/8260B
4-Chlorotoluene	EPA 524.2	- - - - - - - - - -	EPA 5030B/8260B	EPA 5030/8260B EPA 5035A/8260B
Dibromoacetic Acid (DBAA)	EPA 552.2	- - - - - - - - - -	- - - - - - - - - -	- - - - - - - - - -
Dibromochloromethane	EPA 524.2	EPA 624	EPA 5030B/8260B	EPA 5030/8260B EPA 5035A/8260B
1,2-Dibromo-3-chloropropane (DBCP)	EPA 504.1 EPA 524.2	- - - - - - - - - -	EPA 5030B/8260B EPA 8011	EPA 5030/8260B EPA 5035A/8260B
Dibromomethane	EPA 524.2	EPA 624	EPA 5030B/8260B	EPA 5030/8260B EPA 5035A/8260B
1,2-Dibromoethane (EDB)	EPA 504.1 EPA 524.2	EPA 624	EPA 5030B/8260B EPA 8011	EPA 5030/8260B EPA 5035A/8260B
Dichloroacetic Acid (DCAA)	EPA 552.2	- - - - - - - - - -	- - - - - - - - - -	- - - - - - - - - -
1,2-Dichlorobenzene	EPA 524.2	EPA 624	EPA 5030B/8260B	EPA 5030/8260B EPA 5035A/8260B
1,3-Dichlorobenzene	EPA 524.2	EPA 624	EPA 5030B/8260B	EPA 5030/8260B EPA 5035A/8260B
1,4-Dichlorobenzene	EPA 524.2	EPA 624	EPA 5030B/8260B	EPA 5030/8260B EPA 5035A/8260B
Trans-1,4-dichloro-2-butene	- - - - - - - - - -	- - - - - - - - - -	EPA 5030B/8260B	EPA 5030/8260B EPA 5035A/8260B
Dichlorodifluoromethane	EPA 524.2	EPA 624	EPA 5030B/8260B	EPA 5030/8260B EPA 5035A/8260B
1,1-Dichloroethane	EPA 524.2	EPA 624	EPA 5030B/8260B	EPA 5030/8260B EPA 5035A/8260B
1,2-Dichloroethane	EPA 524.2	EPA 624	EPA 5030B/8260B	EPA 5030/8260B EPA 5035A/8260B
1,1-Dichloroethene	EPA 524.2	EPA 624	EPA 5030B/8260B	EPA 5030/8260B EPA 5035A/8260B
cis-1,2-Dichloroethene	EPA 524.2	EPA 624	EPA 5030B/8260B	EPA 5030/8260B EPA 5035A/8260B
trans-1,2-Dichloroethene	EPA 524.2	EPA 624	EPA 5030B/8260B	EPA 5030/8260B EPA 5035A/8260B
1,2-Dichloroethene, Total	- - - - - - - - - -	- - - - - - - - - -	EPA 5030B/8260B	EPA 5030/8260B EPA 5035A/8260B
1,2-Dichloropropane	EPA 524.2	EPA 624	EPA 5030B/8260B	EPA 5030/8260B EPA 5035A/8260B

Parameter/Analyte	Potable Water	Nonpotable Water	Solid Hazardous Waste	
			Aqueous	Solid
1,3-Dichloropropane	EPA 524.2	- - - - - - - - - -	EPA 5030B/8260B	EPA 5030/8260B EPA 5035A/8260B
2,2-Dichloropropane	EPA 524.2	- - - - - - - - - -	EPA 5030B/8260B	EPA 5030/8260B EPA 5035A/8260B
1,1-Dichloropropene	EPA 524.2	EPA 624	EPA 5030B/8260B	EPA 5030/8260B EPA 5035A/8260B
cis-1,3-Dichloropropene	EPA 524.2	EPA 624	EPA 5030B/8260B	EPA 5030/8260B EPA 5035A/8260B
trans-1,3-Dichloropropene	EPA 524.2	EPA 624	EPA 5030B/8260B	EPA 5030/8260B EPA 5035A/8260B
1,3-Dichloropropene, Total	EPA 524.2	EPA 624	EPA 5030B/8260B	EPA 5030/8260B EPA 5035A/8260B
Diethyl ether	- - - - - - - - - -	- - - - - - - - - -	EPA 5030B/8260B	EPA 5030/8260B EPA 5035A/8260B
Diisopropyl ether	EPA 524.2	- - - - - - - - - -	- - - - - - - - - -	- - - - - - - - - -
1,4-Dioxane	- - - - - - - - - -	- - - - - - - - - -	EPA 5030B/8260B	EPA 5030/8260B EPA 5035A/8260B
Ethanol	- - - - - - - - - -	- - - - - - - - - -	EPA 8015B-DAI EPA 8015C-DAI EPA 5030B/8260B	EPA 8015B-DAI EPA 8015C-DAI EPA 5030/8260B EPA 5035A/8260B
Ethyl acetate	- - - - - - - - - -	EPA 1666	EPA 1666 EPA 8015B-DAI EPA 8015C-DAI	EPA 8015B-DAI EPA 8015C-DAI
Ethyl benzene	EPA 524.2	EPA 624	EPA 5030B/8260B	EPA 5030/8260B EPA 5035A/8260B
Ethyl methacrylate	- - - - - - - - - -	- - - - - - - - - -	EPA 5030B/8260B	EPA 5030/8260B EPA 5035A/8260B
Ethylene glycol	- - - - - - - - - -	- - - - - - - - - -	EPA 8015B-DAI EPA 8015C-DAI	EPA 8015B-DAI EPA 8015C-DAI
Tetraethylene glycol	- - - - - - - - - -	- - - - - - - - - -	EPA 8015B-DAI EPA 8015C-DAI	EPA 8015B-DAI EPA 8015C-DAI
Triethylene glycol	- - - - - - - - - -	- - - - - - - - - -	EPA 8015B-DAI EPA 8015C-DAI	EPA 8015B-DAI EPA 8015C-DAI
Furan	- - - - - - - - - -	- - - - - - - - - -	EPA 5030B/8260B	EPA 5030/8260B EPA 5035A/8260B
Haloacetic Acids, Total (HAA5)	EPA 552.2	- - - - - - - - - -	- - - - - - - - - -	- - - - - - - - - -
n-Heptane	- - - - - - - - - -	- - - - - - - - - -	EPA 5030B/8260B	EPA 5030/8260B EPA 5035A/8260B
n-Heptanol	- - - - - - - - - -	- - - - - - - - - -	EPA 8015B-DAI EPA 8015C-DAI	EPA 8015B-DAI EPA 8015C-DAI
2-Hexanone	EPA 524.2	EPA 624	EPA 5030B/8260B	EPA 5030/8260B EPA 5035A/8260B

Parameter/Analyte	Potable Water	Nonpotable Water	Solid Hazardous Waste	
			Aqueous	Solid
Hexachlorobutadiene	EPA 524.2	- - - - - - - - - -	EPA 5030B/8260B	EPA 5030/8260B EPA 5035A/8260B
Hexane	- - - - - - - - - -	- - - - - - - - - -	EPA 5030B/8260B	EPA 5030/8260B EPA 5035A/8260B
Isoamyl acetate	- - - - - - - - - -	- - - - - - - - - -	EPA 8015B-DAI EPA 8015C-DAI	EPA 8015B-DAI EPA 8015C-DAI
Isobutanol	- - - - - - - - - -	- - - - - - - - - -	EPA 5030B/8260B EPA 8015B-DAI EPA 8015C-DAI	EPA 5030/8260B EPA 5035A/8260B EPA 8015B-DAI EPA 8015C-DAI
Isobutyl acetate	- - - - - - - - - -	- - - - - - - - - -	EPA 8015B-DAI EPA 8015C-DAI	EPA 8015B-DAI EPA 8015C-DAI
Isopropyl acetate	- - - - - - - - - -	EPA 1666	EPA 1666 EPA 8015B-DAI EPA 8015C-DAI	EPA 8015B-DAI EPA 8015C-DAI
Isopropanol	- - - - - - - - - -	- - - - - - - - - -	EPA 8015B-DAI EPA 8015C-DAI	EPA 8015B-DAI EPA 8015C-DAI
Isopropyl ether	- - - - - - - - - -	- - - - - - - - - -	EPA 5030B/8260B	EPA 5030/8260B EPA 5035A/8260B
Isopropylbenzene	EPA 524.2	- - - - - - - - - -	EPA 5030B/8260B	EPA 5030/8260B EPA 5035A/8260B
Iodomethane	- - - - - - - - - -	- - - - - - - - - -	EPA 5030B/8260B	EPA 5030/8260B EPA 5035A/8260B
Methacrylonitrile	- - - - - - - - - -	- - - - - - - - - -	EPA 5030B/8260B	EPA 5030/8260B EPA 5035A/8260B
Methanol	- - - - - - - - - -	- - - - - - - - - -	EPA 8015B-DAI EPA 8015C-DAI	EPA 8015B-DAI EPA 8015C-DAI
Methyl acetate	- - - - - - - - - -	- - - - - - - - - -	EPA 5030B/8260B EPA 8015B-DAI EPA 8015C-DAI	EPA 5030/8260B EPA 5035A/8260B EPA 8015B-DAI EPA 8015C-DAI
Methylene chloride	EPA 524.2	EPA 624	EPA 5030B/8260B	EPA 5030/8260B EPA 5035A/8260B
Methyl isobutyl ketone	EPA 524.2	EPA 624	EPA 5030B/8260B	EPA 5030/8260B EPA 5035A/8260B
Methyl methacrylate	- - - - - - - - - -	- - - - - - - - - -	EPA 5030B/8260B	EPA 5030/8260B EPA 5035A/8260B
Methyl cyclohexane	- - - - - - - - - -	- - - - - - - - - -	EPA 5030B/8260B	EPA 5030/8260B EPA 5035A/8260B
Monobromoacetic Acid (MBAA)	EPA 552.2	- - - - - - - - - -	- - - - - - - - - -	- - - - - - - - - -
Monochloroacetic Acid (MCAA)	EPA 552.2	- - - - - - - - - -	- - - - - - - - - -	- - - - - - - - - -
Methyl tert-butyl ether (MTBE)	EPA 524.2	EPA 624	EPA 5030B/8260B	EPA 5030/8260B EPA 5035A/8260B

Parameter/Analyte	Potable Water	Nonpotable Water	Solid Hazardous Waste	
			Aqueous	Solid
Naphthalene	EPA 524.2	- - - - - - - - - -	EPA 5030B/8260B	EPA 5030/8260B EPA 5035A/8260B
2,2'-Oxybisethanol (Diethylene glycol)	- - - - - - - - - -	- - - - - - - - - -	EPA 8015B-DAI EPA 8015C-DAI	EPA 8015B-DAI EPA 8015C-DAI
Pentachloroethane	- - - - - - - - - -	- - - - - - - - - -	EPA 5030B/8260B	EPA 5030/8260B EPA 5035A/8260B
Phenol	- - - - - - - - - -	- - - - - - - - - -	EPA 8015B-DAI EPA 8015C-DAI	EPA 8015B-DAI EPA 8015C-DAI
n-Propanol	- - - - - - - - - -	- - - - - - - - - -	EPA 8015B-DAI EPA 8015C-DAI	EPA 8015B-DAI EPA 8015C-DAI
Propionitrile	- - - - - - - - - -	- - - - - - - - - -	EPA 5030B/8260B	EPA 5030/8260B EPA 5035A/8260B
2-Propoxy ethanol (Propyl cellosolve)	- - - - - - - - - -	- - - - - - - - - -	EPA 8015B-DAI EPA 8015C-DAI	EPA 8015B-DAI EPA 8015C-DAI
n-Propyl acetate	- - - - - - - - - -	- - - - - - - - - -	EPA 8015B-DAI EPA 8015C-DAI	EPA 8015B-DAI EPA 8015C-DAI
n-Propylbenzene	EPA 524.2	- - - - - - - - - -	EPA 5030B/8260B	EPA 5030/8260B EPA 5035A/8260B
Propylene glycol	- - - - - - - - - -	- - - - - - - - - -	EPA 8015B-DAI EPA 8015C-DAI	EPA 8015B-DAI EPA 8015C-DAI
Di-propylene glycol	- - - - - - - - - -	- - - - - - - - - -	EPA 8015B-DAI EPA 8015C-DAI	EPA 8015B-DAI EPA 8015C-DAI
Di-propylene glycol methyl ether	- - - - - - - - - -	- - - - - - - - - -	EPA 8015B-DAI	EPA 8015B-DAI
Styrene	EPA 524.2	EPA 624	EPA 5030B/8260B	EPA 5030/8260B EPA 5035A/8260B
Tert-amyl alcohol	- - - - - - - - - -	- - - - - - - - - -	EPA 8015B-DAI EPA 8015C-DAI	EPA 8015B-DAI EPA 8015C-DAI
Tert-amyl methyl ether (TAME)	EPA 524.2	- - - - - - - - - -	- - - - - - - - - -	- - - - - - - - - -
Tert-butyl alcohol (TBA)	EPA 524.2	- - - - - - - - - -	EPA 5030B/8260B	EPA 5030/8260B EPA 5035A/8260B
Tert-butyl ethyl ether (ETBE)	EPA 524.2	- - - - - - - - - -	- - - - - - - - - -	- - - - - - - - - -
1,1,1,2-Tetrachloroethane	EPA 524.2	EPA 624	EPA 5030B/8260B	EPA 5030/8260B EPA 5035A/8260B
1,1,2,2-Tetrachloroethane	EPA 524.2	EPA 624	EPA 5030B/8260B	EPA 5030/8260B EPA 5035A/8260B
Tetrachloroethene	EPA 524.2	EPA 624	EPA 5030B/8260B	EPA 5030/8260B EPA 5035A/8260B
Tetrahydrofuran	- - - - - - - - - -	- - - - - - - - - -	EPA 5030B/8260B	EPA 5030/8260B EPA 5035A/8260B
Toluene	EPA 524.2	EPA 624	EPA 5030B/8260B	EPA 5030/8260B EPA 5035A/8260B

Parameter/Analyte	Potable Water	Nonpotable Water	Solid Hazardous Waste	
			Aqueous	Solid
Trichloroacetic acid	EPA 552.2	- - - - - - - - -	- - - - - - - - - -	- - - - - - - - - -
1,1,1-Trichloroethane	EPA 524.2	EPA 624	EPA 5030B/8260B	EPA 5030/8260B EPA 5035A/8260B
1,1,2-Trichloroethane	EPA 524.2	EPA 624	EPA 5030B/8260B	EPA 5030/8260B EPA 5035A/8260B
Trichloroethene	EPA 524.2	EPA 624	EPA 5030B/8260B	EPA 5030/8260B EPA 5035A/8260B
Trichlorofluoromethane	EPA 524.2	EPA 624	EPA 5030B/8260B	EPA 5030/8260B EPA 5035A/8260B
1,2,3-Trichlorobenzene	EPA 524.2	- - - - - - - - - -	EPA 5030B/8260B	EPA 5030/8260B EPA 5035A/8260B
1,2,4-Trichlorobenzene	EPA 524.2	- - - - - - - - - -	EPA 5030B/8260B	EPA 5030/8260B EPA 5035A/8260B
1,2,3-Trichloropropane	EPA 524.2 EPA 504.1	- - - - - - - - - -	EPA 5030B/8260B EPA 8011	EPA 5030/8260B EPA 5035A/8260B
1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113)	EPA 524.2	- - - - - - - - - -	EPA 5030B/8260B	EPA 5030/8260B EPA 5035A/8260B
1,2,4-Trimethylbenzene	EPA 524.2	- - - - - - - - - -	EPA 5030B/8260B	EPA 5030/8260B EPA 5035A/8260B
1,3,5-Trimethylbenzene	EPA 524.2	- - - - - - - - - -	EPA 5030B/8260B	EPA 5030/8260B EPA 5035A/8260B
Trihalomethanes, Total	EPA 524.2	- - - - - - - - - -	- - - - - - - - - -	- - - - - - - - - -
Vinyl acetate	- - - - - - - - - -	- - - - - - - - - -	EPA 5030B/8260B	EPA 5030/8260B EPA 5035A/8260B
Vinyl chloride	EPA 524.2	EPA 624	EPA 5030B/8260B	EPA 5030/8260B EPA 5035A/8260B
Xylenes, total	EPA 524.2	EPA 624	EPA 5030B/8260B	EPA 5030/8260B EPA 5035A/8260B
1,2-Xylene	EPA 524.2	EPA 624	EPA 5030B/8260B	EPA 5030/8260B EPA 5035A/8260B
1,3 & 1,4-Xylene	EPA 524.2	EPA 624	EPA 5030B/8260B	EPA 5030/8260B EPA 5035A/8260B
Gasoline Range Organics	- - - - - - - - - -	- - - - - - - - - -	EPA 5030B/8015B EPA 5030B/8015C	EPA 5030/8015B EPA 5035A/8015B EPA 5030/8015C EPA 5035A/8015C

Parameter/Analyte	Potable Water	Nonpotable Water	Solid Hazardous Waste	
			Aqueous	Solid
Extractable Organics (Semivolatiles)				
Acenaphthene	EPA 525.2	EPA 625	EPA 3520C/8270C EPA 3520C/8270D	EPA 3550B/8270C EPA 3546/8270C EPA 3550C/8270D EPA 3546/8270D
Acenaphthylene	EPA 525.2	EPA 625	EPA 3520C/8270C EPA 3520C/8270D	EPA 3550B/8270C EPA 3546/8270C EPA 3550C/8270D EPA 3546/8270D
Acetochlor	EPA 525.2	- - - - - - - - - -	- - - - - - - - - -	- - - - - - - - - -
Acetophenone	- - - - - - - - - -	- - - - - - - - - -	EPA 3520C/8270C EPA 3520C/8270D	EPA 3550B/8270C EPA 3546/8270C EPA 3550C/8270D EPA 3546/8270D
2-Acetylaminofluorene	- - - - - - - - - -	- - - - - - - - - -	EPA 3520C/8270C EPA 3520C/8270D	EPA 3550B/8270C EPA 3546/8270C EPA 3550C/8270D EPA 3546/8270D
Alachlor	EPA 525.2	- - - - - - - - - -	- - - - - - - - - -	- - - - - - - - - -
4-Aminobiphenyl	- - - - - - - - - -	- - - - - - - - - -	EPA 3520C/8270C EPA 3520C/8270D	EPA 3550B/8270C EPA 3546/8270C EPA 3550C/8270D EPA 3546/8270D
Aniline	- - - - - - - - - -	- - - - - - - - - -	EPA 3520C/8270C EPA 3520C/8270D	EPA 3550B/8270C EPA 3546/8270C EPA 3550C/8270D EPA 3546/8270D
Anthracene	EPA 525.2	EPA 625	EPA 3520C/8270C EPA 3520C/8270D	EPA 3550B/8270C EPA 3546/8270C EPA 3550C/8270D EPA 3546/8270D
Aramite, Total	- - - - - - - - - -	- - - - - - - - - -	EPA 3520C/8270C EPA 3520C/8270D	EPA 3550B/8270C EPA 3546/8270C EPA 3550C/8270D EPA 3546/8270D
Atrazine	- - - - - - - - - -	- - - - - - - - - -	EPA 3520C/8270C EPA 3520C/8270D	EPA 3550B/8270C EPA 3546/8270C EPA 3550C/8270D EPA 3546/8270D
Benzaldehyde	- - - - - - - - - -	- - - - - - - - - -	EPA 3520C/8270C EPA 3520C/8270D	EPA 3550B/8270C EPA 3546/8270C EPA 3550C/8270D EPA 3546/8270D

Parameter/Analyte	Potable Water	Nonpotable Water	Solid Hazardous Waste	
			Aqueous	Solid
Benzidine	- - - - - - - - - -	EPA 625	EPA 3520C/8270C EPA 3520C/8270D	EPA 3550B/8270C EPA 3546/8270C EPA 3550C/8270D EPA 3546/8270D
Benzoic acid	- - - - - - - - - -	- - - - - - - - - -	EPA 3520C/8270C EPA 3520C/8270D	EPA 3550B/8270C EPA 3546/8270C EPA 3550C/8270D EPA 3546/8270D
Benzo (a) anthracene	EPA 525.2	EPA 625	EPA 3520C/8270C EPA 3520C/8270D	EPA 3550B/8270C EPA 3546/8270C EPA 3550C/8270D EPA 3546/8270D
Benzo (b) fluoranthene	EPA 525.2	EPA 625	EPA 3520C/8270C EPA 3520C/8270D	EPA 3550B/8270C EPA 3546/8270C EPA 3550C/8270D EPA 3546/8270D
Benzo (k) fluoranthene	EPA 525.2	EPA 625	EPA 3520C/8270C EPA 3520C/8270D	EPA 3550B/8270C EPA 3546/8270C EPA 3550C/8270D EPA 3546/8270D
Benzo (ghi) perylene	EPA 525.2	EPA 625	EPA 3520C/8270C EPA 3520C/8270D	EPA 3550B/8270C EPA 3546/8270C EPA 3550C/8270D EPA 3546/8270D
Benzo (a) pyrene	EPA 525.2	EPA 625	EPA 3520C/8270C EPA 3520C/8270D	EPA 3550B/8270C EPA 3546/8270C EPA 3550C/8270D EPA 3546/8270D
Benzyl alcohol	- - - - - - - - - -	- - - - - - - - - -	EPA 3520C/8270C EPA 3520C/8270D	EPA 3550B/8270C EPA 3546/8270C EPA 3550C/8270D EPA 3546/8270D
1,1-Biphenyl	- - - - - - - - - -	- - - - - - - - - -	EPA 3520C/8270C EPA 3520C/8270D	EPA 3550B/8270C EPA 3546/8270C EPA 3550C/8270D EPA 3546/8270D
Bis (2-chloroethoxy) methane	- - - - - - - - - -	EPA 625	EPA 3520C/8270C EPA 3520C/8270D	EPA 3550B/8270C EPA 3546/8270C EPA 3550C/8270D EPA 3546/8270D
Bis (2-chloroethyl) ether	- - - - - - - - - -	EPA 625	EPA 3520C/8270C EPA 3520C/8270D	EPA 3550B/8270C EPA 3546/8270C EPA 3550C/8270D EPA 3546/8270D

Parameter/Analyte	Potable Water	Nonpotable Water	Solid Hazardous Waste	
			Aqueous	Solid
Bis (2-chloroisopropyl) ether	- - - - - - - - - -	EPA 625	EPA 3520C/8270C EPA 3520C/8270D	EPA 3550B/8270C EPA 3546/8270C EPA 3550C/8270D EPA 3546/8270D
Bis (2-ethylhexyl) phthalate	EPA 525.2	EPA 625	EPA 3520C/8270C EPA 3520C/8270D	EPA 3550B/8270C EPA 3546/8270C EPA 3550C/8270D EPA 3546/8270D
Bromacil	EPA 525.2	- - - - - - - - - -	- - - - - - - - - -	- - - - - - - - - -
4-Bromophenylphenyl ether	- - - - - - - - - -	EPA 625	EPA 3520C/8270C EPA 3520C/8270D	EPA 3550B/8270C EPA 3546/8270C EPA 3550C/8270D EPA 3546/8270D
Butachlor	EPA 525.2	- - - - - - - - - -	- - - - - - - - - -	- - - - - - - - - -
Butylate	EPA 525.2	- - - - - - - - - -	- - - - - - - - - -	- - - - - - - - - -
Butyl benzyl phthalate	EPA 525.2	EPA 625	EPA 3520C/8270C EPA 3520C/8270D	EPA 3550B/8270C EPA 3546/8270C EPA 3550C/8270D EPA 3546/8270D
2-sec-Butyl-4,6-dinitrophenol	- - - - - - - - - -	- - - - - - - - - -	EPA 3520C/8270C EPA 3520C/8270D	EPA 3550B/8270C EPA 3546/8270C EPA 3550C/8270D EPA 3546/8270D
Caprolactam	- - - - - - - - - -	- - - - - - - - - -	EPA 3520C/8270C EPA 3520C/8270D	EPA 3550B/8270C EPA 3546/8270C EPA 3550C/8270D EPA 3546/8270D
Carbazole	- - - - - - - - - -	EPA 625	EPA 3520C/8270C EPA 3520C/8270D	EPA 3550B/8270C EPA 3546/8270C EPA 3550C/8270D EPA 3546/8270D
4-Chloroaniline	- - - - - - - - - -	- - - - - - - - - -	EPA 3520C/8270C EPA 3520C/8270D	EPA 3550B/8270C EPA 3546/8270C EPA 3550C/8270D EPA 3546/8270D
4-Chloro-3-methylphenol	- - - - - - - - - -	EPA 625	EPA 3520C/8270C EPA 3520C/8270D	EPA 3550B/8270C EPA 3546/8270C EPA 3550C/8270D EPA 3546/8270D
2-Chloronaphthalene	- - - - - - - - - -	EPA 625	EPA 3520C/8270C EPA 3520C/8270D	EPA 3550B/8270C EPA 3546/8270C EPA 3550C/8270D EPA 3546/8270D
2-Chlorobiphenyl	EPA 525.2	- - - - - - - - - -	- - - - - - - - - -	- - - - - - - - - -

Parameter/Analyte	Potable Water	Nonpotable Water	Solid Hazardous Waste	
			Aqueous	Solid
2-Chlorophenol	- - - - - - - - - -	EPA 625	EPA 3520C/8270C EPA 3520C/8270D	EPA 3550B/8270C EPA 3546/8270C EPA 3550C/8270D EPA 3546/8270D
4-Chlorophenol	- - - - - - - - - -	- - - - - - - - - -	EPA 3520C/8270C EPA 3520C/8270D	EPA 3550B/8270C EPA 3546/8270C EPA 3550C/8270D EPA 3546/8270D
4-Chlorophenyl phenyl ether	- - - - - - - - - -	EPA 625	EPA 3520C/8270C EPA 3520C/8270D	EPA 3550B/8270C EPA 3546/8270C EPA 3550C/8270D EPA 3546/8270D
Chrysene	EPA 525.2	EPA 625	EPA 3520C/8270C EPA 3520C/8270D	EPA 3550B/8270C EPA 3546/8270C EPA 3550C/8270D EPA 3546/8270D
Cresols (total methyl phenols)	- - - - - - - - - -	- - - - - - - - - -	EPA 3520C/8270C EPA 3520C/8270D	EPA 3550B/8270C EPA 3546/8270C EPA 3550C/8270D EPA 3546/8270D
Diallate	- - - - - - - - - -	- - - - - - - - - -	EPA 3520C/8270C EPA 3520C/8270D	EPA 3550B/8270C EPA 3546/8270C EPA 3550C/8270D EPA 3546/8270D
Dibenzofuran	- - - - - - - - - -	- - - - - - - - - -	EPA 3520C/8270C EPA 3520C/8270D	EPA 3550B/8270C EPA 3546/8270C EPA 3550C/8270D EPA 3546/8270D
Dibenz(a,h) anthracene	EPA 525.2	EPA 625	EPA 3520C/8270C EPA 3520C/8270D	EPA 3550B/8270C EPA 3546/8270C EPA 3550C/8270D EPA 3546/8270D
1,2-Dichlorobenzene	- - - - - - - - - -	EPA 625	EPA 3520C/8270C EPA 3520C/8270D	EPA 3550B/8270C EPA 3546/8270C EPA 3550C/8270D EPA 3546/8270D
1,3-Dichlorobenzene	- - - - - - - - - -	EPA 625	EPA 3520C/8270C EPA 3520C/8270D	EPA 3550B/8270C EPA 3546/8270C EPA 3550C/8270D EPA 3546/8270D
1,4-Dichlorobenzene	- - - - - - - - - -	EPA 625	EPA 3520C/8270C EPA 3520C/8270D	EPA 3550B/8270C EPA 3546/8270C EPA 3550C/8270D EPA 3546/8270D

Parameter/Analyte	Potable Water	Nonpotable Water	Solid Hazardous Waste	
			Aqueous	Solid
3,3-Dichlorobenzidine	- - - - - - - - - -	EPA 625	EPA 3520C/8270C EPA 3520C/8270D	EPA 3550B/8270C EPA 3546/8270C EPA 3550C/8270D EPA 3546/8270D
2,4-Dichlorophenol	- - - - - - - - - -	EPA 625	EPA 3520C/8270C EPA 3520C/8270D	EPA 3550B/8270C EPA 3546/8270C EPA 3550C/8270D EPA 3546/8270D
2,6-Dichlorophenol	- - - - - - - - - -	- - - - - - - - - -	EPA 3520C/8270C EPA 3520C/8270D	EPA 3550B/8270C EPA 3546/8270C EPA 3550C/8270D EPA 3546/8270D
Diethyl phthalate	EPA 525.2	EPA 625	EPA 3520C/8270C EPA 3520C/8270D	EPA 3550B/8270C EPA 3546/8270C EPA 3550C/8270D EPA 3546/8270D
Di(2-ethylhexyl)adipate	EPA 525.2	- - - - - - - - - -	EPA 3520C/8270C EPA 3520C/8270D	EPA 3550B/8270C EPA 3546/8270C EPA 3550C/8270D EPA 3546/8270D
Dimethoate	- - - - - - - - - -	- - - - - - - - - -	EPA 3520C/8270C EPA 3520C/8270D	EPA 3550B/8270C EPA 3546/8270C EPA 3550C/8270D EPA 3546/8270D
p-Dimethylaminoazobenzene	- - - - - - - - - -	- - - - - - - - - -	EPA 3520C/8270C EPA 3520C/8270D	EPA 3550B/8270C EPA 3546/8270C EPA 3550C/8270D EPA 3546/8270D
7,12-Dimethylbenz (a) anthracene	- - - - - - - - - -	- - - - - - - - - -	EPA 3520C/8270C EPA 3520C/8270D	EPA 3550B/8270C EPA 3546/8270C EPA 3550C/8270D EPA 3546/8270D
3,3'-Dimethylbenzidine	- - - - - - - - - -	- - - - - - - - - -	EPA 3520C/8270C EPA 3520C/8270D	EPA 3550B/8270C EPA 3546/8270C EPA 3550C/8270D EPA 3546/8270D
Alpha-, alpha-Dimethylphenethylamine	- - - - - - - - - -	- - - - - - - - - -	EPA 3520C/8270C EPA 3520C/8270D	EPA 3550B/8270C EPA 3546/8270C EPA 3550C/8270D EPA 3546/8270D
2,3-Dimethylphenol	- - - - - - - - - -	- - - - - - - - - -	EPA 3520C/8270C EPA 3520C/8270D	EPA 3550B/8270C EPA 3546/8270C EPA 3550C/8270D EPA 3546/8270D

Parameter/Analyte	Potable Water	Nonpotable Water	Solid Hazardous Waste	
			Aqueous	Solid
2,4-Dimethylphenol	- - - - - - - - - -	EPA 625	EPA 3520C/8270C EPA 3520C/8270D	EPA 3550B/8270C EPA 3546/8270C EPA 3550C/8270D EPA 3546/8270D
2,5-Dimethylphenol	- - - - - - - - - -	- - - - - - - - - -	EPA 3520C/8270C EPA 3520C/8270D	EPA 3550B/8270C EPA 3546/8270C EPA 3550C/8270D EPA 3546/8270D
2,4 & 2,5-Dimethylphenol	- - - - - - - - - -	- - - - - - - - - -	EPA 3520C/8270C EPA 3520C/8270D	EPA 3550B/8270C EPA 3546/8270C EPA 3550C/8270D EPA 3546/8270D
2,6-Dimethylphenol	- - - - - - - - - -	- - - - - - - - - -	EPA 3520C/8270C EPA 3520C/8270D	EPA 3550B/8270C EPA 3546/8270C EPA 3550C/8270D EPA 3546/8270D
3,4-Dimethylphenol	- - - - - - - - - -	- - - - - - - - - -	EPA 3520C/8270C EPA 3520C/8270D	EPA 3550B/8270C EPA 3546/8270C EPA 3550C/8270D EPA 3546/8270D
Dimethyl phthalate	EPA 525.2	EPA 625	EPA 3520C/8270C EPA 3520C/8270D	EPA 3550B/8270C EPA 3546/8270C EPA 3550C/8270D EPA 3546/8270D
Di-n-butyl phthalate	EPA 525.2	EPA 625	EPA 3520C/8270C EPA 3520C/8270D	EPA 3550B/8270C EPA 3546/8270C EPA 3550C/8270D EPA 3546/8270D
Di-n-octyl phthalate	- - - - - - - - - -	EPA 625	EPA 3520C/8270C EPA 3520C/8270D	EPA 3550B/8270C EPA 3546/8270C EPA 3550C/8270D EPA 3546/8270D
Diphenyl ether	- - - - - - - - - -	- - - - - - - - - -	EPA 3520C/8270C EPA 3520C/8270D	EPA 3550B/8270C EPA 3546/8270C EPA 3550C/8270D EPA 3546/8270D
1,3-Dinitrobenzene	- - - - - - - - - -	- - - - - - - - - -	EPA 3520C/8270C EPA 3520C/8270D	EPA 3550B/8270C EPA 3546/8270C EPA 3550C/8270D EPA 3546/8270D
2,4-Dinitrophenol	- - - - - - - - - -	EPA 625	EPA 3520C/8270C EPA 3520C/8270D	EPA 3550B/8270C EPA 3546/8270C EPA 3550C/8270D EPA 3546/8270D

Parameter/Analyte	Potable Water	Nonpotable Water	Solid Hazardous Waste	
			Aqueous	Solid
2,4-Dinitrotoluene	EPA 525.2	EPA 625	EPA 3520C/8270C EPA 3520C/8270D	EPA 3550B/8270C EPA 3546/8270C EPA 3550C/8270D EPA 3546/8270D
2,6-Dinitrotoluene	EPA 525.2	EPA 625	EPA 3520C/8270C EPA 3520C/8270D	EPA 3550B/8270C EPA 3546/8270C EPA 3550C/8270D EPA 3546/8270D
1,4-Dioxane	- - - - - - - - - -	EPA 625	EPA 3520C/8270C EPA 3520C/8270D	EPA 3550B/8270C EPA 3546/8270C EPA 3550C/8270D EPA 3546/8270D
1,2-Diphenylhydrazine	- - - - - - - - - -	EPA 625	EPA 3520C/8270C EPA 3520C/8270D	EPA 3550B/8270C EPA 3546/8270C EPA 3550C/8270D EPA 3546/8270D
Diphenamide	EPA 525.2	- - - - - - - - - -	- - - - - - - - - -	- - - - - - - - - -
EPTC	EPA 525.2	- - - - - - - - - -	- - - - - - - - - -	- - - - - - - - - -
Ethoprop (Mocap)	EPA 525.2	- - - - - - - - - -		- - - - - - - - - -
Ethyl methane sulfonate	- - - - - - - - - -	- - - - - - - - - -	EPA 3520C/8270C EPA 3520C/8270D	EPA 3550B/8270C EPA 3546/8270C EPA 3550C/8270D EPA 3546/8270D
Etridiazole	EPA 525.2	- - - - - - - - - -	- - - - - - - - - -	- - - - - - - - - -
Fenarimol	EPA 525.2	- - - - - - - - - -	- - - - - - - - - -	- - - - - - - - - -
Fluoroanthene	EPA 525.2	EPA 625	EPA 3520C/8270C EPA 3520C/8270D	EPA 3550B/8270C EPA 3546/8270C EPA 3550C/8270D EPA 3546/8270D
Fluorene	EPA 525.2	EPA 625	EPA 3520C/8270C EPA 3520C/8270D	EPA 3550B/8270C EPA 3546/8270C EPA 3550C/8270D EPA 3546/8270D
Fluridone	EPA 525.2	- - - - - - - - - -	- - - - - - - - - -	- - - - - - - - - -
2,2',3,3',4,4',6-Heptachlorobiphenyl	EPA 525.2	- - - - - - - - - -	- - - - - - - - - -	- - - - - - - - - -
Hexachlorobenzene	EPA 525.2	EPA 625	EPA 3520C/8270C EPA 3520C/8270D	EPA 3550B/8270C EPA 3546/8270C EPA 3550C/8270D EPA 3546/8270D
Hexachlrobutadiene	- - - - - - - - - -	EPA 625	EPA 3520C/8270C EPA 3520C/8270D	EPA 3550B/8270C EPA 3546/8270C EPA 3550C/8270D EPA 3546/8270D

Parameter/Analyte	Potable Water	Nonpotable Water	Solid Hazardous Waste	
			Aqueous	Solid
Hexachlorocyclopentadiene	EPA 525.2	EPA 625	EPA 3520C/8270C EPA 3520C/8270D	EPA 3550B/8270C EPA 3546/8270C EPA 3550C/8270D EPA 3546/8270D
Hexachloroethane	- - - - - - - - - -	EPA 625	EPA 3520C/8270C EPA 3520C/8270D	EPA 3550B/8270C EPA 3546/8270C EPA 3550C/8270D EPA 3546/8270D
Hexachlorophene	- - - - - - - - - -	- - - - - - - - - -	EPA 3520C/8270C EPA 3520C/8270D	EPA 3550B/8270C EPA 3546/8270C EPA 3550C/8270D EPA 3546/8270D
Hexachloropropene	- - - - - - - - - -	- - - - - - - - - -	EPA 3520C/8270C EPA 3520C/8270D	EPA 3550B/8270C EPA 3546/8270C EPA 3550C/8270D EPA 3546/8270D
Hexazinone	EPA 525.2	- - - - - - - - - -	- - - - - - - - - -	- - - - - - - - - -
Indeno (1,2,3-cd) pyrene	EPA 525.2	EPA 625	EPA 3520C/8270C EPA 3520C/8270D	EPA 3550B/8270C EPA 3546/8270C EPA 3550C/8270D EPA 3546/8270D
Isophorone	EPA 525.2	EPA 625	EPA 3520C/8270C EPA 3520C/8270D	EPA 3550B/8270C EPA 3546/8270C EPA 3550C/8270D EPA 3546/8270D
Isosafrole	- - - - - - - - - -	- - - - - - - - - -	EPA 3520C/8270C EPA 3520C/8270D	EPA 3550B/8270C EPA 3546/8270C EPA 3550C/8270D EPA 3546/8270D
Methapyrilene	- - - - - - - - - -	- - - - - - - - - -	EPA 3520C/8270C EPA 3520C/8270D	EPA 3550B/8270C EPA 3546/8270C EPA 3550C/8270D EPA 3546/8270D
Methylbenzoate	- - - - - - - - - -	- - - - - - - - - -	EPA 3520C/8270C EPA 3520C/8270D	EPA 3550B/8270C EPA 3546/8270C EPA 3550C/8270D EPA 3546/8270D
3-Methylcholanthrene	- - - - - - - - - -	- - - - - - - - - -	EPA 3520C/8270C EPA 3520C/8270D	EPA 3550B/8270C EPA 3546/8270C EPA 3550C/8270D EPA 3546/8270D
2-Methyl-4,6-Dinitrophenol	- - - - - - - - - -	EPA 625	EPA 3520C/8270C EPA 3520C/8270D	EPA 3550B/8270C EPA 3546/8270C EPA 3550C/8270D EPA 3546/8270D

Parameter/Analyte	Potable Water	Nonpotable Water	Solid Hazardous Waste	
			Aqueous	Solid
Methyl methane sulfonate	- - - - - - - - - -	- - - - - - - - - -	EPA 3520C/8270C EPA 3520C/8270D	EPA 3550B/8270C EPA 3546/8270C EPA 3550C/8270D EPA 3546/8270D
1-Methylnaphthalene	- - - - - - - - - -	- - - - - - - - - -	EPA 3520C/8270C EPA 3520C/8270D	EPA 3550B/8270C EPA 3546/8270C EPA 3550C/8270D EPA 3546/8270D
2-Methylnaphthalene	- - - - - - - - - -	- - - - - - - - - -	EPA 3520C/8270C EPA 3520C/8270D	EPA 3550B/8270C EPA 3546/8270C EPA 3550C/8270D EPA 3546/8270D
Methyl paraoxon	EPA 525.2	- - - - - - - - - -	- - - - - - - - - -	- - - - - - - - - -
2-Methylphenol	- - - - - - - - - -	EPA 625	EPA 3520C/8270C EPA 3520C/8270D	EPA 3550B/8270C EPA 3546/8270C EPA 3550C/8270D EPA 3546/8270D
3 & 4-Methylphenol	- - - - - - - - - -	EPA 625	EPA 3520C/8270C EPA 3520C/8270D	EPA 3550B/8270C EPA 3546/8270C EPA 3550C/8270D EPA 3546/8270D
Metolachlor	EPA 525.2	- - - - - - - - - -	- - - - - - - - - -	- - - - - - - - - -
Metribuzin	EPA 525.2	- - - - - - - - - -	- - - - - - - - - -	- - - - - - - - - -
Mevinphos	EPA 525.2	- - - - - - - - - -	- - - - - - - - - -	- - - - - - - - - -
MGK 264, total (isomer a+b)	EPA 525.2	- - - - - - - - - -	- - - - - - - - - -	- - - - - - - - - -
Molinate	EPA 525.2	- - - - - - - - - -	- - - - - - - - - -	- - - - - - - - - -
Napropamide	EPA 525.2	- - - - - - - - - -	- - - - - - - - - -	- - - - - - - - - -
Naphthalene	EPA 525.2	EPA 625	EPA 3520C/8270C EPA 3520C/8270D	EPA 3550B/8270C EPA 3546/8270C EPA 3550C/8270D EPA 3546/8270D
1,4-Naphthoquinone	- - - - - - - - - -	- - - - - - - - - -	EPA 3520C/8270C EPA 3520C/8270D	EPA 3550B/8270C EPA 3546/8270C EPA 3550C/8270D EPA 3546/8270D
1-Naphthylamine	- - - - - - - - - -	- - - - - - - - - -	EPA 3520C/8270C EPA 3520C/8270D	EPA 3550B/8270C EPA 3546/8270C EPA 3550C/8270D EPA 3546/8270D
2-Naphthylamine	- - - - - - - - - -	- - - - - - - - - -	EPA 3520C/8270C EPA 3520C/8270D	EPA 3550B/8270C EPA 3546/8270C EPA 3550C/8270D EPA 3546/8270D

Parameter/Analyte	Potable Water	Nonpotable Water	Solid Hazardous Waste	
			Aqueous	Solid
2-Nitroaniline	- - - - - - - - - -	- - - - - - - - - -	EPA 3520C/8270C EPA 3520C/8270D	EPA 3550B/8270C EPA 3546/8270C EPA 3550C/8270D EPA 3546/8270D
3-Nitroaniline	- - - - - - - - - -	- - - - - - - - - -	EPA 3520C/8270C EPA 3520C/8270D	EPA 3550B/8270C EPA 3546/8270C EPA 3550C/8270D EPA 3546/8270D
4-Nitroaniline	- - - - - - - - - -	- - - - - - - - - -	EPA 3520C/8270C EPA 3520C/8270D	EPA 3550B/8270C EPA 3546/8270C EPA 3550C/8270D EPA 3546/8270D
Nitrobenzene	- - - - - - - - - -	EPA 625	EPA 3520C/8270C EPA 3520C/8270D	EPA 3550B/8270C EPA 3546/8270C EPA 3550C/8270D EPA 3546/8270D
2-Nitrophenol	- - - - - - - - - -	EPA 625	EPA 3520C/8270C EPA 3520C/8270D	EPA 3550B/8270C EPA 3546/8270C EPA 3550C/8270D EPA 3546/8270D
4-Nitrophenol	- - - - - - - - - -	EPA 625	EPA 3520C/8270C EPA 3520C/8270D	EPA 3550B/8270C EPA 3546/8270C EPA 3550C/8270D EPA 3546/8270D
N-Nitroso-di-n-butylamine	- - - - - - - - - -	- - - - - - - - - -	EPA 3520C/8270C EPA 3520C/8270D	EPA 3550B/8270C EPA 3546/8270C EPA 3550C/8270D EPA 3546/8270D
N-Nitrosodiethylamine	- - - - - - - - - -	- - - - - - - - - -	EPA 3520C/8270C EPA 3520C/8270D	EPA 3550B/8270C EPA 3546/8270C EPA 3550C/8270D EPA 3546/8270D
N-Nitrosodimethylamine	- - - - - - - - - -	EPA 625	EPA 3520C/8270C EPA 3520C/8270D	EPA 3550B/8270C EPA 3546/8270C EPA 3550C/8270D EPA 3546/8270D
N-Nitrosomethylethylamine	- - - - - - - - - -	- - - - - - - - - -	EPA 3520C/8270C EPA 3520C/8270D	EPA 3550B/8270C EPA 3546/8270C EPA 3550C/8270D EPA 3546/8270D
N-Nitrosomorpholine	- - - - - - - - - -	- - - - - - - - - -	EPA 3520C/8270C EPA 3520C/8270D	EPA 3550B/8270C EPA 3546/8270C EPA 3550C/8270D EPA 3546/8270D

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Project-specific Technical Specifications
DOD QSM Version 4.2

Project: _____ Date: _____

PM: _____

1. DOD QSM Appendix G outlines specific target analyte lists which fall under the scope of the DOD QSM. This Appendix is limited to SW-846 methods and the routine Target Analyte List (TAL). The laboratory defaults to its in-house SOP requirements, for any additional requested analytes (e.g., Appendix IX analytes) and methods.

   Note: The laboratory does not perform detection limit studies, quarterly detection limit verifications, or quarterly limit of quantitation verifications for non-routine analytes and non-routine matrices (e.g., biota, wipes, etc.). In these instances, the Limit of Quantitation (LOQ), Limit of Detection (LOD), and Detection Limit (DL) are equivalent to the laboratory's reporting limit (RL).

2. DOD QSM Appendix G specifies that the laboratory shall use project-specific control limits based on data quality objectives (DQOs), if available. In the absence of project-defined control limits, the laboratory uses its in-house control limits and evaluation criteria for surrogate and spike recoveries for all methods.

3. DOD QSM Gray Box D-3 states in-house laboratory control limits may not be greater than +/- 3 times the standard deviation of the mean LCS recovery. The laboratory uses the following guideline to evaluate the reasonableness of its statistically derived in-house control limits:
   - Any lower limit greater than 70% will be lowered to 70%
   - Any upper limit less than 130% will be raised to 130%
   - Any standard deviation (%RPD) less than 30% will be raised to 30%

4. DOD QSM Gray Box D-16 states that when reporting data from methods that require analyte confirmation using a secondary column or detector, project-specific reporting requirements shall be followed. In the absence of project-defined evaluation requirements, the laboratory reports results as outlined in its SOP. That is, the %RPD will be evaluated between the primary and confirmation column. For results <40% RPD, the higher value will be reported. For results >40% RPD, the lower value will be reported and the data qualified as such.

5. DOD QSM Table F states that calibration curves must not be forced through the origin. The laboratory allows the option to force calibration curves through the origin if the y-intercept falls *outside* the range of –1*DL to +0.5*DL (expressed in the units of the calibration curve). In these situations, forcing through zero can allow for more reasonable quantitation of values between the LOQ and DL.

6. Method-specific Variance (EPA 8260 & EPA 8270):

    i. DOD QSM Table F-4 states that all project analytes must be within 20% of the true value in the Second Source Calibration Verification (ICV) and the Continuing Calibration Verification (CCV). The laboratory proposes to require 95% of analytes in the Second Source Calibration Verification (ICV) and the Continuing Calibration Verification (CCV) to be within 20% of the expected value. Poor performer and/or erratic responders, as outlined in the laboratory's SOP, are exempt from this requirement.

    ii. DOD QSM Table F-4 states that all EICP areas of all standards, field samples, and QC items must be within -50% to +100% of the ICAL midpoint standard. The laboratory proposes to evaluate each CCV against the midpoint of the ICAL and to evaluate all field samples and QC items to their associated CCV. This is consistent with the requirements outlined in SW846 Update IV.

    iii. The laboratory performs a modified version of the EPA 8270 method specific to low-level concentrations of PAHs (referred to as LL_PAH). This method incorporates different analytical conditions, surrogate compounds, tune criteria, and ICAL criteria due to the shortened list of analytes reported. As such, the laboratory will evaluate this method in accordance with our SOP as opposed to the Table F-4 requirements.

7. Method-specific Variance (Dual Column/Detector Analyses)

    i. EPA 8015 DAI – Alcohols, Acetates, & Glycols:
    DOD QSM requires all positive results to be confirmed using a second column or detector. A suitable second column has not been identified for EPA 8015 DAI; therefore, if requested, second column confirmation is not available for this method.

    ii. EPA 8141 – Organophosphorous Pesticides:
    DOD QSM requires all positive results to be confirmed using a second column or detector. The laboratory utilizes dual detectors (i.e., an NPD and an FPD) for this analysis. The FPD is used for quantitative analysis, with qualitative confirmation performed for positive detections, only, via the NPD.

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Analyte	CAS No.	LOQ (mg/kg)	LOD (mg/kg)	DL (mg/kg)	LOD Spike Concentration (mg/kg)	Comments
1,4-Naphthoquinone	130-15-4	0.033	0.0033	0.0033	0.0033	1
1,2,4,5-Tetrachlorobenzene	95-94-3	0.033	0.0033	0.0033	0.0033	1
2,3,4,6-Tetrachlorophenol	58-90-2	0.033	0.0033	0.0033	0.0033	1
2,4,5-Trichlorophenol	95-95-4	0.033	0.0076	0.0076	0.0033	2
2,4,6-Trichlorophenol	88-06-2	0.033	0.0079	0.0079	0.0033	2
2,4-Dichlorophenol	120-83-2	0.033	0.0072	0.0072	0.0033	2
2,4-Dimethylphenol	105-67-9	0.066	0.0076	0.0076	0.0033	2
2,4-Dinitrophenol	51-28-5	0.33	0.042	0.017	0.042	
2,4-Dinitrotoluene	121-14-2	0.033	0.0075	0.0075	0.0033	2
2,6-Dinitrotoluene	606-20-2	0.033	0.0079	0.0079	0.0033	2
2,6-Dichlorophenol	87-65-0	0.033	0.0033	0.0033	0.0033	1
2-Chloronapthalene	91-58-7	0.033	0.006	0.006	0.0033	2
2-Chlorophenol	95-57-8	0.033	0.0053	0.0053	0.0033	2
2-Methylphenol	95-48-7	0.033	0.0063	0.0063	0.0033	2
2-Nitroaniline	88-74-4	0.17	0.007	0.007	0.0033	2
2-Nitrophenol	88-75-5	0.033	0.0058	0.0058	0.0033	2
3,3'-Dichlorobenzidine	91-94-1	0.066	0.017	0.017	0.017	3
3-Nitroaniline	99-09-2	0.17	0.0067	0.0067	0.0033	2
4,6-Dinitro-2-methylphenol	534-52-1	0.17	0.017	0.017	0.017	3
4-Bromophenyl-phenylether	101-55-3	0.033	0.0069	0.0069	0.0033	2
4-Chloro-3-methylphenol	59-50-7	0.033	0.007	0.007	0.0033	2
4-Chloroaniline	106-47-8	0.066	0.0052	0.0052	0.0033	2
4-Chlorophenyl-phenylether	7005-72-3	0.033	0.0064	0.0064	0.0033	2
4-Nitroaniline	100-01-6	0.17	0.017	0.0083	0.017	
4-Nitrophenol	100-02-7	0.17	0.073	0.073	0.017	2
Acetophenone	98-86-2	0.033	0.0068	0.0068	0.0033	2
bis(2-Chloroethoxy) methane	111-91-1	0.033	0.0065	0.0065	0.0033	2
bis(2-Chloroethyl) ether	111-44-4	0.033	0.0065	0.0065	0.0033	2
bis(2-Chloro-1-methylethyl)ether	108-60-1	0.033	0.0072	0.0072	0.0033	2
bis-(2-Ethylhexyl)phthalate	117-81-7	0.066	0.006	0.006	0.0033	4
Butylbenzylphthalate	85-68-7	0.033	0.0067	0.0055	0.0067	
Dibenzofuran	132-64-9	0.033	0.0067	0.0067	0.0067	3
Diethylphthalate	84-66-2	0.033	0.0074	0.0074	0.0033	2
Dimethylphthalate	131-11-3	0.033	0.0075	0.0075	0.0033	2
Dinoseb	88-85-7	0.066	0.0067	0.0062	0.0067	
Di-n-butylphthalate	84-74-2	0.17	0.017	0.017	0.0033	2
Di-n-octylphthalate	117-84-0	0.033	0.0067	0.0036	0.0067	
Hexachlorobenzene	118-74-1	0.033	0.0076	0.0076	0.0033	2
Hexachlorobutadiene	87-68-3	0.033	0.0068	0.0068	0.0033	2
Hexachlorocyclopentadiene	77-47-4	0.066	0.0037	0.0037	0.0033	2
Hexachloroethane	67-72-1	0.033	0.0058	0.0058	0.0033	2
Hexachlorophene	70-30-4	17	2.4	2.4	0.83	2
Isophorone	78-59-1	0.033	0.007	0.007	0.0033	2
Nitrobenzene	98-95-3	0.033	0.0066	0.0066	0.0033	2
N-Nitroso-di-n-propylamine	621-64-7	0.033	0.0075	0.0075	0.0033	2
N-Nitrosodiphenylamine	86-30-6	0.033	0.0061	0.0061	0.0033	2
Pentachlorophenol	87-86-5	0.17	0.017	0.017	0.017	3
Phenol	108-95-2	0.033	0.0065	0.0065	0.0033	2
Pyridine	110-86-1	0.033	0.02	0.02	0.017	2
Safrole	94-59-7	0.033	0.0033	0.0033	0.0033	1
o-Toluidine	95-53-4	0.033	0.0033	0.0033	0.0033	1
O,O,O-Triethylphosphorothioate	126-68-1	0.066	0.0067	0.0044	0.0067	
1,3,5-trinitrobenzene	99-35-4	0.066	0.017	0.017	0.017	3
1,3 Dinitrobenzene	99-65-0	0.033	0.017	0.017	0.017	3
1-Naphthylamine	134-32-7	0.066	0.017	0.017	0.017	3
2-Acetylaminofluorene	53-96-3	0.033	0.033	0.033	0.033	3

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Analyte	CAS No.	LOQ (mg/kg)	LOD (mg/kg)	DL (mg/kg)	LOD Spike Concentration (mg/kg)	Comments
2-Naphthylamine	91-59-8	0.066	0.017	0.017	0.017	3
2-Picoline	109-06-8	0.066	0.0033	0.0033	0.0033	1
3,3'-dimethylbenzidine	119-93-7	0.066	0.066	0.066	0.066	2
3-Methylcholanthrene	56-49-5	0.033	0.042	0.042	0.042	3
4-Aminobiphenyl	92-67-1	0.066	0.017	0.017	0.017	3
4-Nitroquinoline-1-Oxide	56-57-5	0.33	0.042	0.042	0.042	3
5-Nitro-O-Toluidine	99-55-8	0.033	0.017	0.017	0.017	3
7,12-Dimethylbenz(a)Anthracene	57-97-6	0.033	0.017	0.017	0.017	3
a,a-Dimethylphenethylamine	122-09-8	6.7	0.33	0.33	0.33	3
Aniline	62-53-3	0.066	0.0082	0.0082	0.0067	2
Aramite	140-57-8	0.066	0.0048	0.0048	0.0033	2
Benzyl Alcohol	100-51-6	0.033	0.0061	0.0061	0.0033	2
Diallate	2303-16-4	0.033	0.0056	0.0056	0.003	
Diphenylamine	122-39-4	-8	-8	-8		
Ethyl Methanesulfonate	62-50-5	0.066	0.0078	0.0078	0.0033	2
Hexachloropropene	1888-71-7	0.033	0.0053	0.0053	0.0033	2
Isosafrole	120-58-1	0.033	0.0033	0.0033	0.0033	1
Methapyrilene	91-80-5	6.7	0.067	0.033	0.067	
Methyl Methanesulfonate	66-27-3	0.033	0.0038	0.0038	0.0038	2
N-Nitrosodiethylamine	55-18-5	0.066	0.0033	0.0033	0.0033	1
N-Nitrosodimethylamine	62-75-9	0.033	0.019	0.019	0.0067	2
N-Nitroso-Di-n-Butylamine	924-16-3	0.033	0.017	0.017	0.017	3
N-Nitrosomethylethylamine	10595-95-6	0.033	0.0033	0.0033	0.0033	1
N-Nitrosomorpholine	59-89-2	0.033	0.0045	0.0045	0.0033	2
N-Nitrosopiperidine	100-75-4	0.033	0.0034	0.0034	0.0033	2
N-Nitrosopyrrolidine	930-55-2	0.033	0.0036	0.0036	0.0033	2
p-Dimethylaminoazobenzene	60-11-7	0.033	0.017	0.017	0.017	3
Pentachlorobenzene	608-93-5	0.033	0.0033	0.0033	0.0033	1
Pentachloronitrobenzene	82-68-8	0.033	0.017	0.017	0.017	3
Phenacetin	62-44-2	0.033	0.017	0.017	0.017	3
p-Phenylenediamine	106-50-3	0.83	0.83	0.36	0.83	
Pronamide	23950-58-5	0.033	0.0042	0.0042	0.0033	2
Thionazin (O,O-diethyl phosphorothioate)	297-97-2	0.033	0.017	0.017	0.017	3
Dimethoate	60-51-5	0.033	0.017	0.017	0.017	3
Disulfoton	298-04-4	0.033	0.017	0.017	0.017	3
Famphur	52-85-7	0.033	0.017	0.017	0.017	3
Methyl parathion	298-00-0	0.033	0.017	0.017	0.017	3
Ethyl parathion (parathion)	56-38-2	0.033	0.033	0.033	0.033	3
Phorate	298-02-2	0.033	0.017	0.0059	0.017	
Sulfotepp (tetraethyl dithiopyrophosphate)	3689-24-5	0.033	0.017	0.0065	0.017	

Analyte	CAS No.	LOQ (mg/kg)	LOD (mg/kg)	DL (mg/kg)	LOD Spike Concentration (mg/kg)	Comments
Kepone	143-50-0	0.17	0.17	0.17	0.17	5
Chlorobenzilate	510-15-6	0.017	0.017	0.017	0.017	5
Isodrin	465-73-6	0.0033	0.0033	0.0033	0.0033	5

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Analyte	CAS No.	LOQ (mg/kg)	LOD (mg/kg)	DL (mg/kg)	LOD Spike Concentration (mg/kg)	Comments

Comments:

[1]Statistical MDL was <1/10 MDL Study spike concentration; therefore, DL has been elevated to a level equal to 1/10 spike concentration. Subsequent LOD pe

[2]LOD was spiked at concentration lower than Statistical MDL; therefore LOD has been elevated to Statistical MDL concentration.

[3]Lowest acceptable LOD was spiked at concentration higher than 3X the Statistical MDL; therefore DL has been elevated to LOD concentration.

[4]Compound is common laboratory contaminant; therefore, DL and LOD have been elevated above level of routine contamination.

[b]DL and LOD have been elevated to the LOQ. Values are not reported below the LOQ for these analytes.

Matrix: Soil
Parameter: Appendix IX VOCs

Analyte	Chemical Abstract Service (CAS) No.	Human Health Project Action Limit (HH PAL) (mg/kg)	HH PAL reference (1)	Ecological PAL (mg/kg)	Ecological PAL reference (2)	Lab LOQ (mg/kg)	Lab LOD (mg/kg)	Lab DL (mg/kg)	
1,1,1,2-Tetrachloroethane	630-20-6	0.004	RBSSL	225	Region 5 SSL	0.005	0.0025	0.00125	
1,1,1-Trichloroethane	71-55-6	64	RBSSL	29.8	Region 5 SSL	0.005	0.0025	0.00125	
1,1,2,2-Tetrachloroethane	79-34-5	0.00052	RBSSL	0.127	Region 5 SSL	0.005	0.0025	0.00125	
1,1,2-Trichloroethane	79-00-5	0.00156	RBSSL	28.6	Region 5 SSL	0.005	0.0025	0.00125	
1,1-Dichloroethane	75-34-3	0.0138	RBSSL	20.1	Region 5 SSL	0.005	0.0025	0.00125	
1,1-Dichloroethene	75-35-4	2.4	RBSSL	8.28	Region 5 SSL	0.005	0.0025	0.00125	
1,2,3-Trichloropropane	96-18-4	0.005	R-RSL	3.36	Region 5 SSL	0.005	0.0025	0.00125	
1,2,4-Trichlorobenzene	120-82-1	0.136	RBSSL	0.51	LANL ESL	0.005	0.0025	0.00125	
1,2-Dibromethane	106-93-4	0.000036	RBSSL	1.23	Region 5 SSL	0.005	0.0025	0.00125	
1,2-Dibromo-3-chloropropane	96-12-8	0.0000028	RBSSL	0.0352	Region 5 SSL	0.01	0.005	0.0025	
1,2-Dichlorobenzene	95-50-1	7.2	RBSSL	1.5	LANL ESL	0.005	0.0025	0.00125	
1,2-Dichloroethane	107-06-2	0.00084	RBSSL	0.85	LANL ESL	0.005	0.0025	0.00125	
1,2-Dichloropropane	78-87-5	0.0026	RBSSL	32.7	Region 5 SSL	0.005	0.0025	0.00125	
1,3-Dichlorobenzene	541-73-1	0.0082	RBSSL	1.3	LANL ESL	0.005	0.0025	0.00125	
1,4-Dichlorobenzene	106-46-7	0.0082	RBSSL	0.546	Region 5 SSL	0.005	0.0025	0.00125	
2-Butanone	78-93-3	30	RBSSL	89.6	Region 5 SSL	0.01	0.005	0.0025	
2-Hexanone	591-78-6	0.22	RBSSL	0.36	LANL ESL	0.005	0.0025	0.00125	
4-Methyl-2-pentanone	108-10-1	9	RBSSL	9.8	LANL ESL	0.005	0.0025	0.00125	
Acetone	67-64-1	90	RBSSL	1.2	LANL ESL	0.02	0.01	0.005	
Acetonitrile	75-05-8	0.52	RBSSL	1.37	Region 5 SSL	0.05	0.025	0.01	
Acrolein	107-02-8	0.000168	RBSSL	5.27	Region 5 SSL	0.02	0.01	0.005	
Acrylonitrile	107-13-1	0.000198	RBSSL	0.0239	Region 5 SSL	0.02	0.01	0.005	
Allyl Chloride	107-05-1	0.0042	RBSSL	0.0134	Region 5 SSL	0.005	0.0025	0.00125	
Benzene	71-43-2	0.0042	RBSSL	0.255	Region 5 SSL	0.005	0.0025	0.00125	
Bromodichloromethane	75-27-4	0.00064	RBSSL	0.54	Region 5 SSL	0.005	0.0025	0.00125	
Bromoform	75-25-2	0.046	RBSSL	15.9	Region 5 SSL	0.005	0.0025	0.00125	
Bromomethane	74-83-9	0.044	RBSSL	0.235	Region 5 SSL	0.01	0.005	0.0025	
Carbon Disulfide	75-15-0	6.2	RBSSL	0.0941	Region 5 SSL	0.005	0.0025	0.00125	
Carbon Tetrachloride	56-23-5	0.0034	RBSSL	2.98	Region 5 SSL	0.005	0.0025	0.00125	
Chlorobenzene	108-90-7	1.24	RBSSL	2.4	LANL ESL	0.005	0.0025	0.00125	
Chloroethane	75-00-3	118	RBSSL	NA	NA	0.01	0.005	0.0025	
Chloroform	67-66-3	0.00106	RBSSL	1.19	Region 5 SSL	0.005	0.0025	0.00125	

Analyte	Chemical Abstract Service (CAS) No.	Human Health Project Action Limit (HH PAL) (mg/kg)	HH PAL reference (1)	Ecological PAL (mg/kg)	Ecological PAL reference (2)	Lab LOQ (mg/kg)	Lab LOD (mg/kg)	Lab DL (mg/kg)	
Chloromethane	74-87-3	0.98	RBSSL	10.4	Region 5 SSL	0.01	0.005	0.0025	
Chloroprene	126-99-8	0.00017	RBSSL	0.0029	Region 5 SSL	0.005	0.0025	0.00125	
cis-1,3-Dichloropropene	542-75-6	0.003	RBSSL	0.398	Region 5 SSL	0.005	0.0025	0.00125	
Dibromochloromethane	124-48-1	0.00078	RBSSL	2.05	Region 5 SSL	0.005	0.0025	0.00125	
Dibromomethane	74-95-3	0.04	RBSSL	65	Region 5 SSL	0.005	0.0025	0.00125	
Dichlorodifluoromethane	75-71-8	6.2	RBSSL	39.5	Region 5 SSL	0.01	0.005	0.0025	
Ethyl Methacrylate	97-63-2	2.4	RBSSL	30	Region 5 SSL	0.005	0.0025	0.00125	
Ethylbenzene	100-41-4	0.034	RBSSL	5.16	Region 5 SSL	0.005	0.0025	0.00125	
Isobutyl alcohol	78-83-1	46	RBSSL	20.8	Region 5 SSL	0.1	0.04	0.02	
Methacrylonitrile	126-98-7	0.0048	RBSSL	0.057	Region 5 SSL	0.05	0.025	0.01	
Methyl Iodide	74-88-4	NC	None	1.23	Region 5 SSL	0.01	0.005	0.0025	
Methyl Methacrylate	80-62-6	6.2	RBSSL	984	Region 5 SSL	0.005	0.0025	0.00125	
Methylene Bromide (dibromomethane - duplicate)	74-95-3	0.04	RBSSL	65	Region 5 SSL	0.005	0.0025	0.00125	
Methylene Chloride	75-09-2	0.024	RBSSL	2.6	LANL ESL	0.01	0.005	0.0025	
Pentachloroethane	76-01-7	0.0072	RBSSL	10.7	Region 5 SSL	0.05	0.025	0.025	(1)
Propionitrile	107-12-0	NC	None	0.0498	Region 5 SSL	0.05	0.025	0.01	
Styrene	100-42-5	36	RBSSL	1.2	LANL ESL	0.005	0.0025	0.00125	
Tetrachloroethene	127-18-4	0.00098	RBSSL	0.36	LANL ESL	0.005	0.0025	0.00125	
Toluene	108-88-3	32	RBSSL	5.45	Region 5 SSL	0.005	0.0025	0.00125	
trans-1,2-Dichloroethene	156-60-5	0.62	RBSSL	0.784	Region 5 SSL	0.005	0.0025	0.00125	
trans-1,3-Dichloropropene	542-75-6	0.003	RBSSL	0.398	Region 5 SSL	0.005	0.0025	0.00125	
trans-1,4-Dichloro-2-butene	110-57-6	0.000108	RBSSL	NA	NA	0.005	0.0025	0.00125	
Trichloroethene	79-01-6	0.0144	RBSSL	12.4	Region 5 SSL	0.005	0.0025	0.00125	
Trichlorofluoromethane	75-69-4	16.6	RBSSL	16.4	Region 5 SSL	0.01	0.005	0.0025	
Vinyl Acetate	108-05-4	1.76	RBSSL	12.7	Region 5 SSL	0.01	0.005	0.0025	
Vinyl Chloride	75-01-4	0.000112	RBSSL	0.13	LANL ESL	0.005	0.0025	0.00125	
Xylenes (Total)	1330-20-7	4	RBSSL	2	LANL ESL	0.015	0.0075	0.00375	

NC - No Criteria available

(1) Estimated value. Will report this compound but will not fall under DoD ELAP certification.

Matrix: Soil
Parameter: Appendix IX SVOCs

Analyte	HH PAL (mg/kg)	HH PAL reference (1)	Ecological PAL (mg/kg)	Ecological PAL reference (2)	Lab LOQ (mg/kg)	Lab LOD (mg/kg)	Lab DL (mg/kg)	
1,4-Dioxane	0.0028	RBSSL	2.05	Region 5 SSL	0.0667	0.0333	0.0167	(2)
2-Methylnaphthalene	15	RBSSL	29	Eco SSL	0.00667	0.00333	0.00167	(2)
Acenaphthene	340	R-RSL	29	Eco SSL	0.00667	0.00333	0.00167	(2)
Acenaphthylene	340	R-RSL	29	Eco SSL	0.00667	0.00333	0.00167	(2)
Anthracene	1700	R-RSL	29	Eco SSL	0.00667	0.00333	0.00167	(2)
Benzo(a)anthracene	0.15	R-RSL	18	Eco SSL	0.00667	0.00333	0.00167	(2)
Benzo(a)pyrene	0.015	R-RSL	18	Eco SSL	0.00667	0.00333	0.00167	(2)
Benzo(b)fluoranthene	0.15	R-RSL	18	Eco SSL	0.00667	0.00333	0.00167	(2)
Benzo(g,h,i)perylene	170	R-RSL	18	Eco SSL	0.00667	0.00333	0.00167	(2)
Benzo(k)fluoranthene	1.5	R-RSL	18	Eco SSL	0.00667	0.00333	0.00167	(2)
Chrysene	15	R-RSL	18	Eco SSL	0.00667	0.00333	0.00167	(2)
Dibenzo(a,h)anthracene	0.015	R-RSL	18	Eco SSL	0.00667	0.00333	0.00167	(2)
Fluoranthene	230	R-RSL	29	Eco SSL	0.00667	0.00333	0.00167	(2)
Fluorene	230	R-RSL	29	Eco SSL	0.00667	0.00333	0.00167	(2)
Indeno(1,2,3-cd)pyrene	0.15	R-RSL	18	Eco SSL	0.00667	0.00333	0.00167	(2)
Naphthalene	0.0094	RBSSL	29	Eco SSL	0.00667	0.00333	0.00167	(2)
Phenanthrene	170	R-RSL	29	Eco SSL	0.00667	0.00333	0.00167	(2)
Pyrene	170	R-RSL	18	Eco SSL	0.00667	0.00333	0.00167	(2)
1,2,4,5-Tetrachlorobenzene	1.02	RBSSL	2.02	Region 5 SSL	0.033	0.0033	0.0033	(1)
1,3 Dinitrobenzene	0.066	RBSSL	0.073	LANL ESL	0.033	0.017	0.017	(1)
1,3,5-trinitrobenzene	78	RBSSL	0.376	Region 5 SSL	0.066	0.017	0.017	(1)
1,4-Naphthoquinone	NC	None	1.67	Region 5 SSL	0.033	0.0033	0.0033	(1)
1-Naphthylamine	NC	None	9.34	Region 5 SSL	0.066	0.017	0.017	(1)
2,3,4,6-Tetrachlorophenol	134	RBSSL	0.199	Region 5 SSL	0.033	0.0033	0.0033	(1)
2,4,5-Trichlorophenol	280	RBSSL	14.1	Region 5 SSL	0.033	0.0076	0.0076	(1)
2,4,6-Trichlorophenol	0.46	RBSSL	9.94	Region 5 SSL	0.033	0.0079	0.0079	(1)
2,4-Dichlorophenol	2.6	RBSSL	87.5	Region 5 SSL	0.033	0.0072	0.0072	(1)
2,4-Dimethylphenol	17.2	RBSSL	0.01	Region 5 SSL	0.066	0.0076	0.0076	(1)
2,4-Dinitrophenol	1.64	RBSSL	0.0609	Region 5 SSL	0.33	0.042	0.017	(1)
2,4-Dinitrotoluene	0.0058	RBSSL	0.52	LANL ESL	0.033	0.0075	0.0075	(1)
2,6-Dichlorophenol	NC	None	1.17	Region 5 SSL	0.033	0.0033	0.0033	(1)
2,6-Dinitrotoluene	1	RBSSL	0.0328	Region 5 SSL	0.033	0.0079	0.0079	(1)
2-Acetylaminofluorene	0.00164	RBSSL	0.596	Region 5 SSL	0.033	0.006	0.006	(1)
2-Chloronapthalene	300	RBSSL	0.0122	Region 5 SSL	0.033	0.006	0.006	(1)
2-Chlorophenol	3	RBSSL	0.243	Region 5 SSL	0.033	0.0053	0.0053	(1)

Analyte	HH PAL (mg/kg)	HH PAL reference (1)	Ecological PAL (mg/kg)	Ecological PAL reference (2)	Lab LOQ (mg/kg)	Lab LOD (mg/kg)	Lab DL (mg/kg)	
2-Methylphenol	30	RBSSL	40.4	Region 5 SSL	0.033	0.0063	0.0063	(1)
2-Naphthylamine	0.0038	RBSSL	3.03	Region 5 SSL	0.066	0.017	0.017	(1)
2-Nitroaniline	3	RBSSL	74.1	Region 5 SSL	0.17	0.007	0.007	(1)
2-Nitrophenol	NC	None	1.6	Region 5 SSL	0.033	0.0058	0.0058	(1)
2-Picoline	NC	None	9.9	Region 5 SSL	0.066	0.0033	0.0033	(1)
3,3'-dimethylbenzidine	0.0008	RBSSL	NA	NA	0.066	0.066	0.066	(1)
3,3'-Dichlorobenzidine	0.0196	RBSSL	0.646	Region 5 SSL	0.066	0.017	0.017	(1)
3-Methylcholanthrene	0.0052	R-RSL	0.0779	Region 5 SSL	0.033	0.042	0.042	(1)
3-methylphenol	30	RBSSL	NA	NA	0.033	0.0073	0.0073	(5)
3-Nitroaniline	NC	None	3.16	Region 5 SSL	0.17	0.0067	0.0067	(1)
4,6-Dinitro-2-methylphenol	0.1	RBSSL	0.144	Region 5 SSL	0.17	0.017	0.017	(1)
4-Aminobiphenyl	0.00032	RBSSL	0.00305	Region 5 SSL	0.066	0.017	0.017	(1)
4-Bromophenyl-phenylether	NC	None	NA	NA	0.033	0.0069	0.0069	(1)
4-Chloro-3-methylphenol	86	RBSSL	7.95	Region 5 SSL	0.033	0.007	0.007	(1)
4-Chloroaniline	0.0028	RBSSL	1	LANL ESL	0.066	0.0052	0.0052	(1)
4-Chlorophenyl-phenylether	NC	None	NA	NA	0.033	0.0064	0.0064	(1)
4-Methylphenol	3	RBSSL	163	Region 5 SSL	0.033	0.0073	0.0073	(5)
4-Nitroaniline	0.028	RBSSL	21.9	Region 5 SSL	0.17	0.017	0.0083	(1)
4-Nitrophenol	NC	None	5.12	Region 5 SSL	0.17	0.073	0.073	(1)
4-Nitroquinoline-1-Oxide	NC	None	0.122	Region 5 SSL	0.33	0.042	0.042	(1)
5-Nitro-O-Toluidine	0.84	RBSSL	8.73	Region 5 SSL	0.033	0.017	0.017	(1)
7,12-Dimethylbenz(a)Anthracene	0.00043	R-RSL	16.3	Region 5 SSL	0.033	0.017	0.017	(1)
a,a-Dimethylphenethylamine	NC	None	0.3	Region 5 SSL	6.7	0.33	0.33	(1)
Acetophenone	22	RBSSL	300	Region 5 SSL	0.033	0.0068	0.0068	(1)
Aniline	0.08	RBSSL	0.0568	Region 5 SSL	0.066	0.0082	0.0082	(1)
Aramite	0.6	RBSSL	166	Region 5 SSL	0.066	0.0048	0.0048	(1)
Benzyl Alcohol	17.8	RBSSL	65.8	Region 5 SSL	0.033	0.0061	0.0061	(1)
bis(2-Chloro-1-methylethyl)ether	0.0024	RBSSL	19.9	Region 5 SSL	0.033	0.0072	0.0072	(1)
bis(2-Chloroethoxy) methane	0.5	RBSSL	0.302	Region 5 SSL	0.033	0.0065	0.0065	(1)
bis(2-Chloroethyl) ether	0.000062	RBSSL	23.7	Region 5 SSL	0.033	0.0065	0.0065	(1)
bis-(2-Ethylhexyl)phthalate	22	RBSSL	0.02	LANL ESL	0.066	0.006	0.006	(1)
Butylbenzylphthalate	10.2	RBSSL	0.239	Region 5 SSL	0.033	0.0067	0.0055	(1)
Chlorobenzilate	0.04	RBSSL	5.05	Region 5 SSL	0.017	0.017	0.017	(1, 3)
Diallate	0.032	RBSSL	0.452	Region 5 SSL	0.033	0.0056	0.0056	(1)
Dibenzofuran	7.8	R-RSL	6.1	LANL ESL	0.033	0.0067	0.0067	(1)

Analyte	HH PAL (mg/kg)	HH PAL reference (1)	Ecological PAL (mg/kg)	Ecological PAL reference (2)	Lab LOQ (mg/kg)	Lab LOD (mg/kg)	Lab DL (mg/kg)	
Diethylphthalate	240	RBSSL	24.8	Region 5 SSL	0.033	0.0074	0.0074	(1)
Dimethylphthalate	NC	None	10	LANL ESL	0.033	0.0075	0.0075	(1)
Di-n-butylphthalate	184	RBSSL	0.011	LANL ESL	0.17	0.017	0.017	(1)
Di-n-octylphthalate	NC	None	2.2	LANL ESL	0.033	0.0067	0.0036	(1)
Dinoseb	6.1	R-RSL	0.0218	Region 5 SSL	0.066	0.0067	0.0062	(1)
Diphenylamine	34	RBSSL	1.01	Region 5 SSL				(1, 4)
Ethyl Methanesulfonate	NC	None	NC	None	0.066	0.0078	0.0078	(1)
Hexachlorobenzene	0.0106	RBSSL	0.079	LANL ESL	0.033	0.0076	0.0076	(1)
Hexachlorobutadiene	0.034	RBSSL	0.0398	Region 5 SSL	0.033	0.0068	0.0068	(1)
Hexachlorocyclopentadiene	13.6	RBSSL	0.755	Region 5 SSL	0.066	0.0037	0.0037	(1)
Hexachloroethane	0.058	RBSSL	0.596	Region 5 SSL	0.033	0.0058	0.0058	(1)
Hexachlorophene	1.8	R-RSL	1.99E-01	Region 5 SSL	17	2.4	2.4	(1)
Hexachloropropene	NC	None	NC	None	0.033	0.0053	0.0053	(1)
Isodrin	NC	None	0.00332	Region 5 SSL	0.0033	0.0033	0.0033	(1, 3)
Isophorone	0.46	RBSSL	139	Region 5 SSL	0.033	0.007	0.007	(1)
Isosafrole	NC	None	9.94	Region 5 SSL	0.033	0.0033	0.0033	(1)
Methapyrilene	NC	None	2.78	Region 5 SSL	6.7	0.067	0.033	(1)
Methyl Methanesulfonate	0.0028	RBSSL	0.315	Region 5 SSL	0.033	0.0038	0.0038	(1)
Nitrobenzene	0.00158	RBSSL	1.31	Region 5 SSL	0.033	0.0066	0.0066	(1)
N-Nitrosodiethylamine	0.00000106	RBSSL	0.0693	Region 5 SSL	0.066	0.0033	0.0033	(1)
N-Nitrosodimethylamine	0.000002	RBSSL	0.0000321	Region 5 SSL	0.033	0.019	0.019	(1)
N-Nitroso-Di-n-Butylamine	0.0001	RBSSL	0.267	Region 5 SSL	0.033	0.017	0.017	(1)
N-Nitroso-di-n-propylamine	0.000144	RBSSL	0.544	Region 5 SSL	0.033	0.0074	0.0075	(1)
N-Nitrosodiphenylamine	1.5	RBSSL	0.545	Region 5 SSL	0.033	0.0061	0.0061	(1)
N-Nitrosomethylethylamine	0.0000176	RBSSL	0.00166	Region 5 SSL	0.033	0.0033	0.0033	(1)
N-Nitrosomorpholine	0.00005	RBSSL	0.0706	Region 5 SSL	0.033	0.0045	0.0045	(1)
N-Nitrosopiperidine	0.000076	RBSSL	0.00665	Region 5 SSL	0.033	0.0034	0.0034	(1)
N-Nitrosopyrrolidine	0.00024	RBSSL	0.0126	Region 5 SSL	0.033	0.0036	0.0036	(1)
O,O,O-Triethylphosphorothioate	NC	None	0.818	Region 5 SSL	0.066	0.0067	0.0044	(1)
o-Toluidine	NC	None	2.97	Region 5 SSL	0.033	0.0033	0.0033	(1)
p-Dimethylaminoazobenzene	0.00124	RBSSL	0.04	Region 5 SSL	0.033	0.017	0.017	(1)
Pentachlorobenzene	4.4	RBSSL	0.497	Region 5 SSL	0.033	0.0033	0.0033	(1)
Pentachloronitrobenzene	0.064	RBSSL	0.7	LANL ESL	0.033	0.017	0.017	(1)
Pentachlorophenol	0.034	RBSSL	2.1	Eco SSL	0.17	0.017	0.017	(1)
Phenacetin	0.172	RBSSL	11.7	Region 5 SSL	0.033	0.017	0.017	(1)
Phenol	126	RBSSL	0.79	LANL ESL	0.033	0.0065	0.0065	(1)

Analyte	HH PAL (mg/kg)	HH PAL reference (1)	Ecological PAL (mg/kg)	Ecological PAL reference (2)	Lab LOQ (mg/kg)	Lab LOD (mg/kg)	Lab DL (mg/kg)	
p-Phenylenediamine	38	RBSSL	6.16	Region 5 SSL	0.83	0.83	0.36	(1)
Pronamide	56	RBSSL	0.0136	Region 5 SSL	0.033	0.0042	0.0042	(1)
Pyridine	0.26	RBSSL	1.03	Region 5 SSL	0.033	0.02	0.02	(1)
Safrole	0.0012	RBSSL	0.404	Region 5 SSL	0.033	0.0033	0.0033	(1)

NC - No Criteria available

(1) Subcontracted to Test America/Savannah.

(2) Analyzed via 8270C low level full scan.

(3) Analyzed via 8081B.

(4) N-nitrosodiphenylamine decomposes in the gas chromatographic inlet and cannot be separated from diphenylamine. Since n-nitrosodiphenylamine is a default compound for 8270, diphenlyamine is not listed.

(5) Subcontracted to Test America/Savannah and reported as 3&4-methylphenol.

Matrix: Soil

Parameter: PCBs

Analyte	CAS No.	HHRA PAL (mg/kg)	HHRA PAL reference (1)	Ecological PAL (mg/kg)	Ecological PAL reference (2)	Lab LOQ (mg/kg)	Lab LOD (mg/kg)	Lab DL (mg/kg)
Aroclor-1016	12674-11-2					0.0167	0.00833	0.00417
Aroclor-1221	11104-28-2	0.0024	RBSSL	0.000332	Region 5 SSL	0.0167	0.00833	0.00417
Aroclor-1232	11141-16-5	0.0024	RBSSL	0.000332	Region 5 SSL	0.0167	0.00833	0.00417
Aroclor-1242	53469-21-9	0.106	RBSSL	0.000332	Region 5 SSL	0.0167	0.00833	0.00417
Aroclor-1248	12672-29-6	0.104	RBSSL	0.000332	Region 5 SSL	0.0167	0.00833	0.00417
Aroclor-1254	11097-69-1	0.11	R-RSL	0.000332	Region 5 SSL	0.0167	0.00833	0.00417
Aroclor-1260	11096-82-5	0.22	R-RSL	0.000332	Region 5 SSL	0.0167	0.00833	0.00417

NC - No criteria available

Matrix: Soil

Parameter: Metals

Analyte	CAS No.	HHRA PAL (mg/kg)	HHRA PAL reference (1)	Ecological PAL (mg/kg)	Ecological PAL reference (2)	Lab LOQ (mg/kg)	Lab LOD (mg/kg)	Lab DL (mg/kg)
Antimony	7440-36-0	3.1	R-RSL	10	Eco SSL	0.50	0.4	0.25
Arsenic	7440-38-2	0.026	RBSSL	18	Eco SSL	0.5	0.3	0.15
Barium	7440-39-9	1500	R-RSL	330	Eco SSL	2	0.5	0.25
Beryllium	7440-41-7	16	R-RSL	21	Eco SSL	0.25	0.1	0.05
Cadmium	7440-43-9	7	R-RSL	0.77	Eco SSL	0.25	0.1	0.05
Chromium (total)	77440-47-3	NC	None	26	Eco SSL	0.5	0.2	0.1
Cobalt	7440-48-4	2.3	R-RSL	13	Eco SSL	0.625	0.5	0.25
Copper	7440-50-8	310	R-RSL	28	Eco SSL	0.5	0.4	0.2
Lead	7439-92-1	280	RBSSL	11	Eco SSL	0.25	0.15	0.075
Mercury	7439-97-6	0.66	RBSSL	0.013	LANL ESL	0.033	0.033	0.0130
Nickel	7440-02-0	150	R-RSL	38	Eco SSL	0.5	0.3	0.15
Selenium	7782-49-2	3.9	R-RSL	0.52	Eco SSL	0.5	0.25	0.15
Silver	7440-22-4	3.9	R-RSL	4.2	Eco SSL	0.5	0.1	0.05
Thallium	7440-28-0	0.078	R-RSL	0.0569	Region 5 SSL	0.4	0.2	0.15
Tin	7440-31-5	4700	R-RSL	7.62	Region 5 SSL	10	2.5	0.5
Vanadium	7440-62-2	39	R-RSL	7.8	Eco SSL	0.625	0.5	0.25
Zinc	7440-66-6	2300	R-RSL	46	Eco SSL	1	0.5	0.25

NC - No Criteria Available

HH Notes:

1 - The residential direct contact (R-RSL) and risk-based migration to groundwater soil screening levels (RBSSL) from

2 - The USEPA RSL (June, 2011) residential soil screening level for noncarcinogens adjusted by dividing by 10,

3 - A dilution attentuation factor of 20 has been applied to EPA soil screening levels, migration to groundwater values.

4 - Calculated from the EPA website (http://epa-prgs.ornl.gov/cgi-bin/chemicals/csl_search).

5 - Value is for mercuric chloride (and other mercury salts).

Ecological Notes:

1 - USEPA Ecological Soil Screening Levels (Eco SSLs) available online: http://www.epa.gov/ecotox/ecossl/. Minimum of plant, invertebrate, avian, and herbivorous mammalian screening value presented.

2 - USEPA Region 5 Ecological Soil Screening Levels (Region 5 SSLs) (USEPA, August 2003).

3 - Los Alamos National Laboratory Ecological Screening Levels (LANL ESLs), Ecorisk Database release 2.4, December 2009. Minimum of plant, earthworm, avian, and mammalian (Desert Cottontail and Deer Mouse) screening value presented.

4 - Final Ecological Screen Criterion was selected in the following order of preference:

a. USEPA Eco SSL.

b. Lower of Region 5 SSL or LANL ESL.

5 - Value for total chromium.

6 - Value for trivalent chromium.

7 - Value for inorganic mercury.

Submitted by: Empirical Laboratories, LLC

Prepared by: Delia Weber, Office Administrator

Date: November 1, 2011

Matrix: Soil

Parameter: Appendix IX Pesticides

Analyte	CAS No.	HHRA PAL (mg/kg)	HHRA PAL reference (1)	Ecological PAL (mg/kg)	Ecological PAL reference (2)	Lab LOQ (mg/kg)	Lab LOD (mg/kg)	Lab DL (mg/kg)	
4,4'-DDD	72-54-8	1.32	RBSSL	0.093	Eco SSL	0.00067	0.00034	0.00017	
4,4'-DDE	72-55-9	0.94	RBSSL	0.093	Eco SSL	0.00067	0.00034	0.00017	
4,4'-DDT	50-29-3	1.34	RBSSL	0.093	Eco SSL	0.00067	0.00034	0.00017	
Aldrin	309-00-2	0.013	RBSSL	0.00332	Region 5 SSL	0.00067	0.00034	0.00011	
alpha-BHC	319-84-6	0.00124	RBSSL	0.0994	Region 5 SSL	0.00067	0.00034	0.00011	
beta-BHC	319-85-7	0.0044	RBSSL	0.00398	Region 5 SSL	0.00067	0.00034	0.00011	
Chlordane	12789-03-6	0.26	RBSSL	0.224	Region 5 SSL	0.0034	0.0017	0.00114	
delta-BHC	319-86-8	0.00124	RBSSL	9.94	Region 5 SSL	0.00067	0.00034	0.00011	
Dieldrin	60-57-1	0.0034	RBSSL	0.022	Eco SSL	0.00067	0.00034	0.00017	
Endosulfan I	115-29-7	37	R-RSL	0.119	Region 5 SSL	0.00067	0.00034	0.00011	
Endosulfan II	33213-65-9	37	R-RSL	0.119	Region 5 SSL	0.00067	0.00034	0.00017	
Endosulfan sulfate	1031-07-8	37	R-RSL	0.0358	Region 5 SSL	0.00067	0.00034	0.00017	
Endrin	72-20-8	1.8	R-RSL	0.0014	LANL ESL	0.00067	0.00034	0.00017	
Endrin aldehyde	7421-93-4	1.8	R-RSL	0.0105	Region 5 SSL	0.00067	0.00034	0.00017	
gamma-BHC	58-89-9	0.0072	RBSSL	0.005	Region 5 SSL	0.00067	0.00034	0.00011	
Heptachlor	76-44-8	0.024	RBSSL	0.00598	Region 5 SSL	0.00067	0.00034	0.00011	
Heptachlor epoxide	1024-57-3	0.003	RBSSL	0.152	Region 5 SSL	0.00067	0.00034	0.00011	
Kepone	143-50-0					0.17	0.17	0.17	(1)
Methoxychlor	72-43-5	31	R-RSL	0.0199	Region 5 SSL	0.00067	0.00034	0.00011	
Toxaphene	8001-35-2	0.188	RBSSL	0.119	Region 5 SSL	0.033	0.022	0.011	

(1) Subcontracted to TestAmerica/Savannah. Analyzed via 8081B.

Matrix: Soil
Parameter: Explosives

Analyte	HHRA PAL (mg/kg)	HHRA PAL reference (1)	Ecological PAL (mg/kg)	Ecological PAL reference (2)	Lab LOQ (mg/kg)	Lab LOD (mg/kg)	Lab DL (mg/kg)
1,3,5-Trinitrobenzene	78	RBSSL	0.376	Region 5 SSL	0.400	0.200	0.100
1,3-Dinitrobenzene	0.066	RBSSL	0.655	Region 5 SSL	0.400	0.200	0.100
2,4,6-Trinitrotoluene	0.26	RBSSL	NC	None	0.400	0.200	0.100
2,4-Dinitrotoluene	0.0058	RBSSL	1.28	Region 5 SSL	0.400	0.200	0.100
2,6-Dinitrotoluene	1	RBSSL	0.0328	Region 5 SSL	0.400	0.200	0.100
2-Amino-4,6-dinitrotoluene	1.12	RBSSL	NC	None	0.400	0.200	0.100
2-Nitrotoluene	0.0058	RBSSL	NC	None	0.400	0.200	0.100
3-Nitrotoluene	0.068	RBSSL	NC	None	0.400	0.200	0.100
4-Amino-2,6-dinitrotoluene	1.12	RBSSL	NC	None	0.400	0.200	0.100
4-Nitrotoluene	0.078	RBSSL	NC	None	0.400	0.200	0.100
Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX)	0.0046	RBSSL	NC	None	0.400	0.200	0.100
Methyl-2,4,6-trinitrophenylnitramine (Tetryl)	24	R-RSL	0.99	LANL ESL	0.400	0.200	0.100
Nitrobenzene	0.00158	RBSSL	1.31	Region 5 SSL	0.400	0.200	0.100
Nitroglycerin	0.032	RBSSL	NC	None	1.00	0.500	0.250
Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)	46	RBSSL	NC	None	0.400	0.200	0.100

NC - No Criteria available

Matrix: Soil

Parameter: Appendix IX Herbicides and Organo phosphorus pesticides

Analyte	CAS No.	HHRA PAL (mg/kg)	HHRA PAL reference (1)	Ecological PAL (mg/kg)	Ecological PAL reference (2)	Lab LOQ (mg/kg)	Lab LOD (mg/kg)	Lab DL (mg/kg)	
Herbicides									
2,4-D	94-75-7	1.9	RBSSL	0.0272	Region 5 SSL	0.1	0.05	0.025	
Silvex (2,4,5-TP)	93-72-1	3.2	RBSSL	0.109	Region 5 SSL	0.01	0.005	0.0025	
2,4,5-T	93-76-5	3	RBSSL	0.596	Region 5 SSL	0.01	0.005	0.0025	
Orthophosphate									
Thionazin (O,O-diethyl phosphorothioate)	297-97-2	NA	NC	0.799	Region 5 SSL	0.033	0.017	0.017	(2)
Dimethoate	60-51-5	0.032	RBSSL	0.218	Region 5 SSL	0.033	0.017	0.017	(2)
Disulfoton	298-04-4	0.054	RBSSL	0.0199	Region 5 SSL	0.033	0.017	0.017	(2)
Famphur	52-85-7	NA	NC	0.0497	Region 5 SSL	0.033	0.017	0.017	(2)
Methyl parathion	298-00-0	0.3	RBSSL	0.000292	Region 5 SSL	0.033	0.017	0.017	(2)
Ethyl parathion (parathion)	56-38-2	22	RBSSL	0.00034	Region 5 SSL	0.033	0.042	0.042	(2)
Phorate	298-02-2	0.164	RBSSL	0.000496	Region 5 SSL	0.033	0.017	0.0059	(2)
Sulfotepp (tetraethyl dithiopyrophosphate)	3689-24-5	0.26	RBSSL	0.596	Region 5 SSL	0.033	0.017	0.0065	(2)

(2) Subcontracted to TestAmerica Savannah. Analyzed via 8270C.