RADFORD ARMY AMMUNITION PLANT, VIRGINIA

Army Reserve Small Arms Range
RCRA Facility Investigation/
Interim Measures Work Plan

Prepared for:

USACE Baltimore District
10 S. Howard St.
Baltimore, MD 21201

Prepared by:

Shaw Environmental, Inc.
2113 Emmorton Park Rd.
Edgewood, MD 21040

Final Document **March 2011**

11-33

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION III
1650 Arch Street
Philadelphia, Pennsylvania 19103-2029

April 11, 2011

Commander,
Radford Army Ammunition Plant
Attn: SJMRF-OP-EQ (Jim McKenna)
P.O. Box 2
Radford, VA 24141-0099

P.W. Holt
Environmental Manager
Alliant Techsystems, Inc.
Radford Army Ammunition Plant
P.O. Box 1
Radford, VA 24141-0100

VIA Electronic Mail

Re: Radford Army Ammunition Plant, VA
Army Reserve Small Arms Range
RCRA Facility Investigation/
Interim Measures Work Plan

Dear Mr. McKenna and Ms. Holt:

The U.S. Environmental Protection Agency (EPA) and Virginia Department of Environmental Quality (VDEQ) have reviewed the U.S. Army's (Army's) March 2011 Final RCRA Facility Investigation Interim Measures Work Plan for the Army Reserve Small Arms Range, located at the Radford Army Ammunition Plant (RFAAP) in Radford, Virginia. Based upon our review, the report is approved, and in accordance with Part II. (E)(5) of RFAAP's Corrective Action Permit; the report is considered final. If you have any questions, please call me at 215-814-3284.

Sincerely,

Erich Weissbart

Erich Weissbart, P.G.
RCRA Project Manager
Office of Remediation (3LC20)

c: James Cutler, VDEQ

ATK Armament Systems
Energetic Systems
Radford Army Ammunition Plant
Route 114, P.O. Box 1
Radford, VA 24143-0100

www.atk.com

April 1, 2011

Mr. Erich Weissbart and Mr. William Geiger
RCRA General Operations Branch, Mail Code: 3WC23
Waste and Chemicals Management Division
U. S. Environmental Protection Agency, Region III
1650 Arch Street
Philadelphia, PA 19103-2029

Mr. James L. Cutler, Jr.
Virginia Department of Environmental Quality
629 East Main Street
Richmond, VA 23219

Subject: With Certification, Army Reserve Small Arms Range RCRA Facility Investigation/Interim Measures Work Plan, Final Document, March 2011
EPA ID# VA1 210020730

Dear Mr. Weissbart, Mr. Geiger and Mr. Cutler:

Enclosed is the certification for the subject document that was sent to you on March 30, 2011. Also enclosed is the 30 March 2011 transmittal email.

Please coordinate with and provide any questions or comments to myself at (540) 639-8658, Jerry Redder ATK staff (540) 639-7536 or Jim McKenna, ACO Staff (540) 731-5782.

Sincerely,

P.W. Holt, Environmental Manager
Alliant Techsystems Inc.

c: Karen Sismour
Virginia Department of Environmental Quality
P. O. Box 1105
Richmond, VA 23218

E. A. Lohman
Virginia Department of Environmental Quality
Blue Ridge Regional Office
3019 Peters Creek Road
Roanoke, VA 24019

11-815-51
JMcKenna

Rich Mendoza
US Army Environmental Center
11711 North IH 35, Suite 110
Attn: Richard Mendoza (C-23)
San Antonio, TX 78233

Tom Meyer
Corps of Engineers, Baltimore District
ATTN: CENAB-EN-HM
10 South Howard Street
Baltimore, MD 21201

bc: Administrative File
J. McKenna, ACO Staff
Rob Davie-ACO Staff
P.W. Holt
J. J. Redder
Env. File

Coordination: J. McKenna

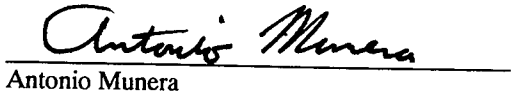
M. A. Miano

11-815-51
JMcKenna

Concerning the following:

Radford Army Ammunition Plant
Army Reserve Small Arms Range
RCRA Facility Investigation/Interim Measures Work Plan,
Finalt Document, March 2011

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fines and imprisonment for knowing violations.

SIGNATURE: 
PRINTED NAME: Antonio Munera
TITLE: LTC, CM
Commanding

SIGNATURE: 
PRINTED NAME: Kent Holiday
TITLE: Vice President and General Manager
ATK Energetics Systems

11-815-51
JMcKenna

Greene, Anne

From: McKenna, Jim
Sent: Wednesday, March 30, 2011 10:53 AM
To: Weissbart.Erich@epamail.epa.gov; Geiger.William@epamail.epa.gov; Gunter, Karen; Redder, Jerome; Lohman,Elizabeth; Mahoney, Kenneth; Mendoza, Rich; Meyer, Tom NAB02; Parks Jeffrey N (E-mail); Davie, Robert; Timothy.Leahy@shawgrp.com; Cutler,Jim; Ryan, Susan M CIV USA IMCOM
Subject: Final Army Reserve Small Arms Range WP (UNCLASSIFIED)
Attachments: 19 Jan 2011 RTCs ARSAR_rev01172011_TL.pdf

Importance: High

Classification: UNCLASSIFIED
Caveats: FOUO

All:

Note the contractor will ship the subject document with a copy of this email to the POCs and tracking numbers below. Attached are the response to comments on the draft.

A certification letter will follow.

Thank you for your support of the Radford Army Ammunition Plant Installation Restoration Program.

Jim McKenna

Jim McKenna	1Z63V8841394421162
Thomas Meyer	1Z63V8841392713770
Jeffrey Leach	1Z63V8841392877380
Susan M. Ryan	1Z63V8841391217602
William Geiger/Erich Weissbart	1Z63V8841390594215
JIM CUTLER	1Z63V8841394241820
E.A. LOHMAN	1Z63V8841390260432

Classification: UNCLASSIFIED
Caveats: FOUO

Response to VDEQ Comments on the
Final ARSAR Interim Measures Work Plan (IMWP)
Radford Army Ammunition Plant (RFAAP), Virginia
January 2011 Final

Comments from Mr. William Geiger, Remediation Project Manager,
United States Environmental Protection Agency Region III,
and Mr. Jim Cutler, Virginia Department of Environmental Quality

General Comments

Comment 1.

Comment: Section 1.2: This section should conclude with the actual selection of the corrective measure objective i.e. residential RG.

Response: The text will be revised as requested, by adding in the selection of a residential remediation goal for lead in the berm.

"Interim Measures will be completed at the target berm where elevated levels of lead were detected during the previous investigation soil will be removed until lead concentrations are below the residential RG of 400 mg/kg. Contamination is not expected in other areas of the site."

Comment 2.

Comment: Section 2.2.3: It is not clear how the berm will be excavated. Will the entire berm be excavated? The first foot? Has a remediation area been defined for the berm or is it the entire berm? How do the terms bottom and sides apply to the berm?

Potential "remediation areas" other than the berm are not discussed in this section. There should be some reference and harmonization with Section 3.

Response: The text will be revised as requested. Additional details regarding the excavation parameters of the berm have been inserted. Excavation and sampling within the additional "remediation areas" has also been further discussed.

"Soil within the 270 ft face and top of the firing berm will be removed in 1-ft lifts and will be screened with the XRF approximately every 20 ft. If lead concentrations are greater than the RG below the excavation, additional 1-ft lifts will be removed until XRF concentrations are below the RG. If the XRF samples collected from the edge of the remediation area contain levels of contaminants above the RG, the sampling area will be expanded outward.

Surface soil within the range floor, potential firing point locations, and the cliff behind the berm will be sampled from 0- to 1-ft and screened with the XRF. If lead concentrations are greater than the RG below the surface samples, 1-ft lifts will be removed until the remediation area contain XRF concentrations are below the RG. If the XRF samples collected from the edge of the remediation area contain levels of contaminants above the RG, the sampling area will be expanded outward. If contamination is determined to extend horizontally or vertically farther than anticipated, soil removal will continue until lead RGs are achieved. All stakeholders will be notified of the changes and modifications needed to complete the IM actions will be documented, as necessary."

Comment 3.

Comment: Section 3.3.1: The text and Table 3-1 indicate that 13 confirmation samples will be collected in the three areas requiring additional characterization. The discussion at the top of page 3-4 (and in section 2.2.3) states that confirmation samples will also be collected in the berm area. Are these in addition to the 13?

Response: Section 3.3.1 and Table 3-1 has been updated to reflect text shown in page 3-4 and Section 2.2.3. Approximately 13 samples will be collected along the berm in 20 foot intervals for laboratory testing IN ADDITION to the proposed 13 samples from the potential firing points, range floor, and behind the berm.

"Berm. **Approximately 13 XRF measurements will be made along the face of the berm. Samples will be collected along the berm in an alternating top-to-bottom pattern until sample lead concentrations are below the proposed r-SL of 400 mg/kg. Additionally, one laboratory confirmation sample will be collected every 20 feet along the face of the berm. The confirmation samples will be analyzed for lead and antimony metals and 50% of the confirmation samples will also be analyzed for target compound list (TCL) volatile organic compounds (VOCs), TCL SVOCs, polynuclear aromatic hydrocarbons (PAHs), TCL pesticides/polychlorinated biphenyls (PCBs), herbicides, and explosives. Because the exact shape and depth of the excavation will be determined in the field, the exact number of samples is not known. As a guide, however, one laboratory sample will be collected from every 20-ft section of the berm. Samples will also be collected from inflection points and/or corners of the excavation."**

Media	Sampling ID	Depth	Location	Analytes
Soil	ARXRF01-90	0-0.5 ft bgs	Potential firing areas and range floor	XRF Lead. A sufficient number of samples will be collected and screened to define the extent of lead in the potential firing areas and range floor soil.
	ARSCF01-09	0-0.5 ft bgs	Random grid samples within potential firing areas and range floor	TCL VOCs, TCL SVOCs, PAHs, TCL pesticides/PCBs, herbicides, explosives, and TAL metals
	ARXRH01-30	0-0.5 ft bgs	Southeast hillside	XRF Arsenic. A sufficient number of samples will be collected and screened to define the extent of arsenic in soil along the southeast hillside.
	ARSCH01-03	0-0.5 ft bgs	Random grid samples within southeast hillside	TCL VOCs, TCL SVOCs, PAHs, TCL pesticides/PCBs, herbicides, explosives, and TAL metals
	ARSBSC01-13	1-2 ft bgs	One berm sample approximately every 20 ft	XRF Lead. TCL Metals. 50% for TCL VOCs, TCL SVOCs, PAHs, TCL pesticides/PCBs, herbicides, explosives
	ARSSCF01	0-0.5 ft bgs	Building debris area	TCLP metals, asbestos
Groundwater	ARGW01	Screened at first encountered water	Proposed upgradient well	TCL VOCs, TCL SVOCs, PAHs, TCL pesticides/PCBs, herbicides, explosives, TAL metals (total and dissolved), and perchlorate
	ARGW02	Screened at first encountered water	Proposed downgradient well	TCL VOCs, TCL SVOCs, PAHs, TCL pesticides/PCBs, herbicides, explosives, TAL metals (total and dissolved), and perchlorate
	ARGW03	Screened at first encountered water	Proposed downgradient well	TCL VOCs, TCL SVOCs, PAHs, TCL pesticides/PCBs, herbicides, explosives, TAL metals (total and dissolved), and perchlorate
Surface Water	ARSW01	na	Upgradient of MRS boundary in Stroubles Creek	TCL VOCs, TCL SVOCs, PAHs, TCL pesticides/PCBs, herbicides, explosives, TAL metals, and perchlorate
	ARSW02	na	Behind berm in Stroubles Creek	TAL metals, explosives, perchlorate
	ARSW03	na	Behind berm in Stroubles Creek	TCL VOCs, TCL SVOCs, PAHs, TCL pesticides/PCBs, herbicides, explosives, TAL metals, and perchlorate
	ARSW04	na	Downgradient Stroubles Creek	TAL metals, explosives, and perchlorate
	ARSW05	na	Downgradient Stroubles Creek	TCL VOCs, TCL SVOCs, PAHs, TCL pesticides/PCBs, herbicides, explosives, TAL metals, and perchlorate
Sediment	ARXSC01-05	na	Stroubles Creek	XRF Lead. Sediment samples will be collected and evaluated for lead in Stroubles Creek.

	ARSD01	na	Upgradient of MRS boundary in Stroubles Creek	TCL VOCs, TCL SVOCs, PAHs, TCL pesticides/PCBs, herbicides, explosives, and TAL metals
	ARSD02	na	Behind berm in Stroubles Creek	TAL metals and explosives
	ARSD03	na	Behind berm in Stroubles Creek	TCL VOCs, TCL SVOCs, PAHs, TCL pesticides/PCBs, herbicides, explosives, and TAL metals
	ARSD04	na	Downgradient Stroubles Creek	TAL metals and explosives

Leahy, Timothy

From: Geiger.William@epamail.epa.gov
Sent: Thursday, December 23, 2010 12:43 PM
To: McKenna, Jim J Mr CIV USA AMC
Cc: Andy Kassoff; Druck, Dennis E Mr CIV USA MEDCOM PHC; Cutler,Jim; Parks, Jeffrey; jeremy.flint@atk.com; jerome.redder@atk.com; Jason Steele; Mendoza, Richard R Mr CIV USA IMCOM; Leahy, Timothy; Meyer, Tom NAB02
Subject: Fw: Small Arms Range work plan

Jim, below are EPA/VDEQ comments on the Small Arms Range IM Workplan. Please call or email us with any questions. Happy Holidays.

William A. Geiger
Remedial Project Manager
Office of Remediation (3LC20)
U.S. Environmental Protection Agency
1650 Arch Street
Philadelphia, PA 19103-2029
Phone: 215.814.3413
Geiger.William@epa.gov

----- Forwarded by William Geiger/R3/USEPA/US on 12/23/2010 12:41 PM -----
From: "Cutler, Jim (DEQ)" <James.Cutler@deq.virginia.gov>
To: William Geiger/R3/USEPA/US@EPA
Date: 12/22/2010 02:35 PM
Subject: Small Arms Range work plan

Will,

I reviewed the Army Reserve Small Arms Range Work Plan and have the following comments:

My general comment is that it is difficult to follow exactly how the characterization/excavation activities are sequenced. It is hard to tell if the discussion refers to the berm, the other potential remediation areas or both.

Section 1.2

This section should conclude with the actual selection of the corrective measure objective i.e. residential RG.

Section 2.2.3

It is not clear how the berm will be excavated. Will the entire berm be excavated? The first foot? Has a remediation area been defined for the berm or is it the entire berm? How do the terms bottom and sides apply to the berm?

Potential "remediation areas" other than the berm are not discussed in this section. There should be some reference and harmonization with Section 3.

Section 3.3.1

The text and Table 3-1 indicate that 13 confirmation samples will be collected in the three areas requiring additional characterization. The discussion at the top of page 3-4 (and in section 2.2.3) states that confirmation samples will also be collected in the berm area. Are these in addition to the 13?

Please contact me if you have any questions.

Thanks,

Jim

James L. Cutler Jr.

Federal Facilities Project Manager

Office of Remediation Programs

Virginia Dept. of Environmental Quality

804-698-4498

ATK Armament Systems
Energetic Systems
Radford Army Ammunition Plant
Route 114, P.O. Box 1
Radford, VA 24143-0100

www.atk.com

July 23, 2010

Mr. William Geiger
RCRA General Operations Branch, Mail Code: 3WC23
Waste and Chemicals Management Division
U. S. Environmental Protection Agency, Region III
1650 Arch Street
Philadelphia, PA 19103-2029

Mr. James L. Cutler, Jr.
Virginia Department of Environmental Quality
629 East Main Street
Richmond, VA 23219

Subject: With Certification, Army Reserve Small Arms Range RCRA Facility Investigation/Interim Measures Work Plan, Draft Document, June 2010
EPA ID# VA1 210020730

Dear Mr. Geiger and Mr. Cutler:

Enclosed is the certification for the subject document that was sent to you on July 19, 2010. Also enclosed is the 19 July 2010 transmittal email.

Please coordinate with and provide any questions or comments to myself at (540) 639-8658, Jerry Redder ATK staff (540) 639-7536 or Jim McKenna, ACO Staff (540) 731-5782.

Sincerely,

P.W. Holt, Environmental Manager
Alliant Techsystems Inc.

c: Karen Sismour
Virginia Department of Environmental Quality
P. O. Box 1105
Richmond, VA 23218

E. A. Lohman
Virginia Department of Environmental Quality
Blue Ridge Regional Office
3019 Peters Creek Road
Roanoke, VA 24019

10-815-106
JMcKenna

Rich Mendoza
U.S. Army Environmental Command
1 Rock Island Arsenal
Attn: IMAE-CDN (Rich Mendoza)
Bldg 350, 3rd Fl, NW Wing, Rm 319
Rock Island, Illinois, 61299

Tom Meyer
Corps of Engineers, Baltimore District
ATTN: CENAB-EN-HM
10 South Howard Street
Baltimore, MD 21201

bc: Administrative File
J. McKenna, ACO Staff
Rob Davie-ACO Staff
P.W. Holt
J. J. Redder
Env. File

Coordination: J. McKenna

Joe Yeakley for M. A. Miano

10-815-106
JMcKenna

Concerning the following:

Radford Army Ammunition Plant
Army Reserve Small Arms Range
RCRA Facility Investigation/Interim Measures Work Plan,
Draft Document, June 2010

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fines and imprisonment for knowing violations.

SIGNATURE: _____
PRINTED NAME: for Antonio Munera
TITLE: LTC, CM
Commanding

SIGNATURE: _____
PRINTED NAME: Kent Holiday
TITLE: Vice President and General Manager
ATK Energetics Systems

10-815-106
JMcKenna

Greene, Anne

From: McKenna, Jim
Sent: Monday, July 19, 2010 2:20 PM
To: Greene, Anne; Cutler,Jim; dennis.druck@us.army.mil; diane.wisbeck@arcadis-us.com; Geiger.William@epamail.epa.gov; Redder, Jerome; jim spencer; Lohman,Elizabeth; Mendoza, Rich; Meyer, Tom NAB02; Parks, Jeffrey N; Sismour,Karen; Timothy.Leahy@shawgrp.com; Tina_MacGillivray@URSCorp.com
Subject: Draft Army Reserve Small Arms Range (UNCLASSIFIED)

Importance: High

Classification: UNCLASSIFIED
Caveats: FOUO

All:

Note the contractor will ship the subject document with a copy of this email to the POCs and tracking numbers below.
Here are the UPS tracking numbers for the Draft Army reserve Small Arms Range (RFAAP-001-R-01) RFI/IM Workplan.

James McKenna 2 Paper copies [previously sent] Will Geiger 1Z63V884 13 9593 7738 3 Paper copy/3 CD Jim Cutler 1Z63V884 13 9795 6124 1 Paper copy/1 CD Tom Meyer 1Z63V884 13 9850 1701 1 Paper copy/1 CD Richard Mendoza 1Z63V884 13 9877 6111 1 Paper copy/1 CD

Thank you for your support of the Radford Army Ammunition Plant Installation Restoration Program.

Jim McKenna
Classification: UNCLASSIFIED
Caveats: FOUO

DEPARTMENT OF THE ARMY
US ARMY PUBLIC HEALTH COMMAND (PROVISIONAL)
5158 BLACKHAWK ROAD
ABERDEEN PROVING GROUND, MD 21010-5403

24 MAY 2010

MCHB-TS-REH

MEMORANDUM FOR Office of Environmental Quality, Radford Army Ammunition Plant (SJMRF-OP-EQ/Mr. Jim McKenna), P.O. Box 2, Radford, VA 24143-0002

SUBJECT: Internal Draft Army Reserve Small Arms Range (RFAAP-001-R-01) RCRA Facility Investigation and Interim Measures Work Plan, Radford Army Ammunition Plant, Virginia, May 2010

1. The US Army Public Health Command (Provisional), formerly the US Army Center for Health Promotion and Preventive Medicine, reviewed the subject document on behalf of the Office of The Surgeon General pursuant to Army Regulation 200-1 (Environmental Protection and Enhancement). We appreciate the opportunity to review the work plan.

2. We have no comments to provide on this document.

3. The document was reviewed by Mr. Dennis Druck, Environmental Health Risk Assessment Program. He can be reached at DSN 584-2953, commercial (410) 436-2953 or electronic mail, dennis.druck@us.army.mil.

FOR THE COMMANDER:

JEFFREY S. KIRKPATRICK
Director, Health Risk Management

CF:
HQDA (DASG-PPM-NC)
IMCOM-NE (IMNE-PWD-E)
USACE (CEHNC-CX-ES)
USAEC (IMAE-CD/Mr. Rich Mendoza)

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The Appendices are Included on a CD Located at the Back of This Report

LIST OF ACRONYMS AND ABBREVIATIONS

°C .....degrees Celsius
°F.....degrees Fahrenheit
ACGIH.....American Conference of Governmental Industrial Hygienists
ARSAR .....Army Reserve Small Arms Range
ATK .....Alliant TechSystems, Inc.
bgs.....below ground surface
CAR .....Corrective Action Request
CCB.....Continuing Calibration Blank
CCV .....Continuing Calibration Verification
CFR.....Code of Federal Regulations
CGI/O_2 .....Combustible Gas Indicator/Oxygen
COC .....Chain-of-Custody
COD .....Chemical Oxygen Demand
COI.....Contaminant of Interest
COPC .....Chemical of Potential Concern
CPR.....Cardiopulmonary Resuscitation
CQC .....Contractor Quality Control
CQCP .....Contractor Quality Control Plan
CRZ.....Contamination Reduction Zone
DoD.....Department of Defense
DOT .....Department of Transportation
DQO.....Data Quality Objective
E&SCP.....Erosion and Sediment Control Plan
ELAP.....Environmental Laboratory Accreditation Program
ENG .....Engineering Form
ERIS.....Environmental Restoration Information System
EZ.....Exclusion Zone
FAR.....Federal Acquisition Regulation
FSP.....Field Sampling Plan
ft .....feet
ft^2.....square feet
GC/MS .....Gas Chromatography/Mass Spectroscopy
GW.....Groundwater
H&S .....Health and Safety
HBV .....Hepatitis B Virus
HIV .....Human Immunodeficiency Virus
HPLC-MS .....High Pressure Liquid Chromatography Mass Spectrometry
HRR .....Historical Records Review
ICP .....Inductively Coupled Plasma
IDLH.....Immediately Dangerous to Life or Health
IDM.....Investigation-Derived Material
IM.....Interim Measures
kV.....kilovolts
LMARC .....Louisville Multiple Award Remediation Contract
LQAP .....Laboratory Quality Assurance Plan
M&TE.....Measuring and Test Equipment
MC .....Munitions Constituents
MCL.....Maximum Contaminant Level
MDL.....Method Detection Limit
MEC.....Munitions and Explosives of Concern
MedEvac .....Medical Evacuation
mg/kg .....milligrams per kilogram
mg/m^3 .....milligrams per cubic meter
mL .....milliliters
MMA.....Main Manufacturing Area
MMRP.....Military Munitions Response Program
MRL.....Method Reporting Limit
MRS .....Munitions Response Site
MS/MSD .....Matrix Spike/Matrix Spike Duplicate
MSDS.....Material Safety Data Sheet

msl.....mean sea level
MWP.....Master Work Plan
NCR.....Nonconformance Report
NIOSH.....National Institute for Occupational Safety and Health
NYDOH.....New York Department of Health
OSHA.....Occupational Safety and Health Administration
OSIC.....On-Scene Incident Commander
OSWER.....Office of Solid Waste and Emergency Response
PAH.....Polynuclear Aromatic Hydrocarbon
PCB.....Polychlorinated Biphenyl
PEL.....Permissible Exposure Limit
PID.....Photoionization Detector
PPE.....Personal Protective Equipment
ppm.....parts per million
PRG.....Preliminary Remedial Goal
QA.....Quality Assurance
QAPP.....Quality Assurance Project Plan
QC.....Quality Control
QL.....Quantitation Limit
QSM.....Quality Systems Manual
RCRA.....Resource Conservation and Recovery Act
RDW.....Remediation-Derived Wastes
RFAAP.....Radford Army Ammunition Plant
RFI.....RCRA Facility Investigation
RG.....Remedial Goal
RMSF.....Rocky Mountain Spotted Fever
r-RG.....Residential Remedial Goal
r-SL.....Residential Screening Level
SED.....Sediment
Shaw.....Shaw Environmental, Inc.
SIM.....Selective Ion Monitoring
SL.....Screening Level
SOP.....Standard Operating Procedure
SSHO.....Site Safety and Health Officer
SSHP.....Site Safety and Health Plan
SSP.....Site Screening Process
STEL.....Short-Term Exposure Limit
SVOC.....Semivolatile Organic Compound
SW.....Surface Water
SZ.....Support Zone
TAL.....Target Analyte List
TCL.....Target Compound List
TCLP.....Toxicity Characteristic Leachate Procedure
TEM.....Threshold Electron Microscope
TLV.....Threshold Limit Value
TSDF.....Treatment, Storage, and Disposal Facility
TWA.....Time-Weighted Average
URS.....URS Corporation
USACE.....U.S. Army Corps of Engineers
USC.....United States Code
USEPA.....U.S. Environmental Protection Agency
UTL.....Upper Tolerance Limit
VAC.....Virginia Administrative Code
VDEQ.....Virginia Department of Environmental Quality
VOC.....Volatile Organic Compound
WTDP.....Waste Transportation and Disposal Plan
XRF.....X-Ray Fluorescence

1.0 INTRODUCTION

Shaw Environmental, Inc. (Shaw) has been contracted by the U.S. Army Corps of Engineers (USACE) to perform Resource Conservation Recovery Act (RCRA) Facility Investigation (RFI) and Interim Measures (IM) activities at the Army Reserve Small Arms Range (ARSAR), at Radford Army Ammunition Plant (RFAAP), Radford, VA. This Work Plan comprises ten sections, as follows:

- Introduction
- Organization and Technical Approach Plan
- Field Sampling Plan (FSP)
- Quality Assurance Project Plan (QAPP)
- Environmental Protection Plan
- Erosion and Sediment Control Plan (E&SCP)
- Waste Transportation and Disposal Plan (WTDP)
- Site Safety and Health Plan (SSHP)
- Contractor Quality Control Plan (CQCP)
- References

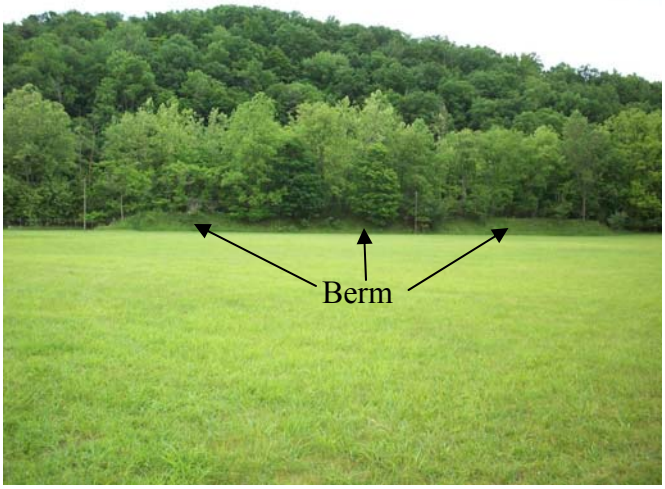
This RFI/IM Work Plan is presented as an addendum to, and incorporates by reference, the elements of the *RFAAP Master Work Plan (MWP)* [URS Corporation (URS), 2003], including Section 8, which discusses entry to the Installation and security concerns and requirements.

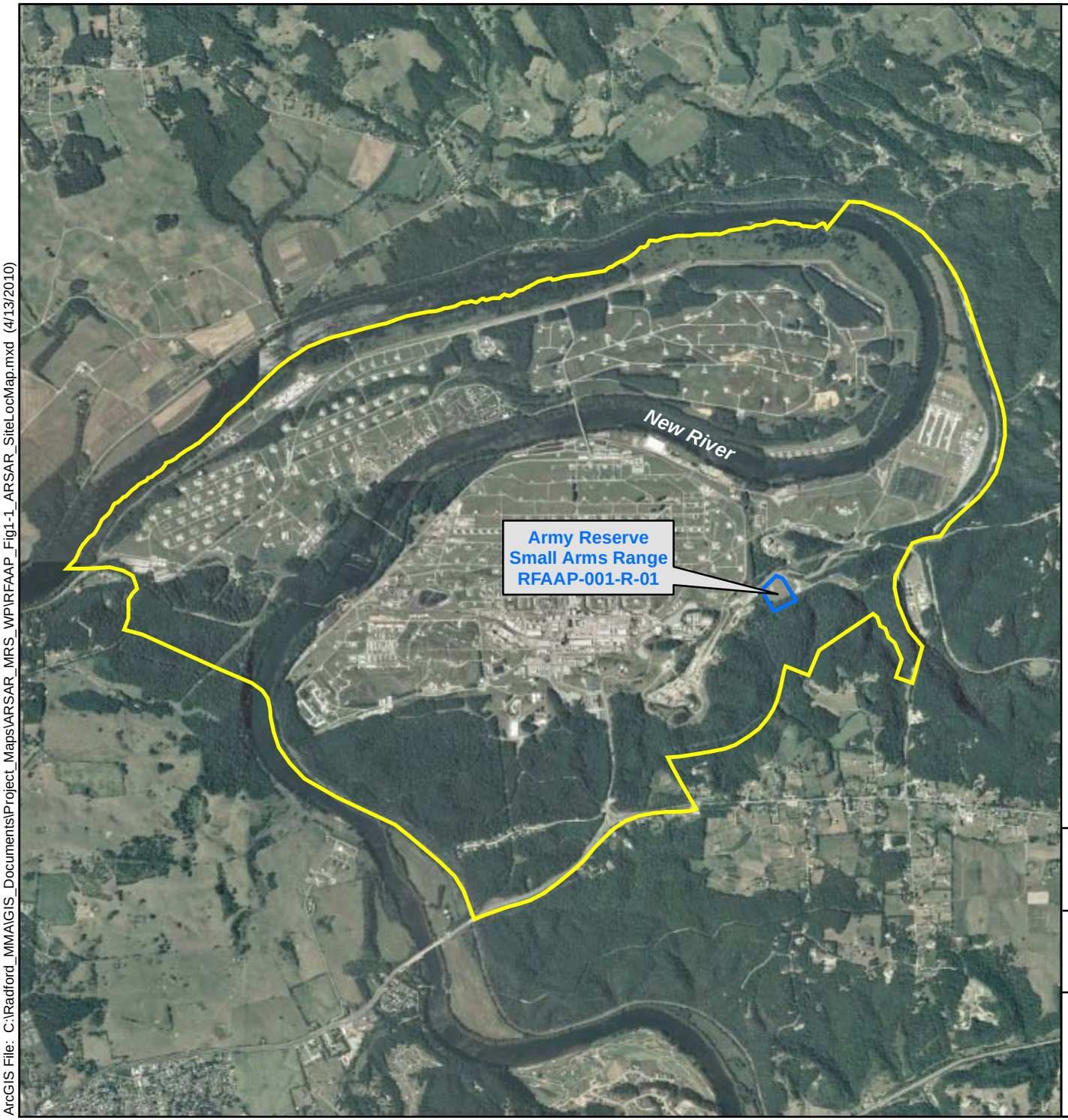
This Work Plan details site-specific procedures for the RFI/IM at the ARSAR. Specifically, this Work Plan addresses the complete characterization of site media and removal of soil in the target berm with concentrations of antimony and lead to below the residential remedial goal (r-RG) in order to facilitate clean closeout in accordance with Part II(D)(11-21) IM of the RFAAP Corrective Action Permit (USEPA, 2000a). This investigation/removal action work is being performed under the Louisville Multiple Award Remediation Contract (LMARC), Contract No. W912QR-04-D-0027, Delivery Order DA04.

1.1 Background

1.1.1 Site Description

The ARSAR is a munitions response site (MRS) being investigated under the Military Munitions Response Program (MMRP). The ARSAR is an approximately 7.6-acre area located along the southeastern boundary of the Main Manufacturing Area (MMA) (**Figure 1-1**). Most of the site is an open grass field with wooded areas located along the banks of Stroubles Creek, which is located along the southern portion of the site. As illustrated on **Figure 1-2**, a target berm that is





LEGEND

MRS Boundary

Installation Boundary

Notes:
1) Aerial photo basemap was obtained from Bing Maps aerial imagery web mapping services, Microsoft, 2009.

N

Scale:

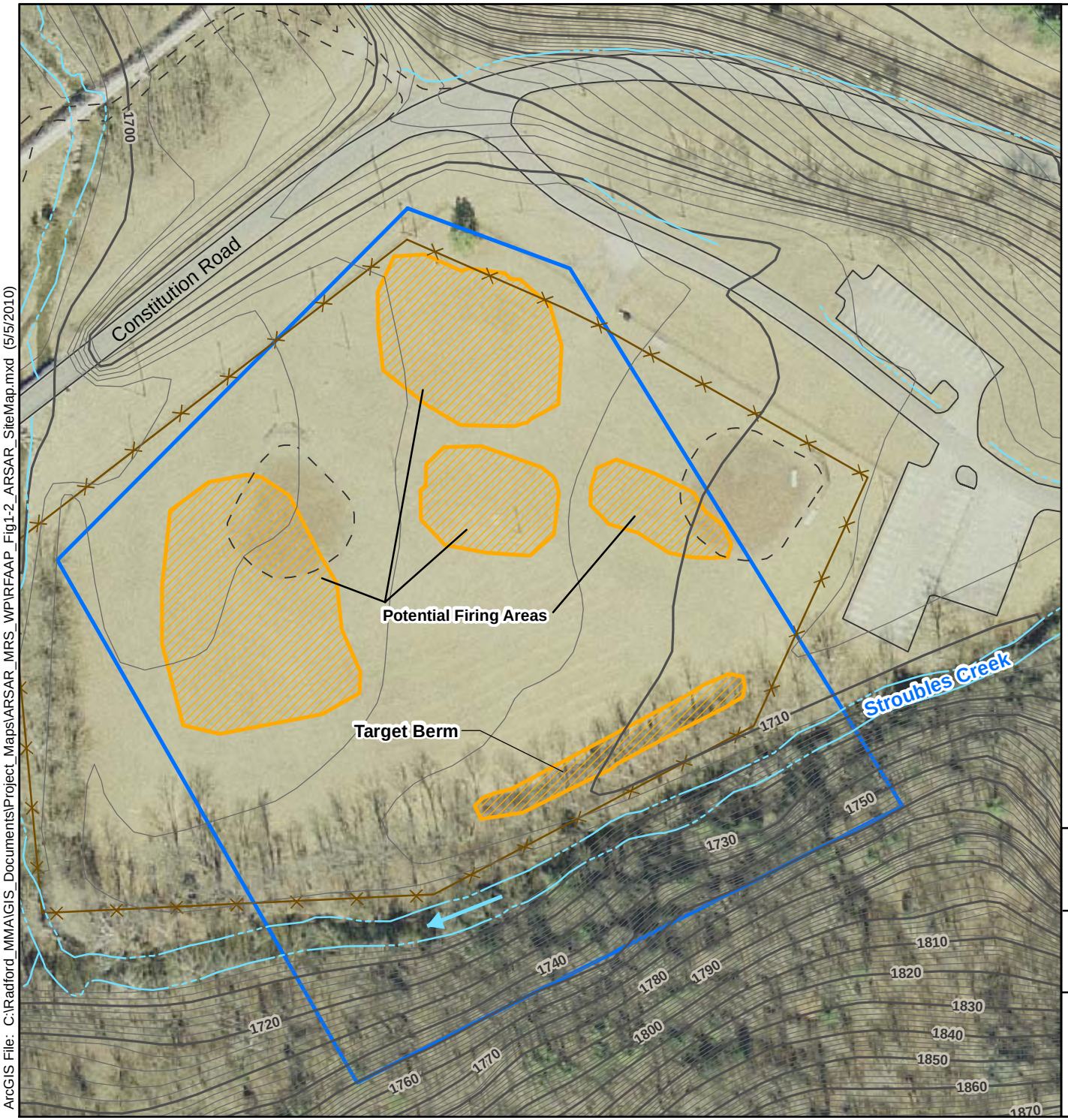
0 1,600 3,200 6,400 Feet

U.S. Army Corps of Engineers

Shaw® Shaw Environmental, Inc.

FIGURE 1-1
Army Reserve Small Arms Range
Site Location Map
Radford Army Ammunition Plant,
Radford, VA

ArcGIS File: C:\Radford_MMA\GIS_Documents\Project_Maps\ARSAR_MRS_WP\RFAAP_Fig1-1_ARSAR_SiteLocMap.mxd (4/13/2010)



ArcGIS File: C:\Radford_MMA\GIS_Documents\Project_Maps\ARSAR_MRS_WP\RFAAP_Fig1-2_ARSAR_SiteMap.mxd (5/5/2010)

LEGEND

- 2 ft Contour Line
- 10 ft Contour Line
- Water Feature
- Surface Water Flow Direction
- Dirt Road
- Paved Road
- Historic Feature
- Fence Line
- MRS Boundary

Notes:
1) Aerial photo, dated 2005, was obtained from Montgomery County Planning, VA Planning & GIS Services.
2) Historic features, MRS boundary, fragment and previous soil sample locations were obtained from Final Site Screening Process Report (URS, 2009).

N

Scale:

0 65 130 260 Feet

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FIGURE 1-2
Army Reserve Small Arms Range
Site Map
Radford Army Ammunition Plant,
Radford, VA

approximately 10 feet (ft) high and 270 ft long, is still present indicating that the direction of fire was to the southeast. Building debris, including pieces of conductive flooring, was observed behind the southeast corner of the berm (URS, 2009).

The site is located within a nearly level alluvial plain at an elevation of approximately 1,715 ft mean sea level (msl) (**Figure 1-2**). The area across Stroubles Creek, to the south, slopes steeply upward to an elevation greater than 1,950 ft msl. It is possible that this hill was used as a backstop before the berm was constructed.

1.1.2 Site History

According to URS (2008), the ARSAR was a .30 caliber small arms firing range used by both the National Guard and the Army Reserve from approximately 1941 to 1968. The closed range consisted of an approximately 10-foot-high berm and four potential firing areas (see **Figure 1-2**). Currently, public access to RFAAP is controlled and includes the former range site although public access may have been possible in the past. The former range is now an unused grass baseball field surrounded by a fence.

The ARSAR was added to RFAAP's RCRA Corrective Action Permit on July 15, 2005.

1.1.3 Site Geology and Hydrogeology

The site area is underlain by Weaver soil, which consists of moderately well drained and deep soil located in nearly level areas within flood plains. This soil has a low to moderate permeability, low to moderate organic content, and it is neutral to moderately alkaline. The Weaver Soil has a high available water capacity and surface runoff is generally slow. A seasonally high water table exists in the soil at a depth of approximately 18 to 30 inches. A typical profile of undisturbed soil consists of a 10-inch-thick surface layer of dark brown silt loam underlain by a 39-inch-thick subsoil of silt loam of variable color. The substratum is dark grey alluvial material consisting of gravel sandy clay loam below approximately 49 inches. Depth to bedrock is greater than 40 inches (URS, 2003).

Soil underlying the hillside across Stroubles Creek is underlain by the Berks-Weikert Complex, which is consists of well-drained soil on moderately steep to steep side slopes. Soils of the Berks-Weikert Complex are extremely to strongly acidic. Permeability ranges from moderate to moderately rapid with high to rapid surface water runoff. The Berks-Weikert Complex typically consists of a surface layer of shaley silt loam underlain by a subsoil of shaley silt loam. Shale bedrock is typically present from 20 to 40 inches (URS, 2003).

Lithology below the site is typically alluvium, consisting of unconsolidated alluvial deposits within the flood plain of Stroubles Creek. Carbonate bedrock of the Cambrian Elbrook formation underlies these alluvial deposits. The Mississippian Price Formation outcrops across Stroubles Creek from the site. This formation consists of mottled red and green shale and mudstone interspersed with brownish-green siltstone and sandstone (URS, 2003).

1.1.4 Surface Water Hydrology

Stroubles Creek is a perennial stream that flows through the southern portion of the ARSAR and then turns northward towards the New River where it discharges approximately 3,000 ft north of the site. The site has no other surface water bodies, manholes, catch basins, or drainage ditches.

It is assumed that overland storm water flow from the site is directed toward Stroubles Creek. In the area of the target berm, runoff from the north side of the berm would flow away from

Stroubles Creek for a short distance north, and then resume flow towards the creek. Surface water on the southern portion of the berm would flow directly towards Stroubles Creek. Due to its location on a flood plain, areas adjacent to Stroubles Creek may experience inundation during periods of high flow and flooding.

1.1.5 Environmental Investigations

There have been two previous investigations at the ARSAR: a Historical Records Review (HRR) by URS in 2008 and a Site Screening Process (SSP), performed by URS in 2009. These investigations are discussed in the following subsections.

Historical Records Review, URS (2008). The HRR Report was completed in 2008 to support the SSP (URS, 2008). The HRR utilized historical records, interviewed on site personnel, aerial photography, existing site maps, and environmental restoration documents to provide information used to identify, verify, and establish physical limits and potential for munitions and explosives of concern (MEC) and munitions constituents (MC) at the ARSAR. The HRR concluded that MEC is not a concern at this site. The field work activities associated with the HRR, however, did indicate the presence of MC.

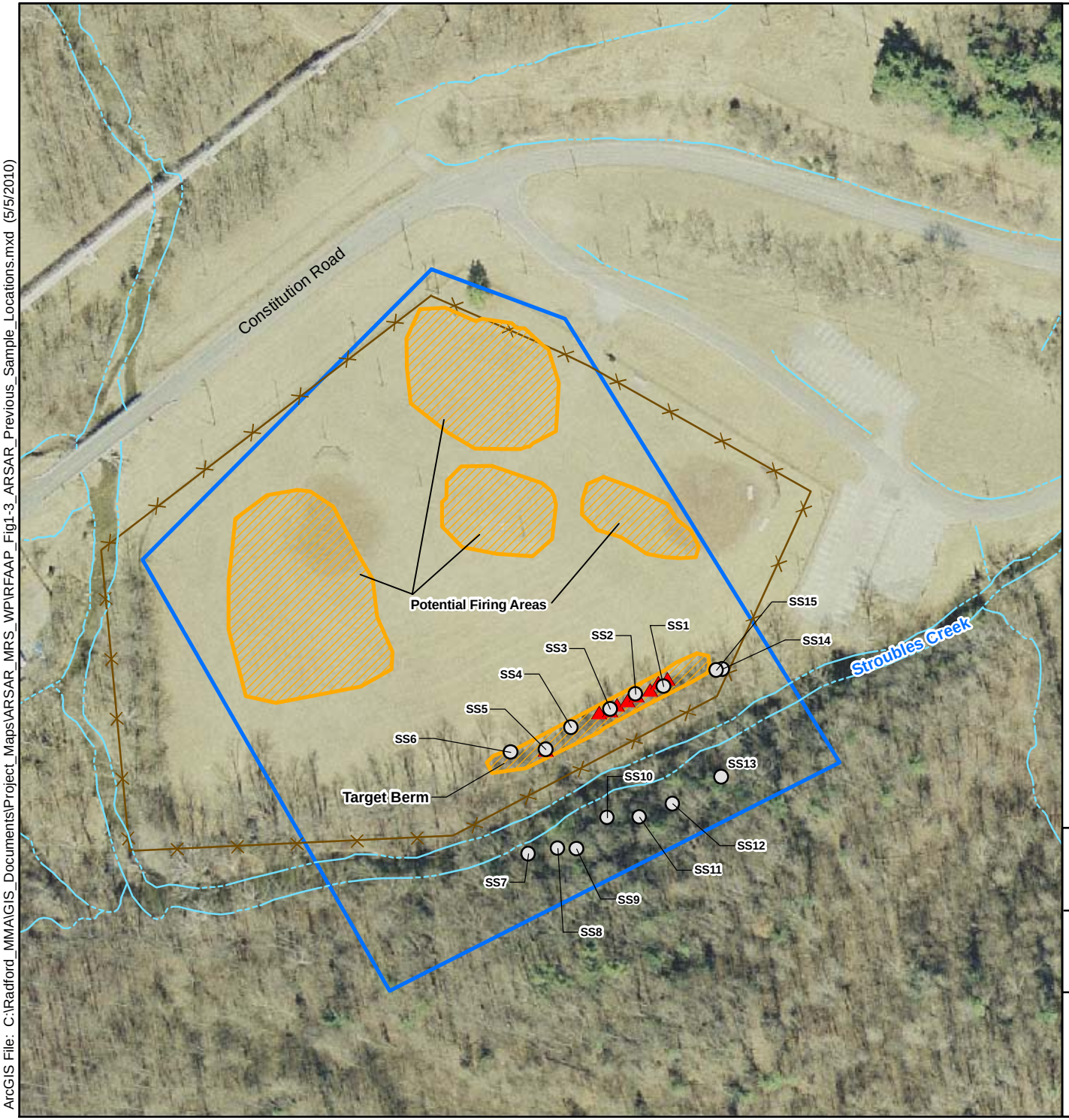
The Final HRR Report was submitted in January 2008 to USACE, Baltimore District, the U.S. Army Environmental Command, RFAAP, the U.S. Environmental Protection Agency (USEPA), and the Virginia Department of Environmental Quality (VDEQ).

Site Screening Process, URS (2009). An SSP was performed by URS in October 2008 to address specific aspects of this project and to describe project-related activities not included in the MWP (URS, 2009). The purpose of the SSP was to assess the presence or absence of MEC and MC that may remain from activities conducted by the Department of Defense (DoD) during the operation of the ARSAR. MEC was not expected at the ARSAR because of its use as only a small arms and pistol firing range. As such, the field sampling activities were developed to investigate MC at the site.

Sampling was conducted using a visual inspection of the berm and hillside, followed by a sweep for potential bullet fragments using a metal detector. Locations where target responses occurred were limited to the berm. Additionally, a shovel was used to dig into the surface soil at the target response locations to investigate whether bullet fragments were present at these locations. Fragments were identified at several locations within the berm at depths of approximately 3 to 4 inches. There were no recordable metal detector responses for the hillside area, indicating that bullets or bullet fragments are not present in the hillside.

Composite soil samples were collected from a depth of 0 to 6 inches within the berm, hillside, and building debris area (**Figure 1-3**). As summarized below, soil samples from the berm and hillside were analyzed for arsenic, antimony, and lead. Samples from the building debris area were analyzed for arsenic, chromium, and lead. Soil sample results are presented in **Table 1-1**.

Sample ID	Location	Analyses
SS1 – SS6	Berm	Arsenic, antimony, lead
SS7 – SS13	Hillside	Arsenic, antimony, lead
SS14 – SS15	Building Debris Area	Arsenic, chromium, lead



LEGEND

- Previous Soil Sample Location
- Fragment Location
- Water Feature
- Fence Line
- Historic Feature
- MRS Boundary

Notes:

1) Aerial photo, dated 2005, was obtained from Montgomery County Planning, VA Planning & GIS Services.
2) Historic features, MRS boundary, fragment and previous soil sample locations were obtained from Final Site Screening Process Report (URS, 2009).

N

Scale:

0 65 130 260 Feet

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FIGURE 1-3
Army Reserve Small Arms Range
Previous Sample Locations
Radford Army Ammunition Plant,
Radford, VA

ArcGIS File: C:\Radford_MMA\GIS_Documents\Project_Maps\ARSAR_MRS_WP\RFAAP_Fig1-3_ARSAR_Previous_Sample_Locations.mxd (5/5/2010)

Table 1-1
Army Reserve Small Arms Range - Detected Soil Results, 2008 SSP

Sample ID	ARSARSS1					DUP-1 (ARSARSS1)					ARSARSS2					ARSARSS3				
Sample Date	10/7/2008		Criteria	MDL	RL	10/7/2008		Criteria	MDL	RL	10/7/2008		Criteria	MDL	RL	10/7/2008		Criteria	MDL	RL
Sample Depth (ft bgs)	0-0.5		Exceeded?			0-0.5		Exceeded?			0-0.5		Exceeded?			0-0.5		Exceeded?		
Constituent	Result	LQ, VQ, r				Result	LQ, VQ, r				Result	LQ, VQ, r				Result	LQ, VQ, r			
Metals (mg/kg)																				
Antimony	7	J,L,m	B,D,E	1.11	11.1	8.98	J,L,m	B,D,E	1.1	11	19.4	L,m	B,D,E	1.18	11.8	24.4	L,m	B,D,E	1.15	11.5
Arsenic	4.22		B,C,D,E	0.443	1.11	3.9		B,C,D,E	0.442	1.1	5.45		B,C,D,E	0.471	1.18	6.01		B,C,D,E	0.462	1.15
Chromium[(1)]	NT					NT					NT					NT				
Lead	319		A,E	0.221	1.11	407		A,B,E	0.221	1.1	1,600		A,B,C,E	0.236	1.18	1,630		A,B,C,E	0.231	1.15

Sample ID	ARSARSS4					ARSARSS5					ARSARSS6					ARSARSS7				
Sample Date	10/7/2008		Criteria	MDL	RL	10/7/2008		Criteria	MDL	RL	10/7/2008		Criteria	MDL	RL	10/8/2008		Criteria	MDL	RL
Sample Depth (ft bgs)	0-0.5		Exceeded?			0-0.5		Exceeded?			0-0.5		Exceeded?			0-0.5		Exceeded?		
Constituent	Result	LQ, VQ, r				Result	LQ, VQ, r				Result	LQ, VQ, r				Result	LQ, VQ, r			
Metals (mg/kg)																				
Antimony	4.47	J,L,m	B,D,E	1.12	11.2	<11.3	U,UL,m		1.13	11.3	3.1	J,L,m	B,D,E	1.14	11.4	1.32	J,L,m	D,E	1.22	12.2
Arsenic	4.56		B,C,D,E	0.447	1.12	4.56		B,C,D,E	0.454	1.13	4.03		B,C,D,E	0.456	1.14	9.59		B,C,D,E	0.488	1.22
Chromium[(1)]	NT					NT					NT					NT				
Lead	400		A,B,E	0.223	1.12	27.1		A,E	0.227	1.13	328		A,E	0.228	1.14	225		A,E	0.244	1.22

Sample ID	ARSARSS8					ARSARSS9					ARSARSS10					ARSARSS11				
Sample Date	10/8/2008		Criteria	MDL	RL	10/8/2008		Criteria	MDL	RL	10/8/2008		Criteria	MDL	RL	10/8/2008		Criteria	MDL	RL
Sample Depth (ft bgs)	0-0.5		Exceeded?			0-0.5		Exceeded?			0-0.5		Exceeded?			0-0.5		Exceeded?		
Constituent	Result	LQ, VQ, r				Result	LQ, VQ, r				Result	LQ, VQ, r				Result	LQ, VQ, r			
Metals (mg/kg)																				
Antimony	<13.3	U,UL,m		1.33	13.3	<13.2	U,UL,m		1.32	13.2	<14.1	U,UL,m		1.41	14.1	<14.5	U,UL,m		1.45	14.5
Arsenic	8.44		B,C,D,E,	0.533	1.33	30.4		A,B,C,D,E	0.53	1.32	25.1		A,B,C,D,E	0.564	1.41	32.6		A,B,C,D,E	0.58	1.45
Chromium[(1)]	NT					NT					NT					NT				
Lead	88.6		A,E	0.266	1.33	95.1		A,E	0.265	1.32	174		A,E	0.282	1.41	104		A,E	0.29	1.45

Sample ID	ARSARSS12					ARSARSS13					ARSARSS14					DUP-2 (ARSARSS14)				
Sample Date	10/8/2008		Criteria	MDL	RL	10/8/2008		Criteria	MDL	RL	10/7/2008		Criteria	MDL	RL	10/7/2008		Criteria	MDL	RL
Sample Depth (ft bgs)	0-0.5		Exceeded?			0-0.5		Exceeded?			0-0.5		Exceeded?			0-0.5		Exceeded?		
Constituent	Result	LQ, VQ, r				Result	LQ, VQ, r				Result	LQ, VQ, r				Result	LQ, VQ, r			
Metals (mg/kg)																				
Antimony	1.32	J,L,m	D,E	1.3	13	<13	U,UL,m		1.3	13	NT					NT				
Arsenic	49.2		A,B,C,D,E	0.519	1.3	37		A,B,C,D,E	0.521	1.3	7.04		B,C,D,E	0.504	1.26	4.65		B,C,D,E	0.504	1.26
Chromium[(1)]	NT					NT					18			0.252	1.26	17.7			0.252	1.26
Lead	138		A,E	0.26	1.3	51.5		A,E	0.26	1.3	55.6		A,E	0.252	1.26	51.6		A,E	0.252	1.26

Sample ID	ARSARSS15				
Sample Date	10/7/2008		Criteria	MDL	RL
Sample Depth (ft bgs)	0-0.5		Exceeded?		
Constituent	Result	LQ, VQ, r			
Metals (mg/kg)					
Antimony	NT				
Arsenic	5.95		B,C,D,E	0.453	1.13
Chromium[(1)]	13			0.227	1.13
Lead	16.6		E	0.227	1.13

SCREENING CRITERIA:

Constituent	CAS #	C/N	A Facility-Wide Background Point Estimate[(A)]	B Adjusted Soil Screening Levels (Residential)	C Adjusted Soil Screening Levels (Industrial)	D Protection of Groundwater Risk-based SSL	E Protection of Groundwater MCL-based SSL
Metals (mg/kg)							
Antimony	7440-36-0	N	-	3.1	41	0.66	0.27
Arsenic	7440-38-2	C	15.8	0.39	1.6	0.0013	0.29
Chromium[(1)]	7440-47-3	C	65.3	280	1,400	9.90E+07	-
Lead	7439-92-1	N	26.8	400	800	-	14

Notes:

CAS = Chemical Abstracts Service
ft bgs = feet below ground surface
mg/kg = milligram per kilogram
MDL = Method Detection Limit
RL = Reporting Limit
LQ = Laboratory Qualifier
VQ = Validation Qualifier
r = Reason Code

NT = Not Tested
- = No Value Available
Screening Levels = USEPA Regional Screening Table (September 2008)
SSL = Site Screening Level 12 September 2008
Adjusted RBCs = a Hazard Quotient (HQ) of 0.1 applied to non-carcinogens
C/N = Carcinogenic/Noncarcinogenic per EPA SSL Table (September 2008)
MCL = Maximum Contaminant Level
(1) = Chromium III Groundwater SSL used
(A) = Facility-Wide Background Point Estimate as Reported in the Facility-Wide Background Study Report (IT, 2001)

Note that all detections are bolded.

Laboratory Qualifiers

J Estimated value
U The compound was analyzed for but not detected. The reporting limit will be adjusted to reflect any dilution, and for soil, the percent moisture.

Validation Qualifiers

L Analyte present. Reported value may be biased low. Actual value is expected to be higher.
UL Not detected, quantitation limit is probably higher.

Reason Codes MS/MSD recovery failure
m

Table adopted from URS, 2009.

Sample results indicated that elevated antimony and lead concentrations were detected in the target berm. Elevated arsenic levels were detected within the hillside area, though no source was identified. Based on the results of the SSP evaluation, further action was recommended at the ARSAR.

1.2 Development of Corrective Measures Objectives

X-ray fluorescence (XRF) soil screening will be performed in uncharacterized areas of the site (i.e., potential firing areas) and in areas where antimony, arsenic, and lead were determined to be present above facility-wide background levels and residential screening levels (r-SLs) during the previous SSP sampling event (see **Table 1-1**). The extent of lead is expected to be the greatest of the chemicals of potential concern (COPCs). Lead will be used as a tracer compound and samples will be screened for lead during excavation activities in the target berm. Once lead concentrations are below the remedial goal (RG), additional samples will be collected for off-site laboratory analysis for target analyte list (TAL) metals and explosives.

The preliminary remedial goals (PRGs) were obtained from USEPA Office of Solid Waste and Emergency Response (OSWER) Directives (USEPA, 1998, 2003), if available. Regional screening levels (SLs) published by EPA in May 2010 were used as conservative PRGs for arsenic and antimony. The published values were then compared with the background values [95% upper tolerance limit (UTL)] and the maximum of the two values was selected as the RG for the analyte. The future land use identified for the ARSAR study area is industrial. However, for comparison purposes in this Work Plan, RGs for both residential and industrial exposure scenarios were developed.

USEPA has published recommended residential and industrial cleanup levels for lead (USEPA, 1998, 2003) in soil, as summarized below:

- Lead:
  - Industrial: 800 milligrams per kilogram (mg/kg)
  - Residential: 400 mg/kg

The background 95% UTL for lead at RFAAP is 26.8 mg/kg (IT, 2001). Therefore, the industrial RG for lead is 800 mg/kg and the r-RG for lead is 400 mg/kg.

USEPA does not have recommended cleanup goals for arsenic, but has established regional SLs for arsenic (USEPA, 2010):

- Arsenic:
  - Industrial: 1.6 mg/kg
  - Residential: 0.39 mg/kg

The background 95% UTL for arsenic at RFAAP is 15.8 mg/kg (IT, 2001). Because the background concentration is higher than the SLs, both the industrial and residential RG for arsenic is 15.8 mg/kg.

USEPA does not have recommended cleanup goals for antimony, but has established regional SLs (USEPA, 2010):

- Antimony:
  - Industrial: 410 mg/kg
  - Residential: 31 mg/kg

The background data set did not have positive detections of antimony to calculate a background level (IT, 2001). Therefore, the industrial RG is 410 mg/kg and the residential RG is 31 mg/kg.

Interim Measures will be completed at the target berm where elevated levels of lead were detected during the previous investigation. Soil will be removed until lead concentrations are below the residential RG of 400 mg/kg. Contamination is not expected in other areas of the site.

1.3 Interim Measures Scope

Based on results from the *Site Screening Process Report, Final Document, May 2009*, IMs are to be performed in the target berm at the ARSAR. The IMs are being conducted to mitigate the threat of a contaminant release, migration, and/or exposure to the public and the environment, as well as facilitate clean closeout in accordance with Part II(D)(11-21) IMs of the *RFAAP Corrective Action Permit* (USEPA, 2000a). The IMs include:

1. **Site Preparation.** Prior to commencement of work, a utility survey will be performed and dig permits will be obtained. In addition, erosion/sediment control measures will be implemented.
2. **Soil Delineation.** Delineation of soil containing antimony and lead above r-RGs.
3. **Soil Excavation.** Excavation of the delineated area such that the remaining soil is below the r-RGs for antimony and lead.
4. **Waste Characterization & Off-Site Disposal.** Samples will be collected to assess appropriate disposal options prior to soil excavation. Sample results will determine the appropriate off-site disposal method.
5. **Site Restoration.** Following the removal of soil, the site will be restored and all equipment will be demobilized.

Specific details on the contractor organization and technical approach for the IM listed above are provided in the Organization and Technical Approach Plan, *Section 2.0*.

1.4 Work Plan Content

This IM Work Plan is composed of an Introduction (*Section 1.0*), eight sub-plans (*Sections 2.0 through 9.0*), and references (*Section 10.0*). The eight sub-plans are as follows:

Section 2 – Organization and Technical Approach Plan

Identifies the Shaw project staff and subcontractors, their roles and responsibilities, and identifies the technical approach to be followed for the IM.

Section 3 – Field Sampling Plan

Describes the sampling rationale and field sampling procedures that will be used to collect field samples.

Section 4 – Quality Assurance Project Plan

Identifies the sample management methods, analytical methods, and quality control (QC) requirements necessary to achieve data quality objectives (DQOs) associated with chemical sampling.

Section 5 – Environmental Protection Plan

Identifies environmental considerations and adequate safeguards to protect the environment during implementation of IM.

Section 6 – Erosion and Sediment Control Plan

Defines the steps that will be taken to minimize and/or eliminate erosion and sedimentation during removal action work.

Section 7 – Waste Transportation and Disposal Plan

Identifies safe handling, transportation, and disposal procedures for waste material resulting from IM.

Section 8 – Site Safety and Health Plan

Provides site-specific safety and health controls to prevent and/or minimize personal injuries, illnesses, and physical damage to equipment and property.

Section 9 – Contractor Quality Control Plan

Defines the contractor QC organization and program for the IM.

1.5 Work Plan Changes

Work outside the scope of this work plan is not to be performed without the approval of the USACE, Baltimore District. Amendments or supplements to this work plan will be submitted in writing to the USACE for approval prior to being implemented by project personnel.

2.0 ORGANIZATION AND TECHNICAL APPROACH PLAN

This section describes the organization and activities to be conducted to accomplish the RFI/IM at the ARSAR. Specifically, this section outlines the organization and responsibilities for project personnel as well as presents the step by step approach to be performed for each of the RFI/IM tasks.

2.1 Organization and Responsibilities

The organizational structure established for this project is depicted on **Figure 2-1** and includes the Shaw management and field staff, and subcontractors. The lines of authority and the lines of communication for the project can be determined from this organizational structure. Communication of project objectives will be provided to project staff through meetings.

Statements of qualifications of key Shaw staff are given in **Appendix A**. Names, addresses, and phone numbers of key Shaw individuals are presented in **Table 2-1**. The duties and responsibilities of the key members of this organization are described below.

Program Manager, Mr. Bob Culbertson, has complete management authority and responsibility for all work performed under the LMARC contract. The Program Manager directs the program management organization as a central resource for management, continuity, and control of all LMARC program activities. The centralized program management is organized to facilitate communication with and reporting to USACE and to expedite and support project execution. The Program Manager has total authority, responsibility, and accountability for managing the contract. He will be involved in the decision-making process and oversight of the management of the project.

RFAAP Project Manager, Mr. Timothy Leahy, PMP, reports to the LMARC Program Manager. He is responsible for ensuring that all activities are conducted in accordance with contractual specifications and technical requirements. The Project Manager will also coordinate with the USACE RFAAP Project Manager. The Project Manager will monitor the budget and schedule to ensure availability of necessary personnel, equipment, subcontractors, and services.

ARSAR RFI/IM Task Manager, Mr. Jeffrey Hillebrand, reports to the RFAAP Project Manager. He is responsible for ensuring that all activities are conducted in accordance with the RFI/IM Work Plan. The IM Task Manager is responsible for management of all operations conducted for this project. He will ensure that all personnel assigned to this project, including subcontractors, have reviewed the technical plans before any task associated with the project is initiated. He will participate in the development of the field program, evaluation of data, and reporting.

ARSAR Project Engineer, Ms. Laura O'Donnell, is responsible for development and/or approval of field procedures and evaluation of applicable or relevant and appropriate requirements for the ARSAR remedial activities.

Health and Safety (H&S) Manager, Mr. Doug Russell, East Region H&S Manager, will oversee the development and implementation of the SSHP to ensure that it meets all specific needs of the project and that appropriate H&S requirements are defined.

Figure 2-1
ARSAR RFI/IM Organizational Chart

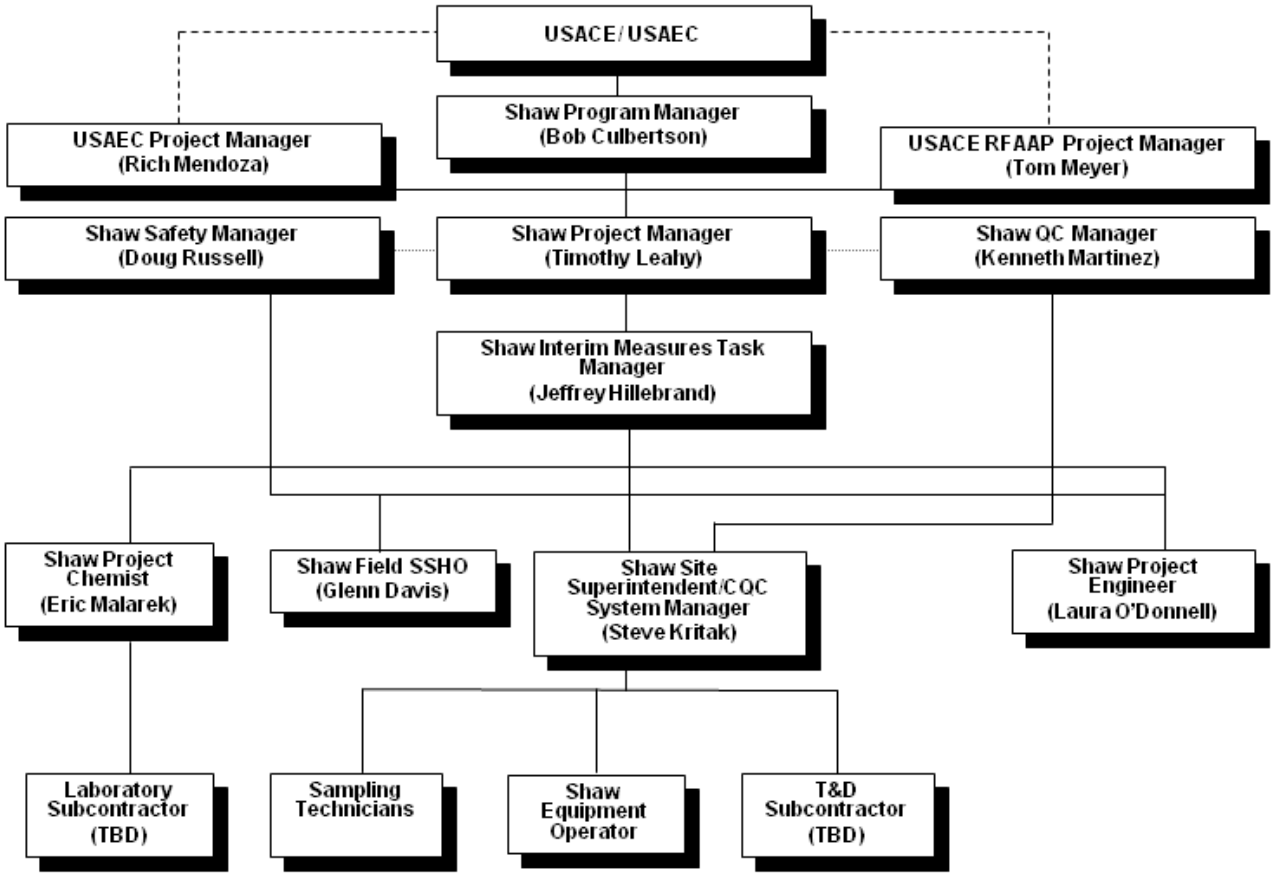


Table 2-1
Shaw Environmental, Inc. and Subcontractor Key Points of Contact

Shaw Environmental, Inc./Subcontractor Personnel	Contact Information
Bob Culbertson Shaw Environmental, Inc. LMARC Program Manager	312 Directors Drive Knoxville, TN 37923 Phone No.: (865) 694-7402 Fax No.: (865) 690-3626 E-Mail: bob.culbertson@shawgrp.com
Timothy Leahy, PMP Shaw Environmental, Inc. RFAAP Project Manager	2113 Emmorton Park Road Edgewood, MD 21040 Phone No.: (410) 612-6332 Fax No.: (410) 612-6351 E-Mail: timothy.leahy@shawgrp.com
Jeffrey Hillebrand Shaw Environmental, Inc. ARSAR RFI/IM Task Manager	2113 Emmorton Park Road Edgewood, MD 21040 Phone No.: (410) 612-6354 Cellular No.: (443) 504-3501 Fax No.: (410) 612-6351 E-Mail: jeffrey.hillebrand@shawgrp.com
Laura O'Donnell Shaw Environmental, Inc. ARSAR Project Engineer	2113 Emmorton Park Road Edgewood, MD 21040 Phone No.: (410) 612-6313 Fax No.: (410) 612-6351 E-Mail: laura.odonnell@shawgrp.com
Doug Russell, OHST Shaw Environmental, Inc. East Region H&S Manager	312 Directors Drive Knoxville, TN 37923 Phone No.: (865) 692-3584 Cellular No.: (865) 414-9545 Fax No.: (865) 690-3626 E-Mail: winston.russell@shawgrp.com
Kenneth Martinez Shaw Environmental, Inc. LMARC QC Manager	312 Directors Drive Knoxville, TN 37923 Phone No.: (865) 670-4799 Fax No.: (865) 694-7497 E-Mail: kenneth.martinez@shawgrp.com
Steve Kritak Shaw Environmental, Inc. Site Superintendent/CQC System Manager	200 Horizon Center Blvd Trenton, NJ 08691-1904 Phone No.: (609) 584-8900 Cellular No.: (540) 922-3316 E-Mail: steve.kritak@shawgrp.com
Glenn Davis Shaw Environmental, Inc. SSHO	1725 Duke Street Alexandria, VA 22314 Phone No.: (804) 247-2108 (cell)
Eric Malarek Shaw Environmental, Inc. Project Chemist	2113 Emmorton Park Road Edgewood, MD 21040 Phone No.: (410) 612-6322 Fax No.: (410) 612-6351 E-Mail: eric.malarek@shawgrp.com

Table 2-1 (Continued)
Shaw Environmental, Inc. and Subcontractor Key Points of Contact

Shaw Environmental, Inc./Subcontractor Personnel	Contact Information
Analytical Laboratory Subcontractor TBD	
Waste Transportation and Disposal Subcontractor TBD	

QC Manager, Mr. Kenneth Martinez, is responsible for ensuring that quality planning is accomplished, QC procedures are available, and a qualified Contractor Quality Control (CQC) System Manager is assigned to the project. The LMARC QC Manager will review and ensure that the CQCP (*Section 9.0*) addresses all project-specific QC needs and that all appropriate QC requirements are addressed. The LMARC QC Manager will also assess the effective implementation of the CQCP through scheduled audits or assessments.

Site Superintendent/CQC System Manager, Mr. Steve Kritak, will be responsible for dual roles during the removal action work: Site Superintendent and CQC System Manager. As Site Superintendent, he will provide on-site management of field activities during removal actions. The Site Superintendent is responsible for coordinating field team activities and meeting schedule deadlines. The Site Superintendent will ensure that the work is being conducted in accordance with this Work Plan. The Site Superintendent will coordinate the initial orientation and safety meeting, as well as the daily safety meeting prior to the start of work each day. As the CQC System Manager, he will be responsible for daily QC oversight of field operations and all aspects of environmental samples. He will be responsible for ensuring that the requirements specified in the CQCP are followed during field activities and will maintain all QC documentation. Additional details on the responsibilities of the CQC System Manager are provided in the CQCP (*Section 9.0*).

Site Safety and Health Officer (SSHO), Mr. Glenn Davis, will be responsible for implementing and oversight of the on-site H&S program and maintaining H&S documentation. He will ensure that an adequate level of personal protection is worn by field personnel for anticipated potential hazards and will work in coordination with the IM Task Manager to ensure compliance of project activities with H&S requirements as outlined in the SSHP. Additional details on the responsibilities of the SSHO are provided in the SSHP (*Section 8.0*).

Project Chemist, Mr. Eric Malarek, will be responsible for sample tracking, data management, laboratory coordination, and data validation activities. The Project Chemist will work with field sampling technicians and the contract laboratory to ensure that the work performed is in accordance with the QAPP (*Section 4.0*).

Equipment Operator. An equipment operator will be utilized to perform the IM work in the field. The equipment operator will be experienced and qualified in operating equipment essential to the project. The equipment operator will be a properly trained Occupational Safety and Health Administration (OSHA) qualified worker.

Field Sampling Technicians. Field sampling technicians will be responsible for collecting all samples associated with the RFI/IM work. These technicians will be under the direction of the Site Superintendent. The technicians will coordinate sampling activities with the Project Chemist who in turn coordinates with the contract laboratory.

Subcontractors. Shaw will procure the following subcontractors: waste transportation and disposal, laboratory support, and clean fill source and transportation.

2.2 Technical Approach

The following sections describe the background and technical approach to the ARSAR RFI/IM. Because the target berm has been previously found to contain elevated levels of lead, the surface of the berm will be removed during the investigation phase. The technical approach below combines elements of the RFI and IMs for ARSAR. The RFI activities include: the investigation of the firing points, the hillside, Stroubles Creek, and site groundwater. The IM activities to be performed include: site preparation; delineation of soil containing antimony, arsenic, and lead above the r-RGs; excavation of the impacted areas such that the remaining soil is below the r-RGs; waste characterization and off-site disposal; and, site restoration. Detailed safety and health requirements for this scope of work are presented in *Section 8.0*.

2.2.1 Background

Investigation activities, including HRR and site screening, were conducted for/at the ARSAR in 2008. The results from these investigations indicated that: 1) MEC is not a concern at this site; 2) MC has not been identified at the site; and, 3) elevated levels of antimony and lead were detected in the target berm and elevated arsenic levels were detected along the southeast hillside area.

The objective of the IM action is to reduce the concentrations of antimony and lead in the berm below the r-RGs of 3.1 and 400 mg/kg, respectively. It is also to facilitate clean closeout in accordance with Part II (D) (11-21) IM of the *RFAAP Corrective Action Permit* (USEPA, 2000a).

2.2.2 Site Preparation

Prior to performing any intrusive activities at the ARSAR, a utility survey to identify underground service lines within or near the excavation site will be performed and dig permits will be obtained from Alliant TechSystems, Inc. (ATK). A hazard analysis has been completed as detailed in *Section 8.0*, and all potential hazards identified will be reviewed prior to commencement of work activities. Erosion and sediment controls will be utilized according to the procedures outlined in *Section 6.0*, as needed. Shaw will spot bathroom facilities on site at the ARSAR, sufficient for the crew size. A nearby water hydrant will be employed to supply water for site activities (decontamination/dust control).

2.2.3 Soil Delineation and Excavation

MEC items are not anticipated to be encountered during field activities at the ARSAR. If a suspected or potential MEC item is discovered, personnel will stop work immediately and direct the other team members to leave the area. USACE and the RFAAP will be contacted to determine the proper course of action.

Prior to mobilization of excavation personnel, composite waste characterization samples will be collected from surface and subsurface locations within the target berm determined during the

SSP field activities to contain elevated levels of antimony and lead (see **Table 1-1**). The receiving facility requires that one composite sample be collected from the waste materials per 1,000 cubic yards of material; it is assumed that one composite soil sample (composited from three locations) will be collected and analyzed for Toxicity Characteristic Leachate Procedure (TCLP) metals, TCLP semivolatile organic compounds (SVOCs), explosives, and RCRA waste characteristics (corrosivity as pH, reactivity, and ignitability) in order to allow direct load-out of soil during excavation activities.

Lead is the primary COPC at the site and has the greatest extent in soil and will be used as a tracer to define the extent of the remediation area. An XRF instrument will be used to obtain field measurements of the lead concentrations in soil as the excavation progresses. The XRF gives real-time measurement of lead concentrations in the field and will allow the delineation and excavation phases to be combined, streamlining the IM process. The XRF will be used to guide the shape and depth of the excavation as it is progressing.

Soil within the 270-ft face and top of the firing berm will be removed in 1-ft lifts and will be screened with the XRF approximately every 20 ft. If lead concentrations are greater than the RG below the excavation, additional 1-ft lifts will be removed until XRF concentrations are below the RG. If the XRF samples collected from the edge of the remediation area contain levels of contaminants above the RG, the sampling area will be expanded outward.

Surface soil within the range floor, potential firing point locations, and the cliff behind the berm will be sampled from 0 to 1 ft and screened with the XRF. If lead concentrations are greater than the RG below the surface samples, 1-ft lifts will be removed until the remediation area contain XRF concentrations below the RG. If the XRF samples collected from the edge of the remediation area contain levels of contaminants above the RG, the sampling area will be expanded outward. If contamination is determined to extend horizontally or vertically farther than anticipated, soil removal will continue until lead RGs are achieved. All stakeholders will be notified of the changes and modifications needed to complete the IM actions will be documented, as necessary.

Prior to the commencement of removal activities, an exploratory trench will be cut through the width of the target berm from the top of the berm to native ground surface. This exploratory trench will be advanced in the area of SSP sample location SS2 and will be the width of the excavator bucket (approximately 3 ft wide). The purpose of the exploratory trench is to visually determine the composition of the berm material (i.e., whether the berm is comprised of just soil or potentially a mixture of soil and rubble).

Excavation will be performed using one 20-Ton excavator (trackhoe). Contaminated soils will be excavated and directly loaded into dump trucks and transported off site. The sides of all excavations in which employees are exposed to danger from moving ground shall be guarded by a support system, sloping or benching of the ground, or other equivalent means. Sloping and benching, if required, will be in accordance with EM 385-1-1. Excavations less than 5 ft below ground surface (bgs) in depth and which a "competent person" examines and determines there to be no potential for cave-in do not require protective systems. EM 385-1-1 defines a "competent person" as "one who can identify existing and predictable hazards in the working environment or working conditions that are dangerous to personnel and who has the authority to take prompt corrective measures to eliminate them." Shaw H&S provides Excavation Competent Person Training, and Shaw will ensure that the Site Superintendent for the project has completed this

training. Excavation work will comply with EM 385-1-1 and 29 Code of Federal Regulations (CFR) 1926 Subpart P – *Excavations*, and Shaw procedure HS307 (Excavation and Trenching). Excavations greater than 4 ft bgs may constitute a confined space. Personnel will not be allowed to enter the excavation if this situation arises. Confirmation sampling will be done from the bucket of the excavator if the excavation is greater than 4 ft bgs.

Geotextile fabric will be used to construct a temporary loading zone on which the trucks will stage while being loaded. The geotextile fabric will extend from the truck to the edge of the excavation zone. The temporary loading zone will be moved as the leading edge of the excavation moves forward. Backfilling will commence after the excavation has been completed and analytical results from the confirmation samples have demonstrated that soil above the RGs has been removed from the site.

Discrete confirmation samples will be collected from the sidewalls of the excavation and analyzed for lead with an XRF instrument. The sampling strategy to be employed is a biased sampling strategy [Standard Operating Procedure (SOP) 30.7] (**Appendix B**). Once lead is shown to be below the RG through XRF sampling, confirmation samples will be collected for off-site laboratory analysis to confirm that all contaminated soils have been removed above the RG.

Confirmation samples for laboratory analysis will be collected from approximately 10% of the XRF sample locations. The confirmation samples will be analyzed for TAL metals and 50% of the confirmation samples will also be analyzed for target compound list (TCL) volatile organic compounds (VOCs), TCL SVOCs, polynuclear aromatic hydrocarbons (PAHs), TCL pesticides/polychlorinated biphenyls (PCBs), herbicides, and explosives. Because the exact shape and depth of the excavation will be determined in the field, the exact number of samples is not known. As a guide, however, one laboratory sample will be collected from every 20-ft section of the berm. Samples will also be collected from inflection points and/or corners of the excavation.

All sampling and excavation equipment will be decontaminated according to the procedures outlined in the SSHP (*Section 8.0*). A decontamination pad will be set up on site for the excavator. The excavator will be decontaminated prior to use, after completion of the excavation phase, and after completion of the project. Decontamination procedures will follow those in SOP 80.1 for a drill rig (**Appendix B**). In addition, a small, temporary decontamination pad will be set up to decontaminate sampling equipment on site. Decontamination water will be pumped out of the pads and containerized in 55-gallon drums.

2.2.4 Waste Characterization and Off-Site Disposal

Samples, as described in *Section 2.2.3,* will be collected from the soil and used to assess the appropriate disposal options for the soil prior to excavation. Composite samples will be collected from the soil, as specified by the receiving facility. Soil will be collected for geotechnical evaluation for the receiving facility, as required. These samples will be collected during the delineation phase, as discussed in *Section 2.2.3*.

As also discussed in *Section 2.2.3*, direct load-out of the soil will be performed. Each waste type generated during this effort shall require a different disposal method based on its waste characterization results. The excavated soil that is classified as a hazardous waste will be disposed in a RCRA Subtitle C Landfill. The excavated soil that is classified as a non-hazardous

waste will be disposed in a RCRA Subtitle D Landfill. The decontamination fluid will be characterized for TAL metals, Chemical Oxygen Demand (COD) and Biological Oxygen Demand, and disposed in the RFAAP wastewater treatment plant, if results are acceptable. Decontamination water that is unable to be disposed of in the wastewater treatment plant will be sprayed onto the backs of soil trucks and disposed with the soil.

Shaw will act as the agent for the Army for treatment and disposal of the wastes. Shaw and the Installation shall select the final disposal facility for the waste based on several factors:

1. Treatment, storage, and disposal facility (TSDF) capacity to accommodate incoming waste.
2. Solicitation of bids using applicable Federal Acquisition Regulations (FARs).
3. Verification of permits and insurance (at time of award).
4. The disposal facility must meet the permit compliance requirements.

The selected TSDF will supply the Army with an independent audit. Contact information for disposal facilities selected for the ARSAR RFI/IM will be presented in **Table 2-1** in subsequent versions of this document, once they have been identified.

2.2.5 Site Restoration

Following removal of the soil above RGs and negative confirmation sample results, site restoration activities will commence. Off-site borrow material will be placed, as necessary, to stabilize the slope. Approximately 6 inches of top soil will then be placed and the area will be graded.

Borrow material will be selected that has physical characteristics consistent with the existing soil at the ARSAR. The borrow material/top soil will be sampled at a rate of 1 sample/1,000 cubic yards (i.e., estimated as one sample from the borrow material, one sample from the top soil) for TCL VOCs, TCL SVOCs, pesticides/PCBs, herbicides, TAL metals, and pH prior to placement. Erosion control measures will be implemented and excavation areas will be seeded.

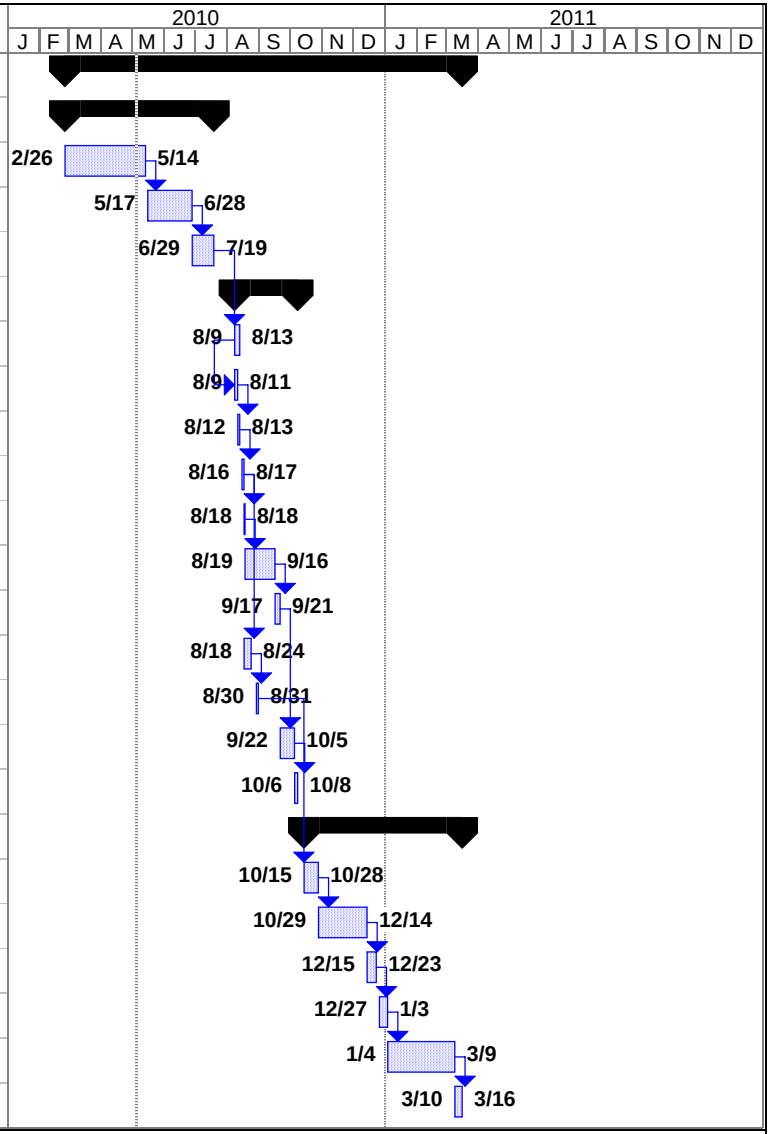
After the site restoration activities are completed, Shaw will demobilize all equipment off site.

2.2.6 Project Schedule

The field activities to be performed as part of the ARSAR RFI/IM are scheduled to commence in June 2010. The proposed schedule of project tasks is provided on **Figure 2-2**.

[NOTE: The project schedule will be updated in each subsequent edition of this work plan and will be updated and maintained throughout the project.]

ID	Task Name	Duration	Start	Finish
1	**Radford - Army Reserve Small Arms Range**	**263 days**	**Fri 2/26/10**	**Wed 3/16/11**
2	**RFI/IM Work Plan**	**100 days**	**Fri 2/26/10**	**Mon 7/19/10**
3	Draft - Work Plan	56 days	Fri 2/26/10	Fri 5/14/10
4	Regulator Review	30 days	Mon 5/17/10	Mon 6/28/10
5	Final Interim Measures Work Plan	14 days	Tue 6/29/10	Mon 7/19/10
6	**Field Work**	**44 days**	**Mon 8/9/10**	**Fri 10/8/10**
7	XRF Sampling on Berm/Hillside	5 days	Mon 8/9/10	Fri 8/13/10
8	Mobe/Site Setup	3 days	Mon 8/9/10	Wed 8/11/10
9	Firing Point Sampling	2 days	Thu 8/12/10	Fri 8/13/10
10	Stroubles Creek Sed/SW Sampling	2 days	Mon 8/16/10	Tue 8/17/10
11	Exploratory Trench through Berm	1 day	Wed 8/18/10	Wed 8/18/10
12	Soil Excavation and Load-out	20 days	Thu 8/19/10	Thu 9/16/10
13	Confirmation Sampling	3 days	Fri 9/17/10	Tue 9/21/10
14	Monitoring Well Installation and Development	5 days	Wed 8/18/10	Tue 8/24/10
15	Monitoring Well Sampling	2 days	Mon 8/30/10	Tue 8/31/10
16	Site Restoration	10 days	Wed 9/22/10	Tue 10/5/10
17	Demobilization	3 days	Wed 10/6/10	Fri 10/8/10
18	**RFI & IM Completion Report**	**102 days**	**Fri 10/15/10**	**Wed 3/16/11**
19	Data Validation	10 days	Fri 10/15/10	Thu 10/28/10
20	Internal Draft - RFI & IM Completion Report	30 days	Fri 10/29/10	Tue 12/14/10
21	USACE/RFAAP Review	7 days	Wed 12/15/10	Thu 12/23/10
22	Draft Interim Action Report	5 days	Mon 12/27/10	Mon 1/3/11
23	Regulator Review	45 days	Tue 1/4/11	Wed 3/9/11
24	Final Interim Action Report	5 days	Thu 3/10/11	Wed 3/16/11



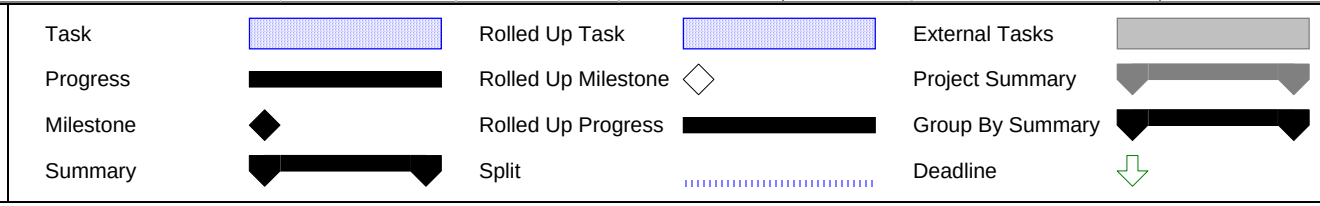


Figure 2-2 Radford - Army Reserve Small Arms Range RFI & IM Schedule

3.0 FIELD SAMPLING PLAN

This FSP describes the RFI/IM sampling activities that will be performed and defines the procedures and methods that will be used to collect field samples. Contents included in this FSP include: procedures for collection of soil characterization, delineation, confirmation, and waste characterization samples; collection of surface water and sediment samples; collection of groundwater samples; and requirements for sample chain-of-custody (COC), documentation, and shipping. This FSP also addresses investigation-derived material (IDM), contractor chemical QC, corrective action procedures, and the schedule for field activities. This FSP was developed in accordance with USACE EM 200-1-3, *Requirements for the Preparation of Sampling and Analysis Plans* (USACE, 2001), and is to be used in conjunction with the QAPP, *Section 4.0*.

3.1 Project Description

A detailed description of the project history and the planned activities has been presented in the Introduction, *Section 1.0*, and the Organization and Technical Approach Plan, *Section 2.0*, of this Work Plan, respectively. As part of the planned removal action work, field sampling activities will be conducted. These field sampling activities are discussed below.

3.2 Project Organization and Responsibilities

A detailed discussion of project personnel organization and responsibilities was previously provided in *Section 2.0*. Coordination of sample collection activities will be the responsibility of the Site Superintendent, who is responsible for running site operations. Field sampling technicians will be responsible for collection and delivery of samples to the laboratory. After delivery, the Project Chemist will be responsible for ensuring proper analysis and timely delivery of sample results by the laboratory.

3.3 Scope and Objectives

Samples to be collected during the RFI/IM work include site soil characterization, delineation, confirmation, and waste characterization samples and surface water, sediment, and groundwater samples. QC samples [i.e., field duplicate samples, rinse blanks, matrix spike/matrix spike duplicate (MS/MSD), etc.] will also be collected as described in the QAPP, *Section 4.0*. The following sections describe the function of each type of field sample. Details on the methods used for collection of the samples are presented in **Appendix B**.

3.3.1 Soil Characterization, Delineation, Confirmation Samples

In order to complete the characterization of the ARSAR, additional sampling is required to fully delineate the extent of antimony, arsenic, and lead in site soil and sample for the previously untested parameter groups (i.e., TCL VOCs, TCL SVOCs, PAHs, TCL pesticides/PCBs, herbicides, explosives, and TAL metals).

Soil Characterization. Soil characterization will be performed through the combination of an on-site portable XRF spectrometer and a fixed-based off-site laboratory. XRF analysis provides a field analytical method for analysis of metals in soil. XRF is capable of detecting lead in soil down to 16 mg/kg and arsenic in soil down to 10 mg/kg. By obtaining real-time data for lead and arsenic concentrations, new sample locations can be guided by results from previous samples. XRF sampling will be conducted in accordance with SOP 30.13, located in **Appendix B**.

Berm. Approximately 13 XRF measurements will be made along the face of the berm. Samples will be collected along the berm in an alternating top-to-bottom pattern until sample lead concentrations are below the proposed r-SL of 400 mg/kg. Additionally, one laboratory confirmation sample will be collected every 20 feet along the face of the berm. The confirmation samples will be analyzed for target compound list (TCL), volatile organic compounds (VOCs), TCL SVOCs, Polynuclear aromatic hydrocarbons (PAHs), TCL pesticides/polychlorinated biphenyls (PCBs), herbicides, and explosives. Because the exact shape and depth of the excavation will be determined in the field, the exact number of samples is not known. As a guide, however, one laboratory sample will be collected from every 20-ft section of the berm. Samples will also be collected from inflection points and/or corners of the excavation.

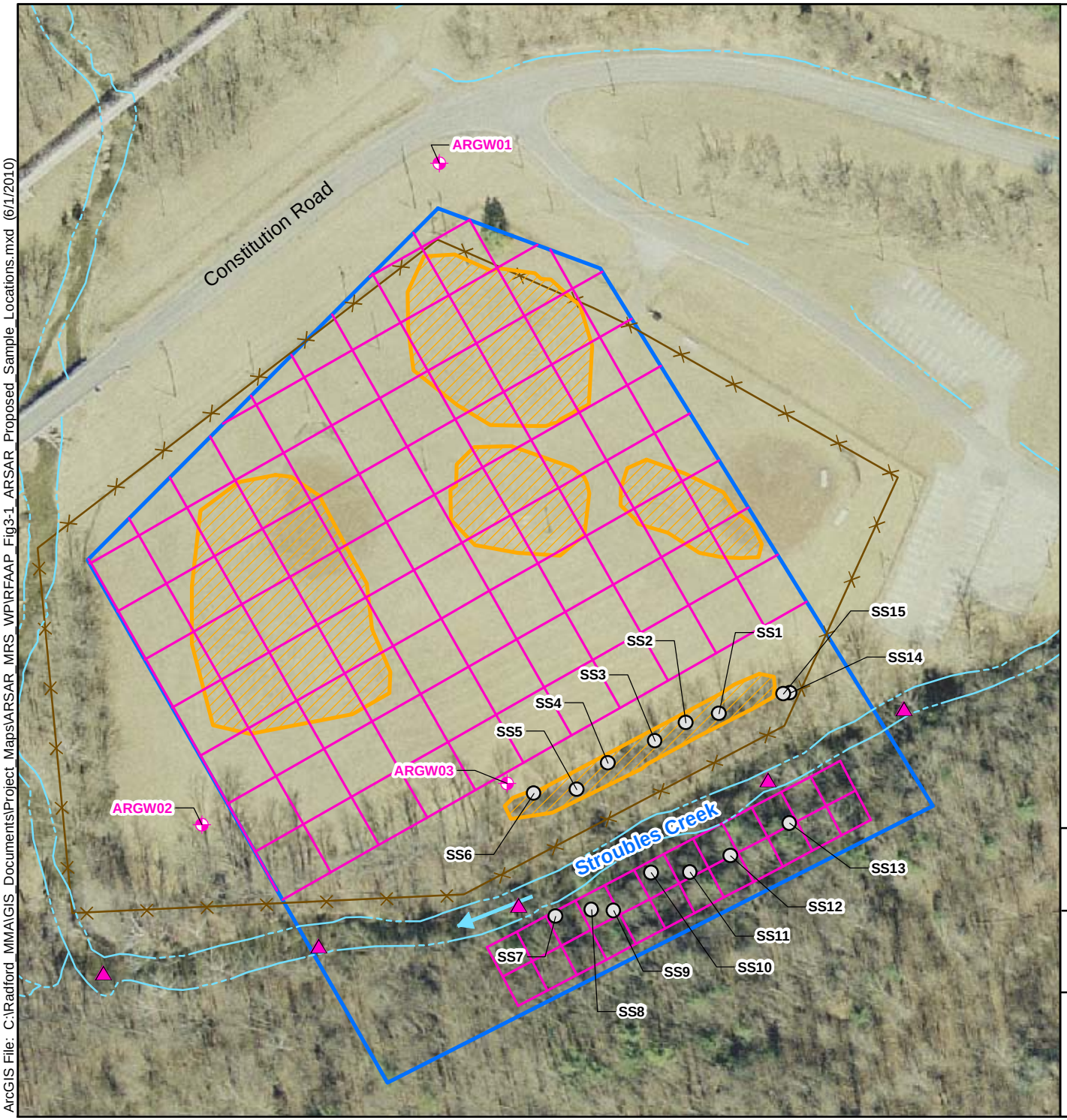
Building Debris Area Behind Berm. As indicated in *Section 1.1.1*, building debris, including pieces of conductive flooring, exists behind the southeast corner of the target berm. Two surface soil samples (SS14 and SS15) were collected in this area during the SSP sampling event in 2008 and analyzed for arsenic, chromium, and lead (see **Figure 1-3**). Soil sample results indicated that none of these metals were detected at concentrations above background concentrations and r-SLs. In addition, a sample of the conductive flooring (ARSS01-TEM) was collected in April 2010 and analyzed by an off-site laboratory for asbestos using NYS Environmental Laboratory Accreditation Program (ELAP) Method 198.4. Sample results indicated that the flooring sample contained only 1.2% total asbestos (chrysotile).

In an effort to fully characterize the soil underlying the construction debris, one surface soil sample (ARSSCF01) will be collected from soil immediately below the building debris and analyzed for TCLP metals and asbestos.

Potential Firing Areas/Range Floor. Approximately 90 XRF measurements will be made in a grid pattern over approximately 5 acres northwest of the target berm (**Figure 3-1**). Samples will be collected, stepping outward along grid lines, until sample concentrations are below the proposed r-SL of 400 mg/kg. It is assumed that approximately 90 XRF samples (ARXRF01-ARXRF90) will be collected along the potential firing areas and range floor to delineate the extent of lead concentrations in soil; however, sampling will continue until the extent of lead is bound.

Once the limits of lead above the r-RG have been defined with the XRF, discrete confirmation samples will be collected and analyzed at a fixed-base laboratory. It is anticipated that nine samples (ARSCF01-ARSCF09) will be sufficient to confirm the XRF results. All confirmation samples will be analyzed for TCL VOCs, TCL SVOCs, PAHs, TCL pesticides/PCBs, herbicides, explosives, and TAL metals. These samples will be collected from randomly picked grid cells in accordance with systematic grid sampling strategy as defined in SOP 30.1 of the MWP (URS, 2003).

Southeast Hillside. Approximately 30 XRF measurements will be made in a grid pattern across the hillside southeast of the target berm (**Figure 3-1**) to delineate elevated arsenic concentrations detected during the SSP (URS, 2009). A 400-ft by 65-ft grid will be superimposed over the site with grid line intersections at approximately 10-ft intervals. Initially, samples will be collected from previous investigation sample locations along the hillside. Samples will be collected, stepping outward along grid lines, until sample concentrations are below the established background value of 15.8 mg/kg (IT, 2002). It is assumed that approximately 30 XRF samples



LEGEND

- Previous Soil Sample Location
- Proposed Direct Push Groundwater Sample Location
- Proposed Creek Sample Location
- Water Feature
- Surface Water Flow Direction
- Proposed XRF Sample Grid
- Fence Line
- Historic Feature
- MRS Boundary

Notes:
1) Aerial photo, dated 2005, was obtained from Montgomery County Planning, VA Planning & GIS Services.
2) Historic features, MRS boundary, fragment and previous soil sample locations were obtained from Final Site Screening Process Report (URS, 2009).

N

Scale:

0 65 130 260 Feet

U.S. Army Corps of Engineers

Shaw® Shaw Environmental, Inc.

FIGURE 3-1
Army Reserve Small Arms Range
Proposed Sample Locations
Radford Army Ammunition Plant,
Radford, VA

ArcGIS File: C:\Radford_MMA\GIS_Documents\Project_Maps\ARSAR_MRS_WP\RFAAP_Fig3-1_ARSAR_Proposed_Sample_Locations.mxd (6/1/2010)

(ARXRH01-ARXRH30) will be collected along the southeast hillside to delineate the extent of arsenic in soil in this area; however, sampling will continue until the extent of arsenic is bound.

Once the limits of arsenic above the established background value have been defined with the XRF, discrete confirmation samples will be collected and analyzed at a fixed-base laboratory. It is anticipated that three samples (ARSCH01-ARSCH03) will be sufficient to confirm the XRF results. All confirmation samples will be analyzed for TCL VOCs, TCL SVOCs, PAHs, TCL pesticides/PCBs, herbicides, explosives, and TAL metals. These samples will be collected from randomly picked grid cells in accordance with systematic grid sampling strategy as defined in SOP 30.1 of the MWP (URS, 2003).

Soil Delineation and Confirmation Sampling. Soil delineation samples will be used to determine the extent of antimony and lead in surface and subsurface soil within the target berm. These samples will be collected during the excavation phase and will also serve as preliminary confirmation samples. Soil delineation samples will be collected from the areas within the berm where contaminants were determined to be present above RGs during the previous SSP sampling event (see **Table 1-1**) and analyzed by an on-site XRF for lead. The extent of lead is expected to be the greatest of the COPCs in the target berm. Lead will be used as a tracer compound and samples will be screened for lead during the excavation. Once lead concentrations are below the r-RG, additional discrete samples will be collected for off-site laboratory analysis for TAL metals for confirmation of the on-site XRF delineation results. Half of these samples will also be analyzed for TCL VOCs, TCL SVOCs, PAHs, TCL pesticides/PCBs, herbicides, and explosives to ensure that untested parameter constituent concentrations are also below r-SLs. Analytical methods to be used for sample analysis are detailed in the QAPP (*Section 4.0*).

3.3.2 Waste and Borrow Characterization Samples

Waste characterization samples will be collected and analyzed to determine the appropriate disposal methods of waste streams resulting from the RFI/IM at the ARSAR. Two types of waste streams will be generated during the RFI/IM: solid (soil) and liquid (decontamination water). In addition, the provider will demonstrate that the borrow material (if necessary) and top soil is clean, and one sample per 1,000 cubic yards or less will be collected and analyzed to confirm that the fill and the top soil is usable at the site.

Soil waste characterization samples will be collected during site delineation to assess the appropriate disposal options for the soil and miscellaneous debris. The samples will be submitted to an ELAP accredited laboratory and analyzed for TCLP metals, TCLP SVOCs, explosives, and RCRA waste characteristics (corrosivity as pH, reactivity, and ignitability). Liquid waste characterization samples from decontamination procedures will be submitted to an ELAP laboratory and analyzed for COD, TAL metals, and pH. The borrow material and top soil will be analyzed for TCL VOCs, TCL SVOCs, TCL pesticides/PCBs, herbicides, TAL metals, and pH. Analytical methods to be used for sample analysis are detailed in the QAPP (*Section 4.0*).

3.3.3 Surface Water/Sediment Samples

Surface water and sediment in Stroubles Creek within the MRS boundary has not previously been characterized. Five surface water/sediment sample pairs (ARSW/SD01-ARSW/SD05) will be collected from Stroubles Creek in order to address this data gap (**Figure 3-1**). Sediment samples will be evaluated for XRF lead, with all five of the sediment and surface water samples

submitted for analysis of TAL metals, explosives, and perchlorate (surface water only). A subset of three of the surface water/sediment sample pairs will also be analyzed for TCL VOCs, TCL SVOCs, PAHs, TCL pesticides/PCBs, and herbicides to characterize these media for these previous untested analyte classes. Water quality conditions will be measured at each surface water collection location using a Horiba U-22 or equivalent and will include temperature, dissolved oxygen, pH, specific conductivity, and turbidity. If turbidity measurements are greater than 10 NTU at any of the proposed surface water collection locations, the proposed surface water sample TAL metals analysis will include total and dissolved fractions.

3.3.4 Groundwater Samples

No groundwater sampling has been performed at the ARSAR. In order to address this data gap, three groundwater samples will be collected with a direct push rig to demonstrate that site soil is not impacting groundwater and assess the presence/absence of groundwater contamination. A shown on (**Figure 3-1**) one sample (ARGW01) will be collected from a perceived upgradient location and two samples (ARGW02 and ARGW03) will be collected from assumed downgradient locations. Local groundwater flow patterns are likely a reflection of surface topography with local discharge occurring at Stroubles Creek, which is a perennial stream that receives its base flow from groundwater discharge. Direct push samples will be analyzed for TCL VOCs, TCL SVOCs, PAHs, TCL pesticides/PCBs, herbicides, explosives, TAL metals (total and dissolved), and perchlorate. Water quality measurements (temperature, dissolved oxygen, pH, specific conductivity, and turbidity) will also be performed on the groundwater samples. Direct push groundwater sampling will be performed in accordance with Section 5.2 and SOP 20.11 of the MWP (URS, 2003).

3.3.5 Anticipated Sampling Program

An overview of the sampling program for the ARSAR RFI/IM is discussed in *Section 2.2*. Samples anticipated for collection during this scope of work include: soil characterization, delineation, confirmation, and waste characterization samples; surface water, sediment, and groundwater samples; and associated QC samples. A list of all anticipated analytical samples, QC samples, and analyses associated with the ARSAR RFI/IM are provided in **Table 3-1**. Analytical methods to be used for sample analysis are detailed in the QAPP (*Section 4.0*). Additional samples and/or analyses may be required depending on site conditions and specific disposal facility requirements. If required, this plan will be modified to include any additional analyses.

Table 3-1
Anticipated Sampling Program for the ARSAR RFI/IM

Media	Sampling ID	Depth	Location	Analytes
Soil	ARXRF01-90	0-0.5 ft bgs	Potential firing areas and range floor	XRF Lead. A sufficient number of samples will be collected and screened to define the extent of lead in the potential firing areas and range floor soil.
	ARSCF01-09	0-0.5 ft bgs	Random grid samples within potential firing areas and range floor	TCL VOCs, TCL SVOCs, PAHs, TCL pesticides/PCBs, herbicides, explosives, and TAL metals
	ARXRH01-30	0-0.5 ft bgs	Southeast hillside	XRF Arsenic. A sufficient number of samples will be collected and screened to define the extent of arsenic in soil along the southeast hillside.
	ARSCH01-03	0-0.5 ft bgs	Random grid samples within southeast hillside	TCL VOCs, TCL SVOCs, PAHs, TCL pesticides/PCBs, herbicides, explosives, and TAL metals
	ARSBSC01-13	1-2 ft bgs	One berm sample approximately every 20 ft	XRF Lead. TCL Metals. 50% for TCL VOCs, TCL SVOCs, PAHs, TCL pesticides/PCBs, herbicides, explosives
	ARSSCF01	0-0.5 ft bgs	Building debris area	TCLP metals, asbestos
Groundwater	ARGW01	Screened at first encountered water	Proposed upgradient well	TCL VOCs, TCL SVOCs, PAHs, TCL pesticides/PCBs, herbicides, explosives, TAL metals (total and dissolved), and perchlorate
	ARGW02	Screened at first encountered water	Proposed downgradient well	TCL VOCs, TCL SVOCs, PAHs, TCL pesticides/PCBs, herbicides, explosives, TAL metals (total and dissolved), and perchlorate
	ARGW03	Screened at first encountered water	Proposed downgradient well	TCL VOCs, TCL SVOCs, PAHs, TCL pesticides/PCBs, herbicides, explosives, TAL metals (total and dissolved), and perchlorate
Surface Water	ARSW01	na	Upgradient of MRS boundary in Stroubles Creek	TCL VOCs, TCL SVOCs, PAHs, TCL pesticides/PCBs, herbicides, explosives, TAL metals, and perchlorate
	ARSW02	na	Behind berm in Stroubles Creek	TAL metals, explosives, perchlorate
	ARSW03	na	Behind berm in Stroubles Creek	TCL VOCs, TCL SVOCs, PAHs, TCL pesticides/PCBs, herbicides, explosives, TAL metals, and perchlorate
	ARSW04	na	Downgradient Stroubles Creek	TAL metals, explosives, and perchlorate
	ARSW05	na	Downgradient Stroubles Creek	TCL VOCs, TCL SVOCs, PAHs, TCL pesticides/PCBs, herbicides, explosives, TAL metals, and perchlorate

Table 3-1 (Continued)
Anticipated Sampling Program for the ARSAR RFI/IM

Media	Sampling ID	Depth	Location	Analytes
Sediment	ARXSC01-05	na	Stroubles Creek	XRF Lead. Sediment samples will be collected and evaluated for lead in Stroubles Creek.
	ARSD01	na	Upgradient of MRS boundary in Stroubles Creek	TCL VOCs, TCL SVOCs, PAHs, TCL pesticides/PCBs, herbicides, explosives, and TAL metals
	ARSD02	na	Behind berm in Stroubles Creek	TAL metals and explosives
	ARSD03	na	Behind berm in Stroubles Creek	TCL VOCs, TCL SVOCs, PAHs, TCL pesticides/PCBs, herbicides, explosives, and TAL metals
	ARSD04	na	Downgradient Stroubles Creek	TAL metals and explosives
	ARSD05	na	Downgradient Stroubles Creek	TCL VOCs, TCL SVOCs, PAHs, TCL pesticides/PCBs, herbicides, explosives, and TAL metals
Waste and Borrow Material	ARDW01	na	Composite of waste soil	TCLP metals, TCLP SVOCs, explosives, and RCRA waste characteristics (corrosivity as pH, reactivity, and ignitability)
	ARDW02	na	Composite of aqueous IDM	COD, TAL metals, and pH
	ARDW03	na	Composite of clean top soil	TCL VOCs, TCL SVOCs, TCL pesticides/PCBs, herbicides, TAL metals, and pH
	ARDW04	na	Composite of clean fill, if necessary	TCL VOCs, TCL SVOCs, TCL pesticides/PCBs, herbicides, TAL metals, and pH

Notes:

1) MS/MSD and rinse blank samples will be collected at a frequency of 5% of the total environmental sample volume (not applicable for waste/borrow, asbestos, or XRF analysis).

2) Blind duplicate samples will be collected at a frequency of 10% of the total environmental sample volume (not applicable for waste/borrow, asbestos, or XRF analysis).

4.0 QUALITY ASSURANCE PROJECT PLAN

This QAPP describes the policy, organization, functional activities, analytical methods, and quality assurance (QA) and QC protocols necessary to achieve the project DQO. This QAPP was developed in accordance with USACE *EM 200-1-3, Requirements for the Preparation of Sampling and Analysis Plans* (USACE, 2001) and is to be used in conjunction with the FSP, *Section 3.0.*

4.1 Project Description

A detailed description of the project history and the planned IM work is presented in the Introduction (*Section 1.0*) and the Organization and Technical Approach Plan (*Section 2.0*) of this Work Plan, respectively. As part of the planned RFI/IM work, field sampling and analysis activities will be conducted. This QAPP, in conjunction with the FSP (*Section 3.0*), describes the sampling and analysis requirements to ensure DQOs are met.

4.2 Project Organization and Responsibilities

A detailed discussion of project personnel organization and responsibilities has been presented in the Organization and Technical Approach Plan, *Section 2.0*. Coordination of sample collection activities will be the responsibility of the Site Superintendent, who is responsible for running site operations. Field sampling technicians will be responsible for collection and delivery of samples to the laboratory. After delivery, the Project Chemist will be responsible for ensuring proper analytical analysis and timely delivery of sample results by the contract laboratory according to the project Statement of Work and QAPP requirements.

The contract laboratory that will be used to support the RFI/IM work at the ARSAR has yet to be determined. A copy of the subcontractor's Laboratory Quality Assurance Plan (LQAP) will be presented in **Appendix C** upon award.

4.3 Data Quality Objectives

Quality assurance is defined as the overall system of activities for assuring the reliability of data produced. The system integrates the quality planning, assessment, and corrective actions of various groups in the organization to provide the independent QA program necessary to establish and maintain an effective system for collection and analysis of environmental samples and related activities. The program encompasses the generation of complete data with its subsequent review, validation, and documentation.

The overall QA objective is to develop and implement procedures for sample and data collection, evaluation, and reporting that will allow reviewers to determine whether the field and laboratory procedures meet the criteria and endpoints established in the DQOs. DQOs are qualitative and quantitative statements that outline the decision-making process and specify the data required to support corrective actions. DQOs specify the level of uncertainty that will be accepted in results derived from environmental data. *Guidance for the DQO Process* (USEPA, 1994a), *USEPA DQO Process for Hazardous Waste Site Investigations EPA QA/G-4HW* (USEPA, 2000b), and the *DoD Quality Systems Manual (QSM), Version 4.1* (DoD, 2009) formed the basis for the DQO process and development of RFAAP data quality criteria and performance specifications. The DQO process consists of the seven steps specified below. Each phase is broken out in the following DQO elements. DQO elements are included in italics following each process step. Project-specific DQOs may be found in **Table 4-1** for the ARSAR RFI/IM.

1. **State the Problem:** Define the problem to focus the study. Specific activities conducted during this process step include 1) the identification of the planning team, 2) primary decision-maker, 3) statement of the problem, and 4) available resources and relevant deadlines.

   (1) The planning team consists of representatives from the VDEQ, USEPA, USACE, U.S. Army Environmental Command, and RFAAP.
   (2) The Army is the primary decision-maker.
   *(3) Refer to **Table 4-1**.*
   (4) Resource specifications are contained in the RFAAP ARSAR RFI/IM Work Plan. The period of performance for this project is approximately 18 months.

2. **Identify the Decision:** Define the decision statement that the study will attempt to resolve. Activities conducted during this step of the process involve 1) identification of the principal study question and 2) definition of resultant alternative actions.

   (1) What is the extent and characteristics of the antimony, arsenic, and lead contaminated soil at the ARSAR and does the soil exceed set RGs? If the impacted areas are above cleanup levels, the soil will be removed and replaced with clean fill/top soil, as necessary. What is the characterization to fill data gaps of previously uncharacterized areas for surface water (SW), sediment (SED), and groundwater (GW) at the site?
   (2) Resultant alternative actions include:
      (2a) Further determine extent of contaminated soil for removal. Further SW/SED/GW characterization is required to fill the data gaps.
      (2b) The extent of soil contamination and SW/SED/GW data gaps have been determined.

3. **Identify Inputs to the Decision:** Identify information inputs required to resolve the decision statement and which inputs require environmental measurements. This step of the process includes 1) identification of the data that will be required to make the decision, 2) information source determination, 3) identification of data required for study action level goals, and 4) confirmation of appropriate field sampling and analytical methods.

   *(1) Refer to **Table 4-1**.*
   (2) Samples for the soil delineation, soil confirmation, SW/SED/GW characterization, and waste and borrow characterization will be analyzed using USEPA SW-846 Update IV, DoD Perchlorate Handbook, Revision 1, Change 1 (DoD, 2007), New York Department of Health (NYDOH) ELAP198.4, and USEPA Methods of Chemical Analysis of Water and Wastes methodology. Refer to Section 4.7.
   (3) The removal action RGs for the ARSAR are identified and will be evaluated against unrestricted use criteria (background and/or r-RGs), disposal facility permit levels, and/or USEPA disposal criteria (40 CFR 261.24, 40 CFR 761.50, & USEPA SW-846 Chapter 7).
   (4) Field sampling will be performed in accordance with the RFAAP ARSAR RFI/IM Work Plan. Refer to Section 3.0.

Table 4-1
Specific Data Quality Objectives for the ARSAR RFI/IM

DQO Elements		Soil Characterization Sampling and Analysis	Pre-Excavation Soil Delineation Sampling and Analysis	Post-Excavation Soil Confirmation Sampling and Analysis	Surface Water / Sediment Characterization Sampling and Analysis	Groundwater Characterization Sampling and Analysis	Waste Characterization Sampling and Analysis	Borrow/Top Soil Characterization Sampling and Analysis
PROBLEM STATEMENT	PROBLEM AND OBJECTIVES	Characterize previously uncharacterized areas and media at the site	Delineate antimony and lead contaminated soil in the target berm to determine if a soil removal is warranted.	Confirm all antimony and lead contaminated soil has been removed from the target berm.	Characterize previously uncharacterized areas and media at the site	Characterize previously uncharacterized areas and media at the site	Waste characterization for disposal.	Confirm borrow soil and top soil is suitable for fill.
DECISION INPUTS	CHEMICAL DATA	XRF arsenic (Southeast Hillside) and XRF lead (Potential Firing Areas and Range Floor) will be analyzed on site to provide near time characterization data. Discrete samples will be collected and analyzed off-site for TCL VOCs, TCL SVOCs, PAHs, TCL pesticides/PCBs, herbicides, explosives, and TAL metals to characterize previously uncharacterized areas and media at the site. To characterize the soil under the construction debris, a soil sample will be collected from immediately below the building debris area and analyzed for TCLP metals and asbestos. The field SOPs may be found in **Appendix B**.	Discrete soil samples will be collected from the target berm determined during the SSP as containing antimony (Sb) and lead (Pb) above remedial goals (RGs). Pb will be analyzed on site by XRF to provide near time delineation data. The field SOPs may be found in **Appendix B**.	Discrete confirmation soil samples will be collected and analyzed off site for TAL metals at the excavation boundaries where found to be fully delineated below RGs. In addition 50% of the samples will be analyzed off-site for TCL VOCs, TCL SVOCs, PAHs, TCL pesticides/ PCBs, herbicides, explosives to fully characterize the bermed area. Field SOPs may be found in **Appendix B**.	XRF lead (Stroubles Creek) will be analyzed on site to provide near time characterization data. All sediment and surface water samples (5) will be analyzed for TAL metals, explosives, and perchlorate (SW only). A subset of 3 of the SW/SED samples will also be analyzed off site for TCL VOCs, TCL SVOCs, PAHs, TCL pesticides/PCBs, and herbicides to characterize previously uncharacterized areas and media at the site. Water quality measurements (temperature, dissolved oxygen, pH, specific conductivity, and turbidity) will also be performed on the surface water. The field SOPs may be found in **Appendix B**.	Direct push ground water samples will be analyzed for TCL VOCs, TCL SVOCs, PAHs, TCL pesticides/PCBs, herbicides, explosives, TAL metals (total and dissolved), and perchlorate to characterize previously uncharacterized areas and media at the site. Water quality measurements (temperature, dissolved oxygen, pH, specific conductivity, and turbidity) will also be performed on the groundwater. The field SOPs may be found in **Appendix B**.	Discrete waste characterization samples will be collected and analyzed off site. The soil samples will be analyzed for TCLP metals, TCLP SVOCs, explosives, and RCRA waste characteristics (corrosivity as pH, reactivity, and ignitability). Decontamination water will be analyzed for COD, TAL metals, and pH. Field SOPs may be found in **Appendix B**.	Discrete characterization samples will be collected for borrow material and top soil, as necessary, prior to placement and analyzed off site for TCL VOCs, TCL SVOCs, TCL pesticides/PCBs, herbicides, TAL metals, and pH. Field SOPs may be found in **Appendix B**.
	PHYSICAL DATA	Map locations for all sample locations will be generated.	NA	Map locations for all sample locations will be generated.	Map locations for all sample locations will be generated.	Map locations for all sample locations will be generated.	NA	NA
	SAMPLING METHOD	Environmental, biased, grab, and intrusive.	Environmental, biased, grab, and intrusive.	Environmental, biased, grab, and non-intrusive.	Environmental, biased, grab, and intrusive.	Environmental, biased, grab, and intrusive.	Environmental, biased, grab and non-intrusive.	Environmental, grab and non-intrusive.
	DATA USE	RFI	Interim Measures	Interim Measures	RFI	RFI	Waste Characterization	Interim Measures
	VALIDATION DATA LEVEL	Full Validation for non-XRF data (USEPA Region III)	No Validation	Full Validation (USEPA Region III)	Full Validation for non-XRF data (USEPA Region III)	Full Validation (USEPA Region III)	Limited Validation	Full Validation (USEPA Region III)

Table 4-1 (Continued)
Specific Data Quality Objectives for the ARSAR RFI/IM

DQO Elements		Soil Characterization Sampling and Analysis	Pre-Excavation Soil Delineation Sampling and Analysis	Post-Excavation Soil Confirmation Sampling and Analysis	Surface Water / Sediment Characterization Sampling and Analysis	Groundwater Characterization Sampling and Analysis	Waste Characterization Sampling and Analysis	Borrow/Top Soil Characterization Sampling and Analysis
DECISION INPUTS (CONT'D.)	ANALYTICAL METHOD	On-Site Chemical Data (USEPA SW-846): XRF lead and arsenic: 6200 Off-Site Chemical Data (USEPA SW-846 and NYDOH ELAP): TAL metals: 3050B/6010B/7471A TCL VOCs: 5035A/8260B TCL SVOCs: 3550C/8270C PAHs: 3550C/8270C SIM TCL Pesticides & PCBs: 3550C/8081A/8082 Herbicides: 8151A Explosives: 8330B Asbestos: NY ELAP Method 198.4 (Solid)	On-Site Chemical Data (USEPA SW-846): XRF lead: 6200	Off-Site Chemical Data (USEPA SW-846): TAL metals: 3050B/6010B/7471A TCL VOCs: 5035A/8260B TCL SVOCs: 3550C/8270C PAHs: 3550C/8270C SIM TCL Pesticides & PCBs: 3550C/8081A/8082 Herbicides: 8151A Explosives: 8330B	On-Site Chemical Data (USEPA SW-846 and MCAWW): XRF lead: 6200 Water Quality Parameters (SW only): temperature (170.1), dissolved oxygen (360.1), pH (150.1), specific conductivity (120.1), and turbidity (180.1). Off-Site Chemical Data (USEPA SW-846): TAL metals: 3010A/3050B/6010B/7470A/7471A TCL VOCs: 5030B/5035/8260B TCL SVOCs: 3510C/3550C/8270C PAHs: 3510C/3550C/8270C SIM TCL Pesticides & PCBs: 3510C/3550C/8081A/8082 Herbicides: 8151A Explosives: 8330B Perchlorate (SW only): 6850	On-Site Chemical Data (MCAWW): Water Quality Parameters: temperature (170.1), dissolved oxygen (360.1), pH (150.1), specific conductivity (120.1), and turbidity (180.1). Off-Site Chemical Data (USEPA SW-846): TAL metals: 3010A/6010B/7470A TCL VOCs: 5030B/8260B TCL SVOCs: 3510C/8270C PAHs: 3510C/8270C SIM TCL Pesticides & PCBs: 3510C/8081A/8082 Herbicides: 8151A Explosives: 8330B Perchlorate: 6850	Off-Site Chemical Data (USEPA SW-846) TCLP Metals: 1311/3010A/6010B/7470A TCLP SVOCs: 1311/3510C/8270C Explosives: 8330B Corrosivity as pH and pH: 9045D (Soil) & 9040C (Aq.) Ignitability: 1030 (Soil) Reactivity (CN & H2S): 9012B/9014/9030B (Soil) TAL Metals: 3010A/6010B/7470A (Aq.) COD: EPA 410.4 (Aq.)	Off-Site Chemical Data (USEPA SW-846) TAL metals: 3050B/6010B/7471A TCL VOCs: 5035A/8260B TCL SVOCs: 3550C/8270C TCL Pesticides & PCBs: 3550C/8081A/8082 Herbicides: 8151A pH: 9045D
	METHOD QUANTITA-TION LIMIT	Refer to **Table 4-2**.	Refer to **Table 4-2**.	Refer to **Table 4-2**.	Refer to **Table 4-2**.	Refer to **Table 4-2**.	Refer to **Table 4-2**.	Refer to **Table 4-2**.
	FIELD QUALITY CONTROL SAMPLES	Off-Site Analysis (excluding asbestos): Rinse Blank (5% frequency) and Field Duplicate (10% frequency)	NA	Off-Site Analysis: Rinse Blank (5% frequency) and Field Duplicate (10% frequency)	Off-Site Analysis: Trip Blank (1 per cooler) Rinse Blank (5% frequency) and Field Duplicate (10% frequency)	Off-Site Analysis: Trip Blank (1 per cooler) Rinse Blank (5% frequency) and Field Duplicate (10% frequency)	NA	NA
STUDY BOUNDARY		1) 7.6 acres 2) No public access permitted, no notable geographic characteristics	1) 6,472 ft^2 2) No public access permitted, no notable geographic characteristics, heterogeneous soil types expected in excavation area	1) 6,472 ft^2 2) No public access permitted, no notable geographic characteristics, heterogeneous soil types expected in excavation area	1) 7.6 acres 2) No public access permitted, no notable geographic characteristics	1) 7.6 acres 2) No public access permitted, no notable geographic characteristics	1) 6,472 ft^2 2) No public access permitted, no notable geographic characteristics, heterogeneous soil types expected in excavation area	1) Unknown

COD = Chemical Oxygen Demand
NA = Not Applicable
PAH = Polynuclear Aromatic Hydrocarbon
PCB = Polychlorinated Biphenyl
RG = Remedial Goal
SOP = Standard Operating Procedure
TAL = Target Analyte List
TCL = Target Compound List
TCLP = Toxicity Characteristic Leaching Procedure
USEPA = U.S. Environmental Protection Agency

4. **Define the Boundaries:** Define decision statement spatial and temporal boundaries. This step specifies 1) the spatial boundary, 2) population characteristics, applicable geographic areas and associated homogeneous characteristics, and 3) constraints on sample collection.

   *(1, 2, 3) Refer to **Table 4-1**.*

5. **Develop a Decision Rule:** Define the 1) parameters of interest, 2) action levels, and 3) develop a decision rule.

   *(1) Parameters of interest are listed in the decision inputs. Refer to **Table 4-1**.*
   (2) The soil removal action RGs for the ARSAR are identified as the r-RG, disposal facility permit levels, and/or USEPA disposal criteria (40 CFR 261.24, 40 CFR 761.50, and USEPA SW-846 Chapter 7). The solid and aqueous referenced SLs are from USEPA Regional Screening Level Table (December 2009). The SLs for non-carcinogenic chemicals are presented with a hazard quotient of 0.1 to allow for cumulative effects, multiple contaminated media, and multiple routes of exposure. The pyrene SLs were used for acenaphthylene, benzo(g,h,i)perylene, and phenanthrene and the chromium III SLs were used for chromium. The aqueous maximum contaminant levels (MCLs) are from the USEPA 2006 Edition of the Drinking Water Standards and Health Advisories (EPA 822-R-06-013).
   (3) If the berm soil characterization samples exceed the RG, the soil will be removed. If the confirmation samples exceed RGs, excavation will continue until all soil above RGs has been removed. Waste characterization samples will be compared to disposal facility criteria. If concentrations of chemicals in these samples exceed target levels, the soil will be disposed at an appropriate disposal facility. The SW and GW samples will be evaluated against the regional SLs.

6. **Specify Acceptable Limits on Decision Errors:** Specify the decision maker's tolerable limits on decision errors. This step of the process includes 1) parameter range of interest, 2) decision errors, 3) potential parameter values, and 4) the probability tolerance for decision errors are identified during this phase.

   (1) Parameter ranges are not defined at this time.
   (2) Decision errors include:
      (2a) Deciding that the soil characteristics exceed cleanup goals (soil removed) and site has been fully characterized for SW/SED/GW when has not and deciding that the soil characteristics do not exceed cleanup goals (soil not removed) and the site has not been fully characterized for SW/SED/GW when actually has been. The consequences of deciding that the soil characteristics exceed cleanup goals (soil removed) and SW/SED/GW characterization to fill data gaps has been met when they do not will result in unnecessary removal actions and additional sampling. The consequences of deciding that the soil characteristics do not exceed cleanup goals (soil not removed) and SW/SED/GW characterization did not fill data gaps when they do will result in liabilities associated with future damages and environmental cleanup/sampling costs. Additionally, public opinion will be compromised.

(2b) (I) The true state is when the most severe decision error occurs [deciding the soil characteristics exceed cleanup goals (soil removed) when they actually do] is that the soil characteristics exceed cleanup goals and it is removed. (II) The true state when the less severe decision error occurs [deciding the soil characteristics do not exceed cleanup goals (soil not removed) when they do not] is that the soil characteristics do not exceed cleanup goals and no removal occurs.

(2c) The null hypothesis (H0) is: the soil characteristics exceed cleanup goals (soil removed) and site has been fully characterized for SW/SED/GW to fill data gaps. The alternative hypothesis (Ha) is the soil characteristics do not exceed cleanup goals (soil not removed) and site has not been fully characterized for SW/SED/GW to fill data gaps.

(2d) The false positive decision error occurs when H0 is erroneously rejected corresponding to decision error I. The false negative decision error occurs when Ha is erroneously accepted corresponding to decision error II. Project-specific Type I and II error rates are 0.05 and 0.2, respectively.

(3, 4) The consequence of decision errors and acceptable probability will be determined as part of the final report.

7. **Optimize Data Design:** Identify data collection activities commensurate with data quality specifications. This final step in the process consists of 1) reviewing DQO outputs and existing environmental data, 2) developing data collection design alternatives, 3) formulating mathematical expressions to resolve design problems for each alternative, 4) selecting cost-effective data design capable of achieving DQOs, and 5) documentation of operational details and theoretical assumptions.

(1) This Work Plan contains the proposed RFI/IM sampling design program for the ARSAR. A phased focus approach has been adopted for site characterization, delineation, confirmation, and waste characterization to optimize resource utilization and minimize decision errors. DQO refinement will be an iterative process throughout the project life cycle.

(2) Non-statistical sampling procedures are proposed. Biased and judgmental sampling will be performed for the collection of the delineation, characterization, and confirmation samples for the media characterization and removal action activities.

(3) Mathematical and qualitative assessments will be established during the refinement process.

(4) This work plan contains the proposed RFI/IM sampling design program based on cost and project DQOs.

4.3.1 Background

The media characterization and soil removal action objectives, rationales, and sampling scopes for the ARSAR are presented in **Table 4-1**.

4.3.2 Applicable or Relevant and Appropriate Requirements

Applicable or relevant and appropriate requirements selected for the media characterization and soil removal action at the ARSAR may be found in **Table 4-2** and include:

- Waste Disposal Criteria per USEPA 40 CFR 261.24; USEPA SW-846 Chapter 7 for TCLP analysis.
- Waste Disposal Criteria of 50 mg/kg for total PCBs (USEPA 40 CFR 761.50).

To-Be-Considered Guidance selected for the contaminated soil removal action at the ARSAR include:

- RGs not to exceed 3.1 and 400 mg/kg for antimony and lead, respectively, in target berm soil.
- RFAAP Metals Background Concentrations.
- USEPA Regional SLs (December, 2009).
- USEPA Drinking Water MCLs (2006; EPA 822-R-06-013).

Sampling locations and procedures and sampling activities and procedures for the RFI/IM at the ARSAR are presented in the FSP (*Section 3.0*). Parameter, container and preservation requirements, and holding times for analytical samples to be collected as part of the ARSAR RFI/IM are presented in **Table 4-3**.

Table 4-2
Analyte List and Levels of Concern for the ARSAR RFI/IM
Page 1 of 5

Parameter	Quantitation Limits		Solid RG/SL		Aqueous SL	
	Aqueous (ug/L)	Solid (mg/kg)	Residential SL (mg/kg)	Industrial SL (mg/kg)	MCL (ug/L)	Tap Water Screening Level (ug/L)
TCL VOCs						
1,1,1-Trichloroethane	1.0	5.0	900	3900	200	910
1,1,2,2-Tetrachloroethane	1.0	5.0	0.59	2.9	na	0.067
1,1,2-Trichloroethane	1.0	5.0	1.1	5.5	5.0	0.24
1,1-Dichloroethane	1.0	5.0	3.4	17	na	2.4
1,1-Dichloroethene	1.0	5.0	25	110	7.0	34
1,2-Dichloroethane	1.0	5.0	0.45	2.2	5.0	0.15
1,2-Dichloropropane	1.0	5.0	0.93	4.7	5.0	0.39
2-Butanone	10	50.0	2800	19000	na	710
2-Hexanone	10	50.0	na	na	na	na
4-Methyl-2-pentanone	10	50.0	530	5200	na	200
Acetone	25	50.0	6100	61000	na	2200
Benzene	1.0	5.0	1.1	5.6	5.0	0.41
Bromodichloromethane	1.0	5.0	0.28	1.4	80	0.12
Bromoform	1.0	5.0	61	220	80	8.5
Bromomethane	1.0	5.0	0.79	3.5	na	0.87
Carbon disulfide	2.0	10.0	67	300	na	100
Carbon tetrachloride	1.0	5.0	0.25	1.3	5.0	0.2
Chlorobenzene	1.0	5.0	31	150	100	9.1
Chlorodibromomethane	1.0	5.0	0.70	3.4	80	0.15
Chloroethane	1.0	5.0	1500	6200	na	2100
Chloroform	1.0	5.0	0.30	1.5	80	0.19
Chloromethane	1.0	5.0	12	51	na	19
cis-1,2-Dichloroethene	1.0	5.0	78	1000	70	37
cis-1,3-Dichloropropene	1.0	5.0	1.7	8.4	na	0.43
Ethylbenzene	1.0	5.0	5.7	29	700	1.5
m- & p-Xylene	2.0	10.0	60	260	10000	140
Methylene chloride	5.0	50.0	11	54	5.0	4.8
o-Xylene	1.0	5.0	530	2300	10000	140
Styrene	1.0	5.0	650	3800	100	160
Tetrachloroethene	1.0	5.0	0.57	2.7	5.0	0.11
Toluene	1.0	5.0	500	4600	1000	230
trans-1,2-Dichloroethene	1.0	5.0	11	50	100	11
trans-1,3-Dichloropropene	1.0	5.0	1.7	8.4	na	0.43
Trichloroethene	1.0	5.0	2.8	14	5.0	1.7
Vinyl chloride	1.0	5.0	0.060	1.7	2.0	0.016
Xylene (total)	2.0	10.0	60	260	10000	20
TCL SVOCs						
1,2,4-Trichlorobenzene	10	330	8.7	40	70	0.82
1,2-Dichlorobenzene	10	330	200	1000	600	37
1,3-Dichlorobenzene	10	330	na	na	na	na
1,4-Dichlorobenzene	10	330	2.6	13	75	0.43
2,4,5-Trichlorophenol	10	330	610	6200	na	370
2,4,6-Trichlorophenol	10	330	44	160	na	6.1
2,4-Dichlorophenol	10	330	18	180	na	11
2,4-Dimethylphenol	10	330	120	1200	na	73
2,4-Dinitrophenol	50	830	12	120	na	7.3
2,4-Dinitrotoluene [a]	10	330	0.71	2.5	na	0.099
2,6-Dinitrotoluene [a]	10	330	0.71	2.5	na	0.099
2-Chloronaphthalene	10	330	630	8200	na	290
2-Chlorophenol	10	330	39	510	na	18
2-Methylnaphthalene	10	330	31	410	na	15

Table 4-2
Analyte List and Levels of Concern for the ARSAR RFI/IM
Page 2 of 5

Parameter	Quantitation Limits		Solid RG/SL		Aqueous SL	
	Aqueous (ug/L)	Solid (mg/kg)	Residential SL (mg/kg)	Industrial SL (mg/kg)	MCL (ug/L)	Tap Water Screening Level (ug/L)
2-Methylphenol	10	330	310	3100	na	180
2-Nitroaniline	50	830	18	180	na	11
2-Nitrophenol	10	330	na	na	na	na
3,3'-Dichlorobenzidine	20	330	1.1	3.8	na	0.15
3+4-Methylphenol	10	330	31	310	na	18
3-Nitroaniline	50	830	na	na	na	na
4,6-Dinitro-2-methylphenol	50	830	0.61	6.2	na	0.37
4-Bromophenylphenylether	10	330	na	na	na	na
4-Chloro-3-methylphenol	10	330	na	na	na	na
4-Chloroaniline	20	660	2.4	8.6	na	0.34
4-Chlorophenylphenylether	10	330	na	na	na	na
4-Nitroaniline	50	830	24	86	na	3.4
4-Nitrophenol	50	830	na	na	na	na
Acenaphthene	10	330	340	3300	na	220
Acenaphthylene [b]	10	330	170	1700	na	110
Anthracene	10	330	1700	17000	na	1100
Benz[*a*]anthracene	10	330	0.15	2.1	na	0.029
Benzo[*a*]pyrene	10	330	0.015	0.21	na	0.0029
Benzo[*b*]fluoranthene	10	330	0.15	2.1	na	0.029
Benzo[*g,h,i*]perylene [b]	10	330	170	1700	na	110
Benzo[*k*]fluoranthene	10	330	1.5	21	na	0.29
Benzoic acid	50	830	24000	250000	na	15000
Benzyl Alcohol	10	330	3100	31000	na	1800
Bis(2-chloroethoxy)methane	10	330	18	180	na	11
Bis(2-chloroethyl)ether	10	330	0.19	0.90	na	0.012
Bis(2-chloroisopropyl)ether	10	330	3.5	17	na	0.32
Bis(2-ethylhexyl)phthalate	10	330	35	120	6.0	4.8
Butylbenzylphthalate	10	330	260	910	na	35
Chrysene	10	330	15	210	na	2.9
Dibenz[*a,h*]anthracene	10	330	0.015	0.21	na	0.0029
Dibenzofuran	10	330	na	na	na	na
Diethylphthalate	10	330	4900	49000	na	2900
Dimethylphthalate	10	330	na	na	na	na
Di-*n* -butylphthalate	10	330	610	6200	na	370
Di-*n* -octylphthalate	10	330	na	na	na	na
Fluoranthene	10	330	230	2200	na	150
Fluorene	10	330	230	2200	na	150
Hexachlorobenzene	10	330	0.30	1.1	1.0	0.042
Hexachlorobutadiene	10	330	6.1	22	na	0.86
Hexachlorocyclopentadiene	10	330	37	370	50	22
Hexachloroethane	10	330	6.1	62	na	3.7
Indeno[1,2,3-*cd*]pyrene	10	330	0.15	2.1	na	0.029
Isophorone	10	330	510	1800	na	71
Naphthalene	10	330	3.9	20	na	0.14
Nitrobenzene	10	330	4.4	22	na	0.12
N-Nitrosodi-*n* -propylamine	10	330	0.069	0.25	na	0.0096
N-Nitrosodiphenylamine	10	330	99	350	na	14
Pentachlorophenol	50	830	3.0	9.0	na	0.56
Phenanthrene [b]	10	330	170	1700	na	110
Phenol	10	330	1800	18000	na	1100
Pyrene	10	330	170	1700	na	110

Table 4-2
Analyte List and Levels of Concern for the ARSAR RFI/IM
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Parameter	Quantitation Limits		Solid RG/SL		Aqueous SL	
	Aqueous (ug/L)	Solid (mg/kg)	Residential SL (mg/kg)	Industrial SL (mg/kg)	MCL (ug/L)	Tap Water Screening Level (ug/L)
PAHs						
1-Methylnaphthalene	0.05	0.0017	22	99	na	2.3
2-Methylnaphthalene	0.05	0.0017	31	410	na	15
Acenaphthene	0.05	0.0017	340	3300	na	220
Acenaphthylene	0.05	0.0017	170	1700	na	110
Anthracene	0.05	0.0017	1700	17000	na	1100
Benz(a)anthracene	0.05	0.0017	0.15	2.1	na	0.029
Benzo(a)pyrene	0.05	0.0017	0.015	0.21	0.2	0.0029
Benzo(b)fluoranthene	0.05	0.0017	0.15	2.1	na	0.029
Benzo(g,h,i)perylene	0.05	0.0017	170	1700	na	110
Benzo(k)fluoranthene	0.05	0.0017	1.5	21	na	0.29
Chrysene	0.05	0.0017	15	210	na	2.9
Dibenz(a,h)anthracene	0.05	0.0017	0.015	0.21	na	0.0029
Fluoranthene	0.05	0.0017	230	2200	na	150
Fluorene	0.05	0.0017	230	2200	na	150
Indeno(1,2,3-cd)pyrene	0.05	0.0017	0.15	2.1	na	0.029
Naphthalene	0.05	0.0017	3.6	18	na	0.14
Phenanthrene	0.05	0.0017	170	1700	na	110
Pyrene	0.05	0.0017	170	1700	na	110
TCL Pesticides and PCBs						
4,4'-DDD	0.10	3.3	2.0	7.2	na	0.28
4,4'-DDE	0.10	3.3	1.4	5.1	na	0.2
4,4'-DDT	0.10	3.3	1.7	7.0	na	0.2
Aldrin	0.050	1.7	0.029	0.10	na	0.004
Alpha-BHC	0.050	1.7	0.077	0.27	na	0.011
beta-BHC	0.050	1.7	0.27	0.96	na	0.037
Chlordane (technical)	0.50	17	1.6	6.5	2.0	0.19
delta-BHC	0.050	1.7	na	na	na	na
Dieldrin	0.10	1.7	0.030	0.11	na	0.0042
Endosulfan I [c]	0.050	1.7	37	370	na	22
Endosulfan II [c]	0.10	3.3	37	370	na	22
Endosulfan sulfate [c]	0.10	3.3	37	370	na	22
Endrin	0.10	3.3	1.8	18	2.0	1.1
Endrin aldehyde [d]	0.10	3.3	1.8	18	na	1.1
Endrin ketone [d]	0.10	3.3	1.8	18	na	1.1
Gamma-BHC (Lindane)	0.050	1.7	0.52	2.1	0.2	0.061
Heptachlor	0.050	1.7	0.11	0.38	0.4	0.015
Heptachlor epoxide	0.050	1.7	0.053	0.19	0.2	0.0074
Methoxychlor	0.50	3.3	31	310	40	18
Toxaphene	5.0	170	0.44	1.6	3.0	0.061
Aroclor-1016	1.0	17	0.39	3.7	0.5	0.26
Aroclor-1221	2.0	34	0.17	0.62	0.5	0.0068
Aroclor-1232	1.0	17	0.17	0.62	0.5	0.0068
Aroclor-1242	1.0	17	0.22	0.74	0.5	0.034
Aroclor-1248	1.0	17	0.22	0.74	0.5	0.034
Aroclor-1254	1.0	17	0.11	0.74	0.5	0.034
Aroclor-1260	1.0	17	0.22	0.74	0.5	0.034
Explosives						
1,3,5-Trinitrobenzene	1.0	0.25	220	2700	na	110
1,3-Dinitrobenzene	1.0	0.25	0.61	6.2	na	0.37
2,4,6-Trinitrotoluene	1.0	0.25	1.9	7.9	na	0.22
2,4-Dinitrotoluene	1.0	0.25	12	120	na	7.3

Table 4-2
Analyte List and Levels of Concern for the ARSAR RFI/IM
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Parameter	Quantitation Limits		Solid RG/SL		Aqueous SL	
	Aqueous (ug/L)	Solid (mg/kg)	Residential SL (mg/kg)	Industrial SL (mg/kg)	MCL (ug/L)	Tap Water Screening Level (ug/L)
2,6-Dinitrotoluene	1.0	0.25	6.1	62	na	3.7
2-amino-4,6-Dinitrotoluene	1.0	0.25	15	200	na	7.3
2-Nitrotoluene	1.0	0.25	2.9	13	na	0.31
3-Nitrotoluene	1.0	0.25	0.61	6.2	na	0.37
4-amino-2,6-Dinitrotoluene	1.0	0.25	15	190	na	7.3
4-Nitrotoluene	1.0	0.25	3	110	na	4.2
HMX	1.0	0.25	380	4900	na	180
Nitrobenzene	1.0	0.25	3.1	28	na	0.34
RDX	1.0	0.25	5.5	24	na	0.61
Tetryl	1.0	0.25	24	250	na	15
Nitroglycerin	1.0	0.25	0.61	6.2	na	0.37
PETN	1.0	0.25	na	na	na	na
Nitroguanidine	1.0	0.25	610	6200	na	370
Nitrocellulose	1.0	0.25	23000000	310000000	na	11000000
Herbicides						
2,4,5-TP (Silvex)	0.50	16	49	490	50	29
2,4,5-T	0.50	8.0	61	620	na	37
2,4-DB	0.50	80	49	490	na	29
2,4-D	0.50	40	69	770	70	37
Dalapon	10	40	180	1800	200	110
Dicamba	0.50	80	180	1800	na	110
Dichlorprop	0.50	40	na	na	na	na
Dinoseb	6.0	80	6.1	62	7.0	3.7
MCPA	120	200	3.1	31	na	1.8
MCPP	120	200	6.1	62	na	3.7
Perchlorate						
Perchlorate	0.20	0.002	5.5	72	na	2.6
TAL Metals						
Aluminum	200	10	7700	99000	50	3700
Antimony	20	3.0	3.1	41	6.0	1.5
Arsenic	20	0.40	0.39	1.6	10	0.045
Barium	10	10	1500	19000	2000	730
Beryllium	4.0	0.25	16	200	4.0	7.3
Cadmium	5.0	0.20	7.0	80	5.0	1.8
Calcium	500	250	na	na	na	na
Chromium[e]	10	0.50	12000	150000	100	11
Cobalt	10	2.5	2.3	30	na	1.1
Copper	20	1.3	310	4100	1300	150
Iron	100	5.0	5500	72000	300	2600
Lead	10	5.0	400	800	15	na
Magnesium	500	250	na	na	na	na
Manganese	10	0.75	180	2300	50	88
Mercury	0.20	0.08	0.43	2.4	2.0	0.057
Nickel	40	2.0	150	2000	na	73
Potassium	1000	1000	na	na	na	na
Selenium	20	5.0	39	510	50	18
Silver	10	0.50	39	510	100	18
Sodium	1000	500	na	na	na	na
Thallium	25	0.50	na	na	2.0	na
Vanadium	10	2.5	0.55	7.2	na	0.26
Zinc	20	1.0	2300	31000	5000	1100

Table 4-2
Analyte List and Levels of Concern for the ARSAR RFI/IM
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Parameter	Quantitation Limits		Solid RG/SL		Aqueous SL	
	Aqueous (ug/L)	Solid (mg/kg)	Residential SL (mg/kg)	Industrial SL (mg/kg)	MCL (ug/L)	Tap Water Screening Level (ug/L)
Asbestos						
actinolite	na	<1.0%	na	na	na	na
ferroactinolite	na	<1.0%	na	na	na	na
amosite	na	<1.0%	na	na	na	na
anthophyllite	na	<1.0%	na	na	na	na
chrysotile	na	<1.0%	na	na	na	na
serpentine	na	<1.0%	na	na	na	na
crocidolite	na	<1.0%	na	na	na	na
tremolite	na	<1.0%	na	na	na	na
amphibole asbestos	na	<1.0%	na	na	na	na

Notes:

Referenced Screening Levels (SLs) are from USEPA Regional Screening Level Table. (December 2009). Regional Screening Levels for Chemical Contaminants at Superfund Sites.

MCLs are from the USEPA 2006 Edition of the Drinking Water Standards and Health Advisories (EPA 822-R-06-013).

The SLs for non-carcinogenic chemicals are presented with a hazard quotient of 0.1 to allow for cumulative effects, multiple contaminated media, and multiple routes of exposure.

The pyrene SLs were used for acenaphthylene, benzo(g,h,i)perylene, and phenanthrene

The SLs for chromium III were used for chromium.

na = not available or not applicable.

Table 4-3
Parameter, Container, Preservation Requirements, and Holding Times for the ARSAR RFI/IM

Parameter	Sample Container*		Preservation Requirement*	Holding Time
	Solid	Aqueous		
TCL VOCs	3, 5 gram EnCore Sampler or TerraCore Sampler, zero headspace	3, 40 mL vials with Teflon septum, zero headspace	Cool: 4 ± 2°C, HCl to pH<2 for aqueous, No Sodium Bisulfate for solids due to sample effervescence TerraCore's are pre-tarred and contain MeOH or DIUF	Aqueous: Analysis: 14 days Solid: Preparation: 2 days Analysis: 14 days
TCL SVOCs	1, 8 oz, wide mouth glass with Teflon cap	2, 1-L amber glass with Teflon lined cap	Cool: 4 ± 2°C	Aqueous: Extraction: 7 days; Analysis: 40 days Solid: Extraction: 14 days; Analysis: 40 days
TCL Pesticides/ PCBs	1, 8 oz, wide mouth glass with Teflon cap	2, 1-L amber glass with Teflon lined cap	Cool: 4 ± 2°C	Aqueous: Extraction: 7 days Analysis: 40 days Solid: Extraction: 14 days Analysis: 40 days
Polynuclear Aromatic Hydrocarbons	1, 8 oz, wide mouth glass with Teflon cap	2, 1-L amber glass with Teflon lined cap	Cool: 4 ± 2°C	Aqueous: Extraction: 7 days Analysis: 40 days Solid: Extraction: 14 days Analysis: 40 days
Herbicides	1, 8 oz, wide mouth glass with Teflon cap	2, 1-L amber glass with Teflon lined cap	Cool: 4 ± 2°C	Aqueous: Extraction: 7 days; Analysis: 40 days Solid: Extraction: 14 days; Analysis: 40 days
Explosives	1, 8 oz, wide mouth glass with Teflon cap	2, 1-L amber glass with Teflon lined cap	Cool: 4 ± 2°C	Aqueous: Extraction: 7 days; Analysis: 40 days Solid: Extraction: 14 days; Analysis: 40 days
TAL Metals	1, 8 oz, wide mouth glass with Teflon cap	1, 1-L HDPE	Cool: 4 ± 2°C solid; Cool: 4 ± 2°C; (HNO_3 to pH<2 for aqueous)	ICP Metals: 180 days Mercury: 28 days
Perchlorate	1x, 8 oz, wide mouth glass with Teflon cap	1x, 1-L HDPE	Cool: 4 ± 2°C	28 days
pH	1, 4 oz, wide mouth glass with Teflon cap	1, 250 mL glass or HDPE	Cool: 4 ± 2°C	ASAP
Asbestos (Solid)	1, 8 oz, wide mouth glass with Teflon cap	Not to be collected	None	Solid: Indefinite; Retain sample for 60 days.
TCLP Metals	1, 8 oz, wide mouth glass with Teflon cap	1, 1-L glass or HDPE	Cool: 4 ± 2°C	TCLP Extraction: 180 days for ICP and 28 days for mercury Sample Analysis: 180 days for ICP and 28 days for mercury
TCLP SVOCs	1, 8 oz, wide mouth glass with Teflon cap	1-L glass or HDPE	Cool: 4 ± 2°C	TCLP Extraction: 14 days So; 7 days Aq Extraction : 7 days Sample Analysis: 40 days
Ignitability	1, 8 oz, wide mouth glass with Teflon cap	1, 1-L glass or HDPE	Cool: 4 ± 2°C	28 days
Reactive Sulfide	1, 8 oz, wide mouth glass with Teflon cap	1, 1-L glass or HDPE	Cool: 4 ± 2°C	7 days
Reactive Cyanide	1, 8 oz, wide mouth glass with Teflon cap	1, 1-L glass or HDPE	Cool: 4 ± 2°C	14 days

Table 4-3 (Continued)
Parameter, Container, Preservation Requirements, and Holding Times for the ARSAR RFI/IM

Parameter	Sample Container*		Preservation Requirement*	Holding Time
	Solid	Aqueous		
Corrosivity as pH & pH	1, 8 oz, wide mouth glass with Teflon cap	1, 250 mL glass or HDPE	Cool: 4 ± 2°C	ASAP
Chemical Oxygen Demand	NA	1, 250 mL glass	Cool: 4 ± 2°C, HCl or H_2SO_4 to pH<2 for aqueous	28 days

*Parameters with same preservation requirements may be combined at laboratory's discretion.

Legend

ASAP = As Soon As Possible
HDPE = High Density Polyethylene
ICP = Inductively Coupled Plasma
L = Liter
mL = milliliter
NA = Not Applicable
PCB = Polychlorinated Biphenyl
TAL = Target Analyte List
TCL = Target Compound List
TCLP = Toxicity Characteristic Leaching Procedure

4.4 Number and Type

The anticipated number and type of samples to be collected during the soil removal action at the ARSAR are presented on **Table 4-4**. **Table 4-4** also presents guidelines for the collection of QC samples that will be taken in conjunction with environmental sampling during the media characterization and soil removal action at the ARSAR.

Table 4-4
Estimated Number and Type of Samples for the ARSAR RFI/IM

Sample Type	Total Samples
XRF Screening	
XRF Lead in Soil (Firing Areas and Range Floor)	90
XRF Arsenic in Soil (Southeast Hillside)	30
XRF Lead in Sediment (Stroubles Creek)	5
XRF Lead in Soil (Berm)	**13**
Total XRF Screening	**138**
Environmental	
Soil Confirmation (Firing Areas and Range Floor)	9
Soil Confirmation (Southeast Hillside)	3
Soil Confirmation (Berm)	13
Surface Water	5
Sediment	5
Groundwater	3
Asbestos in Soil	1
Total Environmental	**39**
QC (for soil, sediment, and groundwater sampling)	
Rinse Blank (5% frequency)[1]	3
Matrix Spike/Matrix Spike Duplicate (5% frequency)[1]	3
Field Duplicate (10% frequency)[2]	4
Total QC	**10**
TOTAL ENVIRONMENTAL and QC SAMPLES	**36**
Waste and Borrow Characterization	
Decontamination Rinse Water	1
Soil	1
Topsoil	1
Borrow Material	1
Total Waste and Borrow Characterization	**4**

[1]MS/MSD and rinse blank samples will be collected at a frequency of 5% of the total environmental sample volume (not applicable for waste/borrow, asbestos, or XRF analysis).
[2]Blind duplicate samples will be collected at a frequency of 10% of the total environmental sample volume (not applicable for waste/borrow, asbestos, or XRF analysis).

4.5 Sample Identification

The sample identification system will be similar with past nomenclature at RFAAP. Samples will be coded in the following order to ensure a unique identification. The sample identification number will consist of an alphanumeric designation related to the sampling location, media type, sequential order sampling location, sample depth, and duplicate. Each sample will be assigned a unique sequential number at the time of sampling on the sample label, which will be permanently affixed to the sample container. **Table 3-1** in the FSP (*Section 3.0*) contains sample identification numbers that will be used for the RFI/IM at the ARSAR.

4.5.1 Environmental Samples

The field sample identification number consists of an alphanumeric designation according to the following convention:

- **Site Location Code:** The first two or three characters will be the site location number or code. The identification will include the following:

AR	= Army Small Arms range
TM	= Blind Field Duplicate

- **Sample/Media Type:** The second two characters will be the sample/media type. Sample types will be designated by the following codes:

XRF	= XRF Range Floor Firing Areas Sample
SCF	= Range Floor Soil Confirmation Sample
XRH	= XRF Hillside Soil Sample
SCH	= Hillside Soil Confirmation Sample
SSCF	= Building Debris Area Asbestos Surface Soil Sample
GW	= Groundwater Sample
SW	= Surface Water Sample
SD	= Sediment Sample
XSC	= XRF Stroubles Creek Sediment Sample
DW	= Waste/Borrow Characterization Sample

- **Sampling Location Number:** The next two characters will be the number of the sampling location (e.g., 01, 02, 03,...).
- **Duplicate:** Field duplicate samples will be identified with a "TM" designation as noted in the "Site Location Code." A record of the samples that correspond to the duplicates will be kept in the field logbook.

4.5.2 Field QC Blank Samples

All field QC blanks will use the following designation system:

- Date: month, day, year as MMDDYY
- Type: R = Rinse Blank or T = Trip Blank
- Sequential Collection Order (if more than one collected per day): This consists of one digit such as 1, 2, 3, and so on.

Rinse blanks will be designated with the date sampled, followed by "R," ending with the sequenced number of the rinse blanks (e.g., 062910R2 is the second rinse blank taken on June 29, 2010).

Trip blanks will be designated similarly, with the date sampled, followed by "T," ending with the sequenced number of the rinse blanks (e.g., 062910T is the first trip blank taken on June 29, 2010).

4.5.3 Documentation Requirements

Information pertinent to the sampling effort will be recorded in a field logbook, and a COC form will trace the sample. Field logbook SOPs 10.1 and 10.2 may be found in **Appendix B**. All entries will be made in indelible ink on consecutively numbered pages, and corrections will

consist of lineout deletions that are initialed and dated. At a minimum, required field logbook entries include:

- Time and date of sample collection.
- Sampler identification.
- Sample identification number.
- Sample type.
- Analytical request.
- Sampling methodology (grab and composite sample).
- Preservation used, as applicable.
- Associated QA/QC samples.
- Physical field measurements.
- Signature and date of personnel responsible for observations.

Each sample will be assigned a unique sequential number at the time of sampling, which will be permanently affixed to the sample container with polyethylene tape to prevent the loss of the label during shipment. Further discussion as to sample labeling is provided in SOP 50.1 in **Appendix B**. The sample label will be filled out using indelible ink and will include the following information:

- Project name and number.
- Sample location/site ID.
- Sampling date and time.
- Analyses to be performed.
- Preservative, as applicable.
- Sampler name.

4.6 Packaging and COC Requirements

Environmental samples required for shipment must be packaged appropriately in leak-proof coolers to the laboratory. Appropriate custody procedures and documentation must be performed to ensure sample integrity. The following sections discuss sample packaging, shipment, and custody requirements.

4.6.1 Shipping Coolers

Leak proof sample coolers will be shipped to arrive at the laboratory the morning after sampling (priority overnight). The laboratory will be notified of the sample shipment and the estimated date of arrival of the samples being delivered. Shipping coolers are to be clean, leak proof, contamination-free, and in good condition. These containers will be used to transport environmental samples to the laboratory. Suitable sample cooler(s) to handle sample containers packed with bagged ice will be required for sample shipment.

4.6.2 Temperature Blanks

Temperature blanks are to be provided to Shaw and will be included in each environmental sample shipping container requiring wet ice. Temperature blanks are required for each cooler

where samples must meet the USEPA storage requirements of 4 degrees Celsius (ºC)±2ºC during shipment. See **Table 4-3** for sample preservation requirements. These blanks will be used by the laboratory to measure the shipping container internal temperatures at receipt. These samples will not be analyzed for any scoped analysis.

4.6.3 Sample Packaging and Shipment

Samples will be transferred to the contract laboratory for analysis via waterproof plastic coolers. Before samples can be put in the cooler, any drains will be sealed with tape to prevent leaking. Each cooler will be packed in the following manner:

1. Ensure sample lids are tight.
2. Wrap environmental samples and associated QC samples in bubble wrap.
3. Fill cooler with enough packing material to prevent breakage of glass bottles.
4. Place sufficient ice in cooler to maintain the internal temperature at 4±2°C during transport. The ice will be double-bagged in sealed bags to prevent contact of the melt water with the samples.
5. Place a temperature blank (if applicable) in cooler.
6. Place associated COCs in a waterproof plastic bag, and tape it to the inside lid of the cooler.
7. Seal coolers at a minimum of two locations with signed custody seals or evidence tape before being transferred off site. Attach completed shipping label and Saturday Delivery label (if applicable) to top of the cooler. Cover seals with wide, clear packing tape, and continue around the cooler to seal the lid. If the cooler has a drain spout, it may also be sealed with clear packing tape.

4.6.4 Chain-of-Custody

Sampling will be evidenced through the completion of a COC form, which accompanies the sample containers in the field, during transit to the laboratory, and upon receipt by the laboratory. The COC will be annotated to indicate time and date that samples are relinquished. In addition, shipping containers will be affixed with custody seals. Further discussion of COC may be found in SOP 10.4 of **Appendix B**. The COC will be filled out using indelible ink and will include the following information:

- Project name and number.
- The signatures of the sampling personnel.
- The site code and sample number.
- Sampling dates, locations, and times (military format).
- List of the chemical analysis, volume, and preservatives used.
- The total number of containers per location.
- The custody seal number.
- Sample relinquisher, date and time.
- Any special remarks (e.g., MS/MSD this sample).

4.7 Analytical Procedures and Data Validation

4.7.1 Method Selection for Chemical Analyses

Sample collection will be performed in accordance with established Shaw SOPs designed to ensure the collection of representative samples. Shaw SOPs may be found in **Appendix B**. An ELAP-accredited laboratory will perform the off-site analytical sample analysis. All laboratory analytical methods will be performed in accordance with USEPA protocols and methods. Shaw will have the laboratory data validated according to the QAPP requirements, DoD QSM Version 4.1 requirements, the analytical method, and laboratory SOPs. Data validation qualifiers will be consistent with the *USEPA Region III Modifications to the National Functional Guidelines for Organic Data Review* (USEPA, 1994b) and *Modifications to the Laboratory Data Validation Functional Guidelines for Evaluating Inorganic Analyses* (USEPA, 1993). The analysis methods, analytical compound lists, and quantitation limits (QLs) are provided in **Table 4-2**.

Analytical QLs were compared to SLs to ensure that they do not exceed the SLs listed in **Table 4-2**. During the planning stage, the QLs are used for comparison rather than method reporting limits (MRLs) or method detection limits (MDLs) because MRLs are sample-specific and take into account characteristics such as dilutions, sample volumes, and percent moistures, which are unknown prior to sampling and analysis. The laboratory will be required to perform and report MDLs for each sample and analysis. These limits are specific to the laboratory, instrumentation, and methodology and are updated at least annually. The MDLs represent the lowest level the laboratory can detect a constituent at a 99% confidence for a specific compound. If a compound is detected >MDL and <MRL, it will be treated as estimated and flagged with a "J."

Economical, technical, comparability, and sensitivity factors were considered during the method selection process for this IM. The MRLs and MDLs will be compared to SLs during the data analysis stage in the IM.

4.7.2 Laboratory Procedures for Chemical Analyses

The laboratory methods listed for the RFI/IM are in accordance with *USEPA OSWER Test Methods for Evaluating Solid Waste Physical/Chemical Methods (SW-846), Update IV* (USEPA, 2007), *DoD Perchlorate Handbook, Revision 1, Change 1* (DoD, 2007), *NYDOH ELAP198.4*, and *USEPA Methods for Chemical Analysis of Water and Wastes* (USEPA, 1983). The LQAP for the subcontracted analytical laboratory for the ARSAR RFI/IM is presented as **Appendix C**. Analytical compound lists and minimum QLs to be used are given in **Table 4-2**. The QC requirements are based on the *DoD QSM Version 4.1* and may be found in **Tables 4-5 through 4-10**.

Table 4-5
Quality Control Method Criteria for Pesticides and PCBs by SW-846 8081 and 8082A and Herbicides by SW-846 8151A

Table F-2. Organic Analysis by Gas Chromatography and High-Performance Liquid Chromatography (Methods 8011, 8015, 8021, 8070, 8081, 8082, 8121, 8141, 8151, 8310, 8330, and 8330A) (continued)

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action	Flagging Criteria	Comments
Minimum five-point initial calibration (ICAL) for all analytes	ICAL prior to sample analysis.	One of the options below: Option 1: RSD for each analyte ≤ 20%; Option 2: linear least squares regression: r ≥ 0.995; Option 3: non-linear regression: coefficient of determination (COD) $r^2 \geq$ 0.99 (6 points shall be used for second order, 7 points shall be used for third order).	Correct problem then repeat ICAL.	Flagging criteria are not appropriate.	Problem must be corrected. No samples may be run until ICAL has passed. Calibration may not be forced through the origin. Quantitation for multicomponent analytes such as chlordane, toxaphene, and Aroclors must be performed using a 5-point calibration. Results may not be quantitated using a single point.
Retention time window position establishment for each analyte and surrogate	Once per ICAL and at the beginning of the analytical shift.	Position shall be set using the midpoint standard of the ICAL curve when ICAL is performed. On days when ICAL is not performed, the initial CCV is used.	NA.	NA.	
Second source calibration verification (ICV)	Immediately following ICAL.	All project analytes within established retention time windows. GC methods: All project analytes within ± 20% of expected value from the ICAL; HPLC methods: All project analytes within ± 15% of expected value from the ICAL.	Correct problem, rerun ICV. If that fails, repeat ICAL.	Flagging criteria are not appropriate.	Problem must be corrected. No samples may be run until calibration has been verified.

Table 4-5 (Continued)
Quality Control Method Criteria for Pesticides and PCBs by SW-846 8081 and 8082A and Herbicides by SW-846 8151A

Table F-2. Organic Analysis by Gas Chromatography and High-Performance Liquid Chromatography (Methods 8011, 8015, 8021, 8070, 8081, 8082, 8121, 8141, 8151, 8310, 8330, and 8330A) (continued)

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action	Flagging Criteria	Comments
Continuing calibration verification (CCV)	Prior to sample analysis, after every 10 field samples, and at the end of the analysis sequence.	All project analytes within established retention time windows. GC methods: All project analytes within ± 20% of expected value from the ICAL; HPLC methods: All project analytes within ± 15% of expected value from the ICAL.	Correct problem, then rerun calibration verification. If that fails, then repeat ICAL. Reanalyze all samples since the last successful calibration verification.	If reanalysis cannot be performed, data must be qualified and explained in the case narrative. Apply Q-flag to all results for the specific analyte(s) in all samples since the last acceptable calibration verification.	Problem must be corrected. Results may not be reported without a valid CCV. Flagging is only appropriate in cases where the samples cannot be reanalyzed. Retention time windows are updated per the method.
Method blank	One per preparatory batch.	No analytes detected > ½ RL and > 1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater). Blank result must not otherwise affect sample results (see Box D-1).	Correct problem, then see criteria in Box D-1. If required, reprep and reanalyze method blank and all samples processed with the contaminated blank.	If reanalysis cannot be performed, data must be qualified and explained in the case narrative. Apply B-flag to all results for the specific analyte(s) in all samples in the associated preparatory batch.	Problem must be corrected. Results may not be reported without a valid method blank. Flagging is only appropriate in cases where the samples cannot be reanalyzed.
Laboratory control sample (LCS) containing all analytes to be reported, including surrogates	One per preparatory batch.	QC acceptance criteria specified by DoD, if available. Otherwise, use in-house control limits. In-house control limits may not be greater than ± 3 times the standard deviation of the mean LCS recovery. See Box D-3 and Appendix G.	Correct problem, then reprep and reanalyze the LCS and all samples in the associated preparatory batch for failed analytes, if sufficient sample material is available (see full explanation in Appendix G).	If reanalysis cannot be performed, data must be qualified and explained in the case narrative. Apply Q-flag to specific analyte(s) in all samples in the associated preparatory batch.	Problem must be corrected. Results may not be reported without a valid LCS. Flagging is only appropriate in cases where the samples cannot be reanalyzed.
Matrix spike (MS)	One per preparatory batch per matrix (see Box D-7).	For matrix evaluation, use LCS acceptance criteria specified by DoD, if available. Otherwise, use in-house LCS control limits.	Examine the project-specific DQOs. Contact the client as to additional measures to be taken.	For the specific analyte(s) in the parent sample, apply J-flag if acceptance criteria are not met.	For matrix evaluation only. If MS results are outside the LCS limits, the data shall be evaluated to determine the source of difference and to determine if there is a matrix effect or analytical error.

Table 4-5 (Continued)
Quality Control Method Criteria for Pesticides and PCBs by SW-846 8081 and 8082A and Herbicides by SW-846 8151A

Table F-2. Organic Analysis by Gas Chromatography and High-Performance Liquid Chromatography (Methods 8011, 8015, 8021, 8070, 8081, 8082, 8121, 8141, 8151, 8310, 8330, and 8330A) (continued)

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action	Flagging Criteria	Comments
Matrix spike duplicate (MSD) or sample duplicate	One per preparatory batch per matrix (see Box D-7).	MSD: For matrix evaluation, use LCS acceptance criteria specified by DoD, if available. Otherwise, use in-house LCS control limits. MSD or sample duplicate: RPD ≤ 30% (between MS and MSD or sample and sample duplicate).	Examine the project-specific DQOs. Contact the client as to additional measures to be taken.	For the specific analyte(s) in the parent sample, apply J-flag if acceptance criteria are not met.	The data shall be evaluated to determine the source of difference.
Surrogate spike	All field and QC samples.	QC acceptance criteria specified by DoD, if available. Otherwise, use in-house control limits.	For QC and field samples, correct problem then reprep and reanalyze all failed samples for failed surrogates in the associated preparatory batch, if sufficient sample material is available. If obvious chromatographic interference with surrogate is present, reanalysis may not be necessary.	Apply Q-flag to all associated analytes if acceptance criteria are not met.	Alternative surrogates are recommended when there is obvious chromatographic interference.
Confirmation of positive results (second column or second detector)	All positive results must be confirmed (with the exception of Method 8015).	Calibration and QC criteria same as for initial or primary column analysis. Results between primary and second column RPD ≤ 40%.	NA.	Apply J-flag if RPD > 40%. Discuss in the case narrative.	Use project-specific reporting requirements if available; otherwise, use method reporting requirements; otherwise, report the result from the primary column (see Box D-16).
Results reported between DL and LOQ	NA.	NA.	NA.	Apply J-flag to all results between DL and LOQ.	

Table 4-6
Quality Control Method Criteria for Explosives by SW-846 8330B

Table F-3. Nitroaromatics, Nitramines, and Nitrate Esters Analysis by High-Performance Liquid Chromatography (Method 8330B)					
QC Check	**Minimum Frequency**	**Acceptance Criteria**	**Corrective Action**	**Flagging Criteria**	**Comments**
Demonstrate acceptable analytical capability	Prior to using any test method and at any time there is a significant change in instrument type, personnel, test method, or sample matrix.	QC acceptance criteria published by DoD, if available; otherwise, method-specified criteria.	Recalculate results; locate and fix problem, then rerun demonstration for those analytes that did not meet criteria (see Section C.1.f).	Flagging criteria are not appropriate.	This is a demonstration of analytical ability to generate acceptable precision and bias per the procedure in Appendix C. No analysis shall be allowed by analyst until successful demonstration of capability is complete.
LOD determination and verification (See Box D-13)					
LOQ establishment and verification (See Box D-14)					
Soil drying procedure	Each sample and batch LCS.	Laboratory must have a procedure to determine when the sample is dry to constant weight. Record date, time, and ambient temperature on a daily basis while drying samples.	NA.	Flagging criteria are not appropriate.	
Soil sieving procedure	Each sample and batch LCS.	Weigh entire sample. Sieve entire sample with a 10 mesh sieve. Breakup pieces of soil (especially clay) with gloved hands. Do not intentionally include vegetation in the portion of the sample that passes through the sieve unless this is a project specific requirement. Collect and weigh any portion unable to pass through the sieve.	NA.	Flagging criteria are not appropriate.	

Table 4-6 (Continued)
Quality Control Method Criteria for Explosives by SW-846 8330B

Table F-3. Nitroaromatics, Nitramines, and Nitrate Esters Analysis by High-Performance Liquid Chromatography (Method 8330B) (continued)

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action	Flagging Criteria	Comments
Aqueous sample preparation	Each sample.	Solid phase extraction (SPE) using resin-based solid phase disks or cartridges is required. The salting-out procedure is not permitted.	NA.	Flagging criteria are not appropriate.	
Initial calibration (ICAL)	Minimum of 5 calibration standards with the lowest standard concentration at or below the RL. Once calibration curve or line is generated, the lowest calibration standard must be re-analyzed.	The apparent signal-to-noise ratio at the RL must be at least 5:1. If linear regression is used, $r \geq 0.995$. If using Internal Standardization, RSD ≤ 15%.	Correct problem, then repeat ICAL.	Flagging criteria are not appropriate.	No samples can be run without a valid ICAL. Analysis by HPLC UV, LC/MS, or LC/MS/MS is allowed.
Second source calibration verification (ICV)	Immediately following ICAL.	All analyte(s) and surrogates within ± 20% of true value.	Correct problem and verify second source standard. Rerun ICV. If that fails, correct problem and repeat ICAL.	Flagging criteria are not appropriate.	Problem must be corrected. No samples may be run until calibration has been verified.
Continuing calibration verification (CCV)	Prior to sample analysis, after every 10 field samples, and at the end of the analysis sequence.	All target analytes and surrogates within ± 20% of the expected value from the ICAL.	Correct problem, rerun calibration verification. If that fails, then repeat ICAL. Reanalyze all samples since the last successful calibration verification.	If reanalysis cannot be performed, data must be qualified and explained in the case narrative. Apply Q-flag to all results for the specific analyte(s) in all samples since the last acceptable calibration verification.	Problem must be corrected. Results may not be reported without a valid CCV. Flagging is only appropriate in cases where the samples cannot be reanalyzed.
Method blank	One per preparatory batch.	No analytes detected > ½ RL and greater than 1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater). Blank result must not otherwise affect sample results.	Correct problem, then see criteria in Box D-1. If required, reprep and reanalyze method blank and all samples processed with the contaminated blank.	If reanalysis cannot be performed, data must be qualified and explained in the case narrative. Apply B-flag to all results for the specific analyte(s) in all samples in the associated preparatory batch.	Problem must be corrected. Results may not be reported without a valid method blank. Flagging is only appropriate in cases where the samples cannot be reanalyzed.

Table 4-6 (Continued)
Quality Control Method Criteria for Explosives by SW-846 8330B

Table F-3. Nitroaromatics, Nitramines, and Nitrate Esters Analysis by High-Performance Liquid Chromatography (Method 8330B) (continued)

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action	Flagging Criteria	Comments
LCS containing all analytes to be reported	One per preparatory batch.	A solid reference material containing all reported analytes must be prepared (e.g., ground and subsampled) and analyzed in exactly the same manner as a field sample. In-house laboratory control limits for the LCS must demonstrate the laboratory's ability to meet the project's MQOs.	Correct problem, then reprep and reanalyze the LCS and all samples in the associated preparatory batch for failed analytes, if sufficient sample material is available (see full explanation in Appendix G).	If reanalysis cannot be performed, data must be qualified and explained in the case narrative. Apply Q-flag to specific analyte(s) in all samples in the associated preparatory batch.	Problem must be corrected. Results may not be reported without a valid LCS. Flagging is only appropriate in cases where the samples cannot be reanalyzed.
Matrix Spike (MS)	One per preparatory batch per matrix (see Box D-7).	For matrix evaluation only, therefore is taken post grinding from same ground sample as parent subsample is taken. Percent recovery must meet LCS limits.	Examine the project-specific DQOs. Contact the client as to additional measures to be taken.	For the specific analyte(s) in the parent sample, apply J-flag if acceptance criteria are not met.	For matrix evaluation only. If MS results are outside the LCS limits, the data shall be evaluated to determine the source of difference and to determine if there is a matrix effect or analytical error.
Matrix spike duplicate (MSD) or sample duplicate	One per preparatory batch per matrix (see Box D-7).	For matrix evaluation only, therefore is taken post grinding from same ground sample as parent subsample is taken. Percent recovery must meet LCS limits and relative percent difference (RPD) < 20%.	Examine the project-specific DQOs. Contact the client as to additional measures to be taken.	For the specific analyte(s) in the parent sample, apply J-flag if acceptance criteria are not met.	The data shall be evaluated to determine the source of difference.

Table 4-6 (Continued)
Quality Control Method Criteria for Explosives by SW-846 8330B

Table F-3. Nitroaromatics, Nitramines, and Nitrate Esters Analysis by High-Performance Liquid Chromatography (Method 8330B) (continued)					
QC Check	**Minimum Frequency**	**Acceptance Criteria**	**Corrective Action**	**Flagging Criteria**	**Comments**
Confirmation analysis	When target analytes are detected on the primary column using the UV Detector (HPLC) at concentrations exceeding the Limit of Detection (LOD).	Calibration and QC criteria are the same as for initial or primary column analysis. Results between primary and second column RPD ≤ 40%.	Report from both columns.	If there is a > 40% RPD between the two column results, data must be J-flagged accordingly.	Confirmation analysis is not needed if LC/MS or LC/MS/MS was used for the primary analysis. Secondary column – Must be capable of resolving (separating) all of the analytes of interest and must have a different retention time order relative to the primary column. Any HPLC column used for confirmation analysis must be able to resolve and quantify all project analytes. Detection by HPLC UV, LC/MS or LC/MS/MS. Calibration and calibration verification acceptance criteria is the same as for the primary analysis.
Results reported between DL and LOQ	NA.	NA.	NA.	Apply J-flag to all results between DL and LOQ.	

Table 4-7
Quality Control Method Criteria for Volatiles Organic Compounds by SW-846 8260B and Semivolatile Organic Compounds by SW-846 8270C

Table F-4. Organic Analysis by Gas Chromatography/Mass Spectrometry (Methods 8260 and 8270)					
QC Check	**Minimum Frequency**	**Acceptance Criteria**	**Corrective Action**	**Flagging Criteria**	**Comments**
Demonstrate acceptable analytical capability	Prior to using any test method and at any time there is a significant change in instrument type, personnel, test method, or sample matrix.	QC acceptance criteria published by DoD, if available; otherwise, method-specific criteria.	Recalculate results; locate and fix problem, then rerun demonstration for those analytes that did not meet criteria (see Section C.1.f).	NA.	This is a demonstration of analytical ability to generate acceptable precision and bias per the procedure in Appendix C. No analysis shall be allowed by analyst until successful demonstration of capability is complete.
LOD determination and verification (See Box D-13)					
LOQ establishment and verification (See Box D-14)					
Tuning	Prior to ICAL and at the beginning of each 12-hour period.	Refer to method for specific ion criteria.	Retune instrument and verify. Rerun affected samples.	Flagging criteria are not appropriate.	Problem must be corrected. No samples may be accepted without a valid tune.
Breakdown check (DDT Method 8270 only)	At the beginning of each 12-hour period, prior to analysis of samples.	Degradation ≤ 20% for DDT. Benzidine and pentachlorophenol should be present at their normal responses, and should not exceed a tailing factor of 2.	Correct problem then repeat breakdown check.	Flagging criteria are not appropriate.	No samples shall be run until degradation ≤ 20%.

Table 4-7 (Continued)
Quality Control Method Criteria for Volatiles Organic Compounds by SW-846 8260B and Semivolatile Organic Compounds by SW-846 8270C

Table F-4. Organic Analysis by Gas Chromatography/Mass Spectrometry (Methods 8260 and 8270) (continued)					
QC Check	**Minimum Frequency**	**Acceptance Criteria**	**Corrective Action**	**Flagging Criteria**	**Comments**
Minimum five-point initial calibration (ICAL) for all analytes	ICAL prior to sample analysis.	1. Average response factor (RF) for SPCCs: VOCs ≥ 0.30 for chlorobenzene and 1,1,2,2-tetrachloroethane; ≥ 0.1 for chloromethane, bromoform, and 1,1-dichloroethane. SVOCs ≥ 0.050. 2. RSD for RFs for CCCs: VOCs and SVOCs ≤ 30% and one option below: Option 1: RSD for each analyte ≤ 15%; Option 2: linear least squares regression r ≥ 0.995; Option 3: non-linear regression–coefficient of determination (COD) r^2 ≥ 0.99 (6 points shall be used for second order, 7 points shall be used for third order).	Correct problem then repeat ICAL.	Flagging criteria are not appropriate.	Problem must be corrected. No samples may be run until ICAL has passed. Calibration may not be forced through the origin.
Second source calibration verification (ICV)	Once after each ICAL.	All project analytes within ± 20% of true value.	Correct problem and verify second source standard. Rerun second source verification. If that fails, correct problem and repeat ICAL.	Flagging criteria are not appropriate.	Problem must be corrected. No samples may be run until calibration has been verified.
Retention time window position establishment for each analyte and surrogate	Once per ICAL.	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.	NA.	

Table 4-7 (Continued)
Quality Control Method Criteria for Volatiles Organic Compounds by SW-846 8260B and Semivolatile Organic Compounds by SW-846 8270C

Table F-4. Organic Analysis by Gas Chromatography/Mass Spectrometry (Methods 8260 and 8270) (continued)					
QC Check	**Minimum Frequency**	**Acceptance Criteria**	**Corrective Action**	**Flagging Criteria**	**Comments**
Evaluation of relative retention times (RRT)	With each sample.	RRT of each target analyte within ± 0.06 RRT units.	Correct problem, then rerun ICAL.	Flagging criteria are not appropriate.	Laboratories may update the retention times based on the CCV to account for minor performance fluctuations or after routine system maintenance (such as column clipping). With each sample, the RRT shall be compared with the most recently updated RRT. If the RRT has changed by more than ±0.06 RRT units since the last update, this indicates a significant change in system performance and the laboratory must take appropriate corrective actions as required by the method and rerun the ICAL to reestablish the retention times.
Continuing calibration verification (CCV)	Daily before sample analysis and every 12 hours of analysis time.	1. Average RF for SPCCs: VOCs ≥ 0.30 for chlorobenzene and 1,1,2,2-tetrachloroethane; ≥ 0.1 for chloromethane, bromoform, and 1,1-dichloroethane. SVOCs ≥ 0.050. 2. %Difference/Drift for all target compounds and surrogates: VOCs and SVOCs ≤ 20%D (Note: D = difference when using RFs or drift when using least squares regression or non-linear calibration).	DoD project level approval must be obtained for each of the failed analytes or corrective action must be taken. Correct problem, then rerun calibration verification. If that fails, then repeat ICAL. Reanalyze all samples since last acceptable CCV.	If reanalysis cannot be performed, data must be qualified and explained in the case narrative. Apply Q-flag to all results for the specific analyte(s) in all samples since last acceptable CCV.	Problem must be corrected. Results may not be reported without a valid CCV. Flagging is only appropriate in cases where the samples cannot be reanalyzed.

Table 4-7 (Continued)
Quality Control Method Criteria for Volatiles Organic Compounds by SW-846 8260B and Semivolatile Organic Compounds by SW-846 8270C

Table F-4. Organic Analysis by Gas Chromatography/Mass Spectrometry (Methods 8260 and 8270) (continued)					
QC Check	**Minimum Frequency**	**Acceptance Criteria**	**Corrective Action**	**Flagging Criteria**	**Comments**
Internal standards verification	Every field sample, standard, and QC sample.	Retention time ± 30 seconds from retention time of the midpoint standard in the ICAL; EICP area within -50% to +100% of ICAL midpoint standard.	Inspect mass spectrometer and GC for malfunctions. Reanalysis of samples analyzed while system was malfunctioning is mandatory.	If corrective action fails in field samples, apply Q-flag to analytes associated with the non-compliant IS. Flagging criteria are not appropriate for failed standards.	Sample results are not acceptable without a valid IS verification.
Method blank	One per preparatory batch.	No analytes detected > ½ RL and > 1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater). Blank result must not otherwise affect sample results. For common laboratory contaminants, no analytes detected > RL (see Box D-1).	Correct problem, then see criteria in Box D-1. If required, reprep and reanalyze method blank and all samples processed with the contaminated blank.	If reanalysis cannot be performed, data must be qualified and explained in the case narrative. Apply B-flag to all results for the specific analyte(s) in all samples in the associated preparatory batch.	Problem must be corrected. Results may not be reported without a valid method blank. Flagging is only appropriate in cases where the samples cannot be reanalyzed.
LCS containing all analytes to be reported, including surrogates	One per preparatory batch.	QC acceptance criteria specified by DoD, if available. Otherwise, use in-house control limits. In-house control limits may not be greater than ± 3 times the standard deviation of the mean LCS recovery. See Box D-3 and Appendix G.	Correct problem, then reprep and reanalyze the LCS and all samples in the associated preparatory batch for failed analytes, if sufficient sample material is available (see full explanation in Appendix G).	If reanalysis cannot be performed, data must be qualified and explained in the case narrative. Apply Q-flag to specific analyte(s) in all samples in the associated preparatory batch.	Problem must be corrected. Results may not be reported without a valid LCS. Flagging is only appropriate in cases where the samples cannot be reanalyzed.
Matrix Spike (MS)	One per preparatory batch per matrix (see Box D-7).	For matrix evaluation, use LCS acceptance criteria specified by DoD, if available. Otherwise, use in-house LCS control limits.	Examine the project-specific DQOs. Contact the client as to additional measures to be taken.	For the specific analyte(s) in the parent sample, apply J-flag if acceptance criteria are not met.	For matrix evaluation only. If MS results are outside the LCS limits, the data shall be evaluated to determine the source of difference and to determine if there is a matrix effect or analytical error.

Table 4-7 (Continued)
Quality Control Method Criteria for Volatiles Organic Compounds by SW-846 8260B and Semivolatile Organic Compounds by SW-846 8270C

Table F-4. Organic Analysis by Gas Chromatography/Mass Spectrometry (Methods 8260 and 8270) (continued)					
QC Check	**Minimum Frequency**	**Acceptance Criteria**	**Corrective Action**	**Flagging Criteria**	**Comments**
Matrix spike duplicate (MSD) or sample duplicate	One per preparatory batch per matrix (see Box D-7).	MSD: For matrix evaluation, use LCS acceptance criteria specified by DoD, if available. Otherwise, use in-house LCS control limits. MSD or sample duplicate: RPD ≤ 30% (between MS and MSD or sample and sample duplicate).	Examine the project-specific DQOs. Contact the client as to additional measures to be taken.	For the specific analyte(s) in the parent sample, apply J-flag if acceptance criteria are not met.	The data shall be evaluated to determine the source of difference.
Surrogate spike	All field and QC samples.	QC acceptance criteria specified by DoD, if available. Otherwise, use in-house control limits.	For QC and field samples, correct problem then reprep and reanalyze all failed samples for failed surrogates in the associated preparatory batch, if sufficient sample material is available. If obvious chromatographic interference with surrogate is present, reanalysis may not be necessary.	Apply Q-flag to all associated analytes if acceptance criteria are not met.	Alternative surrogates are recommended when there is obvious chromatographic interference.
Results reported between DL and LOQ	NA.	NA.	NA.	Apply J-flag to all results between DL and LOQ.	

Table 4-8
Quality Control Method Criteria for Metals by SW-846 6010B and 7470A/7471A

Table F-7. Inorganic Analysis by Inductively Coupled Plasma (ICP) Atomic Emission Spectrometry and Atomic Absorption Spectrophotometry (AA) (Methods 6010 and 7000 Series)					
QC Check	**Minimum Frequency**	**Acceptance Criteria**	**Corrective Action**	**Flagging Criteria**	**Comments**
Demonstrate acceptable analytical capability	Prior to using any test method and at any time there is a significant change in instrument type, personnel, test method, or sample matrix.	QC acceptance criteria published by DoD, if available; otherwise, method-specified criteria.	Recalculate results; locate and fix problem, then rerun demonstration for those analytes that did not meet criteria (see Section C.1.f).	NA.	This is a demonstration of analytical ability to generate acceptable precision and bias per the procedure in Appendix C. No analysis shall be allowed by analyst until successful demonstration of capability is complete.
LOD determination and verification (See Box D-13)					
LOQ establishment and verification (See Box D-14)					
Instrument detection limit (IDL) study (ICP only)	At initial set-up and after significant change in instrument type, personnel, test method, or sample matrix.	IDLs shall be ≤ LOD.	NA.	NA.	Samples may not be analyzed without a valid IDL.
Linear dynamic range or high-level check standard (ICP only)	Every 6 months.	Within ± 10% of true value.	NA.	NA.	

Table 4-8 (Continued)
Quality Control Method Criteria for Metals by SW-846 6010B and 7470A/7471A

Table F-7. Inorganic Analysis by Inductively Coupled Plasma (ICP) Atomic Emission Spectrometry and Atomic Absorption Spectrophotometry (AA) (Methods 6010 and 7000 Series) (continued)

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action	Flagging Criteria	Comments
Initial calibration (ICAL) for all analytes **ICP: minimum one high standard and a calibration blank;** **GFAA: minimum three standards and a calibration blank;** **CVAA: minimum 5 standards and a calibration blank**	Daily ICAL prior to sample analysis.	If more than one calibration standard is used, $r \geq 0.995$.	Correct problem, then repeat ICAL.	Flagging criteria are not appropriate.	Problem must be corrected. No samples may be run until ICAL has passed.
Second source calibration verification (ICV)	Once after each ICAL, prior to beginning a sample run.	Value of second source for all analyte(s) within ± 10% of true value.	Correct problem and verify second source standard. Rerun ICV. If that fails, correct problem and repeat ICAL.	Flagging criteria are not appropriate.	Problem must be corrected. No samples may be run until calibration has been verified.
Continuing calibration verification (CCV)	After every 10 field samples and at the end of the analysis sequence.	ICP: within ± 10% of true value; GFAA: within ± 20% of true value; CVAA: within ± 20% of true value.	Correct problem, rerun calibration verification. If that fails, then repeat ICAL. Reanalyze all samples since the last successful calibration verification.	If reanalysis cannot be performed, data must be qualified and explained in the case narrative. Apply Q-flag to all results for the specific analyte(s) in all samples since the last acceptable calibration verification.	Problem must be corrected. Results may not be reported without a valid CCV. Flagging is only appropriate in cases where the samples cannot be reanalyzed.
Low-level calibration check standard (ICP only)	Daily, after one-point ICAL.	Within ± 20% of true value.	Correct problem, then reanalyze.	Flagging criteria are not appropriate.	No samples may be analyzed without a valid low-level calibration check standard. Low-level calibration check standard should be less than or equal to the reporting limit.

Table 4-8 (Continued)
Quality Control Method Criteria for Metals by SW-846 6010B and 7470A/7471A

Table F-7. Inorganic Analysis by Inductively Coupled Plasma (ICP) Atomic Emission Spectrometry and Atomic Absorption Spectrophotometry (AA) (Methods 6010 and 7000 Series) (continued)

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action	Flagging Criteria	Comments
Method blank	One per preparatory batch.	No analytes detected > ½ RL and greater than 1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater). Blank result must not otherwise affect sample results. For common laboratory contaminants, no analytes detected > RL (see Box D-1).	Correct problem, then see criteria in Box D-1. If required, reprep and reanalyze method blank and all samples processed with the contaminated blank.	If reanalysis cannot be performed, data must be qualified and explained in the case narrative. Apply B-flag to all results for the specific analyte(s) in all samples in the associated preparatory batch.	Problem must be corrected. Results may not be reported without a valid method blank. Flagging is only appropriate in cases where the samples cannot be reanalyzed.
Calibration blank	Before beginning a sample run, after every 10 samples, and at end of the analysis sequence.	No analytes detected > LOD.	Correct problem. Re-prep and reanalyze calibration blank. All samples following the last acceptable calibration blank must be reanalyzed.	Apply B-flag to all results for specific analyte(s) in all samples associated with the blank.	
Interference check solutions (ICS) (ICP only)	At the beginning of an analytical run.	ICS-A: Absolute value of concentration for all non-spiked analytes < LOD (unless they are a verified trace impurity from one of the spiked analytes); ICS-AB: Within ± 20% of true value.	Terminate analysis; locate and correct problem; reanalyze ICS, reanalyze all samples.	If corrective action fails, apply Q-flag to all results for specific analyte(s) in all samples associated with the ICS.	
LCS containing all analytes to be reported	One per preparatory batch.	QC acceptance criteria specified by DoD, if available; see Box D-3 and Appendix G.	Correct problem, then reprep and reanalyze the LCS and all samples in the associated preparatory batch for failed analytes, if sufficient sample material is available (see full explanation in Appendix G).	If reanalysis cannot be performed, data must be qualified and explained in the case narrative. Apply Q-flag to specific analyte(s) in all samples in the associated preparatory batch.	Problem must be corrected. Results may not be reported without a valid LCS. Flagging is only appropriate in cases where the samples cannot be reanalyzed.

Table 4-8 (Continued)
Quality Control Method Criteria for Metals by SW-846 6010B and 7470A/7471A

Table F-7. Inorganic Analysis by Inductively Coupled Plasma (ICP) Atomic Emission Spectrometry and Atomic Absorption Spectrophotometry (AA) (Methods 6010 and 7000 Series) (continued)

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action	Flagging Criteria	Comments
Matrix spike (MS)	One per preparatory batch per matrix (see Box D-7).	For matrix evaluation, use QC acceptance criteria specified by DoD for LCS.	Examine the project-specific DQOs. If the matrix spike falls outside of DoD criteria, additional quality control tests are required to evaluate matrix effects.	For the specific analyte(s) in the parent sample, apply J-flag if acceptance criteria are not met.	For matrix evaluation only. If MS results are outside the LCS limits, the data shall be evaluated to determine the source of difference and to determine if there is a matrix effect or analytical error.
Matrix spike duplicate (MSD) or sample duplicate	One per preparatory batch per matrix (see Box D-7).	MSD: For matrix evaluation use QC acceptance criteria specified by DoD for LCS. MSD or sample duplicate: RPD ≤ 20% (between MS and MSD or sample and sample duplicate).	Examine the project-specific DQOs. Contact the client as to additional measures to be taken.	For the specific analyte(s) in the parent sample, apply J-flag if acceptance criteria are not met.	The data shall be evaluated to determine the source of difference.
Dilution test (ICP and GFAA only)	One per preparatory batch.	Five-fold dilution must agree within ± 10% of the original measurement.	ICP: Perform post-digestion spike (PDS) addition; GFAA: Perform recovery test.	Flagging criteria are not appropriate.	Only applicable for samples with concentrations > 50 x LOQ.
Post-digestion spike (PDS) addition (ICP only)	When dilution test fails or analyte concentration in all samples < 50 x LOD.	Recovery within 75-125% (see Table B-1).	Run all associated samples in the preparatory batch by method of standard additions (MSA) or see flagging criteria.	For the specific analyte(s) in the parent sample, apply J-flag if acceptance criteria are not met.	Spike addition should produce a concentration of 10 – 100 x LOQ.
Recovery test (GFAA only)	When dilution test fails or analyte concentration in all samples < 25 x LOD.	Recovery within 85-115%.	Run all associated samples in the preparatory batch by method of standard additions (MSA) or see flagging criteria.	For the specific analyte(s) in the parent sample, apply J-flag if acceptance criteria are not met.	
Method of standard additions (MSA)	When matrix interference is confirmed.	NA.	NA.	NA.	Document use of MSA in the case narrative.
Results reported between DL and LOQ	NA.	NA.	NA.	Apply J-flag to all results between DL and LOQ.	

Table 4-9
Quality Control Method Criteria for Perchlorate by SW-846 6850

Table F-12. Perchlorate Analysis (Methods 6850 and 6860)					
QC Check	**Minimum Frequency**	**Acceptance Criteria**	**Corrective Action**	**Flagging Criteria**	**Comments**
Demonstrate acceptable analytical capability	Prior to using any test method and at any time there is a significant change in instrument type, personnel, test method, or sample matrix.	QC acceptance criteria published by DoD, if available; otherwise, method-specified criteria.	Recalculate results; locate and fix problem, then rerun demonstration for the analyte that did not meet criteria (see Section C.1.f).	Flagging criteria are not appropriate.	This is a demonstration of analytical ability to generate acceptable precision and bias per the procedure in Appendix C. No analysis shall be allowed by analyst until successful demonstration of capability is complete.
LOD determination and verification (See Box D-13)					
LOQ establishment and verification (See Box D-14)					
Initial calibration (ICAL)	Minimum of 5 calibration standards to establish linearity at method set-up and after major maintenance.	$r \geq 0.995$ or RSD $\leq 20\%$. The concentration corresponding to the absolute value of the calibration curve's Y-intercept must be $\leq$ LOD.	Correct problem, then repeat ICAL.	Flagging criteria are not appropriate.	Problem must be corrected. No samples may be run until ICAL has passed. The calibration is linear and shall not be forced through the origin.
Initial calibration verification (ICV)	Once after each ICAL, analysis of a second source standard at the midpoint of the calibration.	Within ± 15% of true value.	Correct problem and verify second source standard. Rerun ICV. If that fails, correct problem and repeat ICAL.	Flagging criteria are not appropriate.	Problem must be corrected. No samples may be run until calibration has been verified.
Continuing calibration verification (CCV)	Analysis of mid-level standard after every 10 field samples. All samples must be bracketed by the analysis of a standard demonstrating that the system was capable of accurately detecting and quantifying perchlorate.	Within ± 15% of true value.	Correct problem, rerun calibration verification. If that fails, then repeat ICAL. Reanalyze all samples since the last successful calibration verification.	If reanalysis cannot be performed, data must be qualified and explained in the case narrative. Apply Q-flag to all results for the specific analyte(s) in all samples since the last acceptable calibration verification.	Problem must be corrected. Results may not be reported without a valid CCV. Flagging is only appropriate in cases where the samples cannot be reanalyzed.

Table 4-9 (Continued)
Quality Control Method Criteria for Perchlorate by SW-846 6850

Table F-12. Perchlorate Analysis (Methods 6850 and 6860) (continued)					
QC Check	**Minimum Frequency**	**Acceptance Criteria**	**Corrective Action**	**Flagging Criteria**	**Comments**
Limit of detection verification (LODV) (per batch)	Prior to sample analysis and at the end of the analysis sequence. It can be analyzed after every 10 samples in order to reduce the reanalysis rate.	Within ± 30% of true value.	Correct problem and rerun LODV and all samples analyzed since last successful LODV. If a sample with perchlorate concentration at or between the LOD and RL is bracketed by a failing LODV, it must be reanalyzed. A sample with concentration above the RL can be reported.	If reanalysis cannot be performed, data must be qualified and explained in the case narrative. Apply Q-flag to all results for the specific analyte(s) in all samples since the last acceptable LODV.	Problem must be corrected. Results may not be reported without a valid LODV. Flagging is only appropriate in cases where the samples cannot be reanalyzed. Perchlorate spike concentration is approximately 2 times the limit of detection.
Isotope ratio $^{35}Cl/^{37}Cl$	Every sample, batch QC sample, and standard.	Monitor for either the parent ion at masses 99/101 or the daughter ion at masses 83/85 depending on which ions are quantitated. Theoretical ratio ~ 3.06. Must fall within 2.3 to 3.8.	If criteria are not met, the sample must be rerun. If the sample was not pretreated, the sample should be reextracted using cleanup procedures. If, after cleanup, the ratio still fails, use alternative techniques to confirm presence of perchlorate (i.e., a post spike sample, dilution to reduce any interference, etc.).	Apply J-flag if acceptance criteria are not met.	Decision to report data failing ratio check should be thoroughly documented in case narrative.
Internal standard (IS)	Addition of ^{18}O-labeled perchlorate to every sample, batch QC sample, standard, instrument blank, and method blank.	Measured ^{18}O IS area within ± 50% of the value from the average of the IS area counts of the ICAL. RRT of the perchlorate ion must be 1.0 ± 2% (0.98 – 1.02).	Rerun the sample at increasing dilutions until the ± 50% acceptance criteria are met. If criteria cannot be met with dilution, the interference are suspected and the sample must be reprepped using additional pretreatment steps.	Apply Q-flag and discuss in the case narrative.	If peak is not within retention time window, presence is not confirmed. Use for quantitation and to ensure identification. Failing internal standard should be thoroughly documented in the case narrative.

Table 4-9 (Continued)
Quality Control Method Criteria for Perchlorate by SW-846 6850

Table F-12. Perchlorate Analysis (Methods 6850 and 6860) (continued)					
QC Check	**Minimum Frequency**	**Acceptance Criteria**	**Corrective Action**	**Flagging Criteria**	**Comments**
Interference check sample (ICS)	One ICS is prepared with every batch of 20 samples and must undergo the same preparation and pretreatment steps as the samples in the batch. It verifies the method performance at the matrix conductivity threshold (MCT). At least one ICS must be analyzed daily.	Within ± 30% of true value.	Correct problem and then reanalyze all samples in that batch. If poor recovery from the cleanup filters is suspected, a different lot of filters must be used to reextract all samples in the batch. If column degradation is suspected, a new column must be calibrated before the samples can be reanalyzed.	Flagging criteria are not appropriate.	Analysis of a standard containing perchlorate at the RL and interfering anions at the concentration determined by the interference threshold study. Monitor recovery of perchlorate and retention time. No samples may be reported that are associated with a failing ICS.
Laboratory reagent blank	Prior to calibration, after samples with overrange concentration of perchlorate, and at the end of the analytical sequence.	No perchlorate detected > ½ RL.	Reanalyze reagent blank (until no carryover is observed) and all samples processed since the contaminated blank.	If reanalysis cannot be performed, data must be qualified and explained in the case narrative. Apply B-flag to all results for the specific analyte(s) in all samples in the associated batch.	Problem must be corrected. Results may not be reported without a valid reagent blank. Flagging is only appropriate in cases where the samples cannot be reanalyzed.
Tuning	Prior to ICAL and after any mass calibration or maintenance is performed.	Tuning standards must contain the analytes of interest and meet acceptance criteria outlined in the laboratory SOP.	Retune instrument. If the tuning will not meet acceptance criteria, an instrument mass calibration must be performed and the tuning redone.	Flagging criteria are not appropriate.	Problem must be corrected. Sample analysis shall not proceed without acceptable tuning.

Table 4-9 (Continued)
Quality Control Method Criteria for Perchlorate by SW-846 6850

Table F-12. Perchlorate Analysis (Methods 6850 and 6860) (continued)					
QC Check	**Minimum Frequency**	**Acceptance Criteria**	**Corrective Action**	**Flagging Criteria**	**Comments**
Mass calibration	Instrument must have a valid mass calibration prior to any sample analysis. The mass calibration is updated on an as-needed basis (e.g., QC failures, ion masses show large deviations from known masses, major instrument maintenance is performed, or the instrument is moved).	Mass calibration range must bracket the ion masses of interest without greatly exceeding the range. The most recent mass calibration must be used for an analytical run, and the same mass calibration must be used for all data files in an analytical run. Mass calibration must be verified by acquiring a full scan continuum mass spectrum of a perchlorate stock standard. Perchlorate ions should be within ± 0.3 *m/z* of mass 99, 101, and 107 or their respective daughter ion masses (83, 85, and 89), depending on which ions are quantitated.	If the mass calibration fails, recalibrate. If it still fails, consult manufacturer instructions on corrective maintenance.	Flagging criteria are not appropriate.	Problem must be corrected. No samples may be analyzed under a failing mass calibration.
Interference threshold study	At initial setup and when major changes occur in the method's operating procedures (e.g., addition of cleanup procedures, column changes, mobile phase changes).	Measure the threshold of common suppressors (chloride, sulfate, carbonate, bicarbonate) that can be present in the system without affecting the quantitation of perchlorate. The threshold is the concentration of the common suppressors where perchlorate recovery falls outside an 85-115% window.	NA.	Flagging criteria are not appropriate.	This study and site history will determine the concentration at which the ICS suppressors should be set.

Table 4-9 (Continued)
Quality Control Method Criteria for Perchlorate by SW-846 6850

Table F-12. Perchlorate Analysis (Methods 6850 and 6860) (continued)					
QC Check	**Minimum Frequency**	**Acceptance Criteria**	**Corrective Action**	**Flagging Criteria**	**Comments**
Method blank (MB)	One per preparatory batch.	No perchlorate detected > ½ RL and greater than 1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater). Blank result must not otherwise affect sample results.	Correct problem, then see criteria in Box D-1. If required, reprep and reanalyze method blank and all samples processed with the contaminated blank.	If reanalysis cannot be performed, data must be qualified and explained in the case narrative. Apply B-flag to all results for the specific analyte(s) in all samples in the associated preparatory batch.	Problem must be corrected. Results may not be reported without a valid method blank. Flagging is only appropriate in cases where the samples cannot be reanalyzed. Method blank must undergo the same preparation and pretreatment steps as the samples in the batch.
Laboratory control sample (LCS)	One per preparatory batch. LCS must be spiked at the RL.	Recovery within method requirements, laboratory-generated limits, or 80-120% (whichever is more stringent) to verify calibration and to check method performance.	Correct problem, then reprep and reanalyze the LCS and all samples in the associated preparatory batch for failed analytes, if sufficient sample material is available (see full explanation in Appendix G).	If reanalysis cannot be performed, data must be qualified and explained in the case narrative. Apply Q-flag to specific analyte(s) in all samples in the associated preparatory batch.	Problem must be corrected. Results may not be reported without a valid LCS. Flagging is only appropriate in cases where the samples cannot be reanalyzed. LCS must undergo the same preparation and pretreatment steps as the samples in the batch.
Matrix spike (MS)	One per preparatory batch per matrix (see Box D-7). The MS must be spiked at the RL.	Recovery within 80-120% or within laboratory generated limits, whichever is more stringent.	Examine the project-specific DQOs. Contact the client as to additional measures to be taken.	For the specific analyte(s) in the parent sample, apply J-flag if acceptance criteria are not met.	For matrix evaluation only. If MS results are outside the limits, the data must be evaluated to determine the source of the difference and to determine if there is a matrix effect or analytical error. MS must undergo the same preparation and pretreatment steps as the samples in the batch.

Table 4-9 (Continued)
Quality Control Method Criteria for Perchlorate by SW-846 6850

Table F-12. Perchlorate Analysis (Methods 6850 and 6860) (continued)					
QC Check	**Minimum Frequency**	**Acceptance Criteria**	**Corrective Action**	**Flagging Criteria**	**Comments**
Matrix spike duplicate (MSD) or laboratory duplicate (LD)	One per preparatory batch per matrix (see Box D-7). The MSD must be spiked at the RL.	MSD: Recovery within 80-120% or within laboratory generated limits, whichever is more stringent. MSD or laboratory duplicate: RPD < 15%.	Examine the project-specific DQOs. Contact the client as to additional measures to be taken.	For the specific analyte(s) in the parent sample, apply J-flag if acceptance criteria are not met.	The data shall be evaluated to determine the source of difference.
Results reported between DL and LOQ	Positive detections calculated per method.	NA.	NA.	Apply J-flag to all results between DL and LOQ.	

Table 4-10
Quality Control Method Criteria for Organic and Inorganic Carbon by SW-846 9060

Procedure	Frequency of QC Procedure	Acceptance Criteria	Corrective Action
Initial calibration curve 5-pt curve	Major maintenance, instrument modification, per manufacturer's specifications	r > 0.995 r: linear correlation coefficient Qualify results between MDL and MRL as estimated.	If r < 0.995, the standards must be prepared again.
Initial calibration standard (calibration verification)	1 per batch	Recovery ±10% of true value.	If criteria are not met, reanalyze the daily standards. If the daily standard fails a second time, initial calibration must be repeated.
Continuing calibration verification (CCV)	Every 10 samples, end of analytical run	Recovery ±10% of true value.	Reanalyze CCV. If the CCV fails second time, the analysis must be terminated, the problem corrected, the instrument re-calibrated, and the calibration re-verified prior to continuing sample analyses.
Continuing calibration blank (CCB)	Every 10 samples, end of analytical run	< ½ MRL	If not within criteria, terminate the analysis, correct the problem, re-calibrate, and reanalyze all samples analyzed since the last acceptable CCB.
Preparation blank	1 per 20 samples per matrix	< ½ MRL	Documented source of contamination.
Laboratory control sample	Every batch for all compounds	75%≤%Rec.≤125% or ± 3 standard deviations of the mean from historical data points.	%R are outside criteria, sample batch should be re-calibrated and re-analyzed. If still outside criteria, qualify associated data biased high or biased low as appropriate.
Matrix spike and duplicate	1 per 20 samples per matrix	75%≤%Rec.≤125% or ± 3 standard deviations of the mean from historical data points. RPD≤20%.	If MS/MSD results do not meet criteria, the reviewer should review the data in conjunction with other QC results to determine if the problem is specific to QC samples or systematic. Qualify as appropriate.

Ref: *USEPA Test Methods for Evaluating Solid Waste Physical/Chemical Methods, Update IV* (USEPA, 2007) and *DoD QSM for Environmental Laboratories, Final Version 4.1* (DoD, 2009).

4.7.2.1 Laboratory Calibration

Prior to sample analysis, chemical calibration of each target analyte/compound must be performed to ensure analytical instrumentation is functioning within the established sensitivity range. Laboratory calibration steps include the performing of solution validation, initial calibration, daily calibration, and continuing calibration procedures. Protocols defining the QC procedures, rounding rules, corrective actions, and QC measurements for instrument calibration should be done in accordance with criteria specified in the analytical method, LQAP, and the prime contractor's SOPs. The units and method QLs for the analytical methods to be used are found in **Table 4-2**. The QA/QC method calibration requirements may be found in **Tables 4-5 through 4-10**. Further details as to laboratory calibrations and equipment use may be found in the laboratory's LQAP located in **Appendix C**.

4.7.2.2 Chemical Analyses for Off-Site Laboratory Samples

TCL VOCs. Aqueous and solid samples will be analyzed for TCL VOCs using USEPA SW-846 Method 5035A/8260B for solid matrices using purge and trap technology. Soil samples will be collected using prescribed field preservation techniques with Terracore samplers or using Encore samplers and subsequently sent to the laboratory for analysis. No sodium bisulfate will be added to the soils due to the possibility of effervescence and ketone formation. For soils, an inert gas is bubbled through a mixture of reagent water and 5-gram sample in a specifically designed purging chamber at 40°C or through a 25 milliliters (mL) for aqueous sample contained at ambient temperature. The vapor is swept through a sorbent column where the purgeable compounds were trapped. After purging was completed for both solid and aqueous samples, the sorbent column was heated and backflushed with the inert gas to desorb the purgeable compounds onto a gas chromatograph programmed to separate the purgeable compounds, which are then detected with a mass spectrometer. The gas chromatography/mass spectroscopy (GC/MS) instrument is calibrated for a series of target analytes using chemical standards of known concentration and purity. Quantification of these target analytes are performed against specific internal standards as identified in the respective method. Identification of these target analytes are based on a comparison of the analyte to the chemical standards used during calibration and on the analyte's retention time and mass spectra.

TCL SVOCs/PAHs. Aqueous and solid samples will be analyzed for TCL SVOCs and PAHs using USEPA SW-846 Method 8270C. A separate run using selective ion monitoring (SIM) by USEPA SW-846 Method 8270C SIM will be employed for PAH analysis to achieve lower quantitation and detection limits in order to meet screening criteria. Soil samples will be extracted using ultrasonic extraction according to USEPA SW-846 Method 3550C and aqueous samples will be extracted using a separatory funnel extraction technique according to USEPA SW-846 Method 3510C. TCLP SVOC extracts will be extracted according to USEPA SW-846 Method 1311/3510C for solid IDM samples. The extracts will be injected into a gas chromatograph programmed to separate the compounds, which are then detected with a mass spectrometer. The GC/MS instrument is calibrated for a series of target analytes using chemical standards of known concentration and purity. Quantification of these target analytes are performed against specific internal standards as identified in the respective method. Identification of these target analytes are based on a comparison of the analyte to the chemical standards used during calibration and on the analyte's retention time and mass spectra.

TCL Pesticides/PCBs. Aqueous and solid samples will be analyzed for TCL pesticides and PCBs using USEPA SW-846 Methods 8081A and 8082, respectively. Aqueous and solid samples will be prepared for analysis using extraction techniques. Solid samples will be extracted using ultrasonic extraction method USEPA SW-846 Method 3550C for samples. Aqueous samples will be extracted using a separatory funnel extraction technique by USEPA SW-846 Method 3510C. The extract will be injected into a gas chromatograph programmed to separate the compounds, which are then detected with an electron capture detector. Sulfur cleanups will be employed to aid in the quantification based upon the matrix interferences. Identification of these target analytes are based on a comparison of the analyte to the chemical standards used during calibration and on the analyte's retention time using primary and secondary dissimilar columns as confirmation.

Herbicides. Aqueous and solid samples will be analyzed for herbicides according to USEPA SW-846 Method 8151A. Solid samples are extracted with diethyl ether and then esterified with either diazomethane or pentafluorobenzyl bromide. The derivatives are determined by GC with an electron capture detector. The results are reported as acid equivalents. Identification of the target analytes are based on a comparison of the analyte to the chemical standards used during calibration and on the analyte's retention time using primary and secondary dissimilar columns as confirmation.

Explosives. Aqueous and solid samples will be analyzed for select explosives using USEPA SW-846 Method 8330B modified using high performance liquid chromatography using a dual wavelength ultraviolet detector. For aqueous samples, a measured volume of sample is adjusted to a specified pH and then extracted using a Solid-phase Extraction device. Target analytes are eluted from the solid-phase media using methylene chloride. The resulting solvent extract is dried using sodium sulfate and concentrated. The concentrated extract may be exchanged into a solvent compatible with subsequent cleanup procedures and then measurement of the target analytes separated on a C-18 reverse phase column. For solid samples, they will be homogenized and analyzed using USEPA SW-846 Method 8330B modified. A 10-g portion is taken for analysis and thoroughly mixed to allow for representative homogenizing. This is achieved by air-drying at room temperature for 24 hours, sieving through a 10-mesh sieve, grinding, and mixing the bulk sample. The modification includes the subjectively removing vegetation (organic debris) and pebbles as well as the sampling and analysis of discrete samples (i.e., no compositing). Solid samples will be extracted using acetonitirile in an ultrasonic bath, then filtered and data reduction similarly to that for the aqueous samples. Sample concentrations are to be confirmed on dissimilar columns.

TAL Metals (excluding mercury). TAL metals (excluding mercury) will be analyzed using inductively coupled plasma (ICP) techniques using USEPA SW-846 Methods 3010A/6010B for aqueous samples (e.g., rinse blanks) and 3050B/6010B for solid samples. The ICP method involves the simultaneous or sequential multi-element assessment of trace elements in solution. The basis of the method is the measurement of atomic emission by optical spectrometry. Samples are nebulized and the aerosol that is produced is transported to the plasma torch where excitation occurs. Characteristic atomic-line emission spectra are produced by a radio-frequency ICP. A background correction technique is utilized to compensate for variable background contribution for the assessment of trace elements.

Mercury. Mercury will be analyzed using cold vapor atomic absorption technique according to USEPA SW-846 Method 7470A for aqueous samples and Method 7471A for solid samples. A

sample aliquot is initially digested with nitric acid to free combined mercury. The mercury is then reduced to its elemental state and aerated from the solution into a closed system. The mercury vapor is passed through a cell positioned in the path of the mercury light source, and the measured abundance is proportional to the concentration of mercury in the sample.

Perchlorate. Aqueous samples will be analyzed for perchlorate using USEPA SW-846 Method 6850 following the *DoD Perchlorate Handbook; Revision 1; Change 1* (DoD, 2007) requirements. The High Pressure Liquid Chromatography Mass Spectrometry (HPLC-MS) method 6850 uses a second order external standard approach using laboratory ChemStation or equivalent software. The method provides HPLC-MS conditions for the detection of perchlorate in SIM mode at m/z 83 and 85, which corresponds to the loss of one oxygen atom from the perchlorate molecule. Samples are injected into the HPLC-MS and the ion ratio of m/z 83 to 85 was used to positively identify the response peak as perchlorate. Quantitation is performed using the m/z 83 peak area. An internal standard of ^{18}O labeled perchlorate is added to each sample to establish the perchlorate peak retention time and used in the quantitation. Confirmation is obtained by the use of the mass spectrometer.

Asbestos. Soil samples are proposed to be analyzed for asbestos using method NYDOH ELAP 198.4 using a threshold electron microscope (TEM). Soil samples are to be ground to insure homogeneity. A portion of the sample is removed for analysis and is weighed and then burned in a muffle furnace for 4-8 hours. The sample is removed from the muffle furnace and weighed again. The material lost during the burning process represents the organic material. If necessary, the sample is treated with hydrochloric acid to remove any acid soluble material. Again, the sample is weighed to determine the amount of material lost in acid treatment. Iso-propanol is added to the ash and the solution is sonicated to ensure an even distribution of fibers in the solution. A micro drop is placed on a copper grid and is examined under the TEM scope to determine the presence, the amount, and the type of asbestos in the sample. If asbestos is present, the amount present in the residual ash is back calculated to account for the material lost during gravimetric reduction and acid treatment. Reports identify the percent and type of asbestos, the percent organic material, the percent acid soluble material, and the percent of "other" material. The limit of detection is 1% -- anything under 1% asbestos is reported as trace.

4.7.2.3 Chemical Analyses for Waste Characterization Samples

TCLP Metals and TCLP SVOCs. Samples for disposal analysis for TCLP metals and SVOCs will undergo a TCLP extraction by USEPA SW-846 Method 1311. Samples are separated by phase, particle size reduced (for solids), and extracted for 18 hours in an extraction fluid. The final liquid extract is separated from the solid material and combined with the initial liquid phase (if applicable). The sample TCLP extract is then treated as an aqueous sample for analysis of metals and SVOCs following the analytical procedures as noted above.

TAL Metals (excluding mercury). Aqueous IDM samples will be analyzed using ICP techniques as discussed above.

Mercury. Aqueous IDM samples for mercury will be analyzed using cold vapor atomic absorption technique as noted above.

Chemical Oxygen Demand. Aqueous IDM samples will be analyzed for COD using *USEPA Methods for Chemical Analysis of Water and Wastes* Method 410.4 (USEPA, 1983). A sample is heated under acidic conditions at a slow, constant rate in an oven or block digestor in the

presence of dichromate at 150°C for 2 hours. The COD is measured at 600 nanometers spectrophotometrically.

pH and Corrosivity as pH. pH and corrosivity as pH will be analyzed using USEPA SW-846 Method 9040C for aqueous samples and Method 9045D for solid samples. A sample pH is directly measured electrometrically using either a glass electrode in combination with a reference potential or a combination electrode. For solids, samples are mixed 1:1 with reagent water prior to measurement.

Reactivity. Reactivity comprises of reactive sulfide and reactive cyanide. Following EPA guidance, reactivity will be determined as total cyanide and total sulfide. Total sulfide is analyzed in aqueous and solid samples using USEPA SW-846 Method 9030B. This procedure is a colorimetric determination. Sulfide reacts with dimethyl-p-phenylenediamine in the presence of ferric chloride to produce methylene blue. Total cyanide is analyzed in aqueous and solid samples using USEPA SW-846 Method 9012B/9014. The cyanide as hydrocyanic acid (HCN) is released from cyanide complexes by means of a reflux-distillation operation and absorbed in a scrubber containing sodium hydroxide solution. The cyanide ion in the absorbing solution was then determined colorimetrically.

Ignitability. Ignitability is analyzed using USEPA SW-846 Method 1010A for aqueous samples and USEPA SW-846 Method 1030 for solid samples. A sample is heated at a slow, constant rate with continual stirring. A small flame is directed into the cup at regular intervals with simultaneous interruption of stirring. The flash point is the lowest temperature at which application of the test flame ignited the vapor above the sample.

4.7.3 Data Validation for Chemical Analyses

Data validation is the process whereby data are determined to be of acceptable or unacceptable quality based on a set of predefined criteria by Shaw. These criteria depend upon the type(s) of data involved and the purpose for which data are collected. Data packages will be validated to ensure project compliance with specified analytical, QA, and data reduction procedures; data reporting requirements; and required accuracy, precision, and completeness criteria. The post-excavation soil confirmation and borrow-top soil sample data will be fully validated (USEPA Region III) for all parameters of interest for the IM. The waste characterization sample data and delineation soil sample data will not require the full USEPA Region III data validation. USEPA Level IV Contract Laboratory Program-like raw data will be provided for where full data validation is required. The Project Chemist will oversee the performance of data validation functions. Specific validation levels may be found in the DQO tables in *Section 4.3* of this QAPP. Data validation results will be reported with the final findings. Data will be validated using a combination of the following criteria:

- Project-specific Work Plan and/or QAPP criteria.
- Master Quality Assurance Plan (Section 9.5) requirements.
- *DoD QSM, Final Version 4.1* (DoD, 2009).
- Method-specific criteria following *USEPA OSWER Test Methods for Evaluating Solid Waste Physical/Chemical Methods (SW-846), Update IV* (USEPA, 2007), *DoD Perchlorate Handbook, Revision 1, Change 1* (DoD, 2007), *NYDOH ELAP198.4*, and *USEPA Method for Chemical Analysis of Water and Wastes* (USEPA, 1983).

Table 4-11 presents the laboratory and data validation qualifiers to be used for RFI/IM and are applied as appropriate. The laboratory qualifiers are as per DoD QSM and the data validation qualifiers are consistent with the following USEPA guidance:

- *USEPA Region III Modifications to the National Functional Guidelines for Organic Data Review Multi-media, Multi-concentration* (USEPA, 1994b).
- *USEPA Region III Modifications to the Laboratory Data Validation Functional Guidelines for Evaluating Inorganic Analyses* (USEPA, 1993).

Shaw will direct the overall data management. Data activity for the sampling program will be divided between Shaw and the subcontract laboratory. Each firm has the equipment needed to perform the required data management functions. The laboratory will perform data entry and manipulation operations associated with the analysis of raw analytical data and provisions of chemical analysis results by sampling location. These data will be transmitted to Shaw for evaluation and interpretation. Data generated will be assessed for accuracy, precision, comparability, representativeness, completeness, and sensitivity. After the data has been assessed by Shaw, it will be uploaded into the Army's Environmental Restoration Information System (ERIS) database.

Table 4-11
Laboratory and Data Validation Qualifiers

Qualifier	Definition
Laboratory Qualifiers[1]	
U	Undetected at the limit of detection or reporting limit: The associated data value is the limit of detection or reporting limit, adjusted by any dilution factor used in the analysis.
J	Estimated: The analyte was positively identified; the quantitation is estimation.
B	Blank contamination. The recorded result is associated with a contaminated blank.
N	Non-target analyte: The analyte is a tentatively identified compound (using mass spectroscopy).
Q	One or more QC criteria failed.
USEPA Region III Data Validation Qualifiers[2]	
B	Not detected substantially above the level of the reported in laboratory or field blanks.
J	Analyte present. Reported value may not be accurate or precise.
K	Analyte present. Reported value may be biased high (estimated) due to QC non-conformance.
L	Analyte present. Reported value may be biased low (estimated) due to QC non-conformance.
UL	Value is estimated bias low and not detected due to QC non-conformance. Reporting limit may be inaccurate or imprecise. QL is probably higher.
UJ	The analyte was analyzed for, but was not detected above the reported sample QL. The reported QL is approximate and may be inaccurate or imprecise.
N	The analysis indicates the present of an analyte for which there is presumptive evidence to make a "tentative identification."
NJ	The analysis indicates the presence of an analyte that has been "tentatively identified" and the associated numerical value represents its approximate concentration.
R	Unreliable result. Analyte may or may not be present in the sample. Supporting data necessary to confirm result.

[1] The noted laboratory qualifiers are a minimum. If a laboratory has more and they are consistent with DoD and properly defined, the laboratory may use them. Data qualifiers may be combined when appropriate. Ref.: *DoD QSM for Environmental Laboratories, Final Version 4.1* (DoD, 2009).

[2] The USEPA data validation qualifiers are referenced from *USEPA Contract Laboratory Program National Functional Guidelines for Organic Data Review* (USEPA, September 1994), and *USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review* (USEPA, April 1993).

5.0 ENVIRONMENTAL PROTECTION PLAN

This section was developed to address environmental considerations during the performance of IM at the ARSAR. The objective of this section is to provide adequate procedures to safeguard the environmental condition of RFAAP property in and around disturbed areas, and to mitigate and/or minimize the environmental impact of IM.

Environmental pollution and damage is the presence of chemical, physical, or biological elements or agents which adversely affect human health or welfare; unfavorably alter ecological balances of importance to human life; affect other species of importance to humankind; or degrade the utility of the environment for aesthetic, cultural and/or historical purposes. The control of environmental pollution and damage requires consideration of land, water, and air, and includes management of visual aesthetics, noise, solid waste, as well as other pollutants.

For the soil removal action at the ARSAR, the Site Superintendent will coordinate all land resource management, waste management, pollution control, and abatement activities, and ensure compliance with the Environmental Protection Plan by all subcontractors.

5.1 Applicable Regulations

Shaw will follow all applicable regulations and obtain all necessary permits concerning environmental protection, pollution control, and abatement necessary for the proposed field operations. Applicable regulations include, but are not limited to:

- Fish and Wildlife Coordination Act [16 United States Code (USC) 661].
- Migratory Bird Treaty Act (16 USC 703).
- Endangered Species Act (16 USC 1531, 50 CFR 402).
- Hazardous Materials Transportation Act (49 USC 1801-1812).
- Noise Pollution and Abatement Act (42 USC 4901).
- Land Disposal Restrictions (40 CFR 268).
- Erosion and Sediment Control [4 Virginia Administrative Code (VAC) 50-30-40].
- Stormwater Management (9 VAC 25-690).
- Visible Emissions and Fugitive Dust/Emissions (9 VAC 5-50).
- Virginia Air Quality Standards (9 VAC 5-50 and 9 VAC 5-30).

5.2 Pre-Construction Survey of Existing Conditions

A survey of environmental conditions will be performed prior to performance of IM actions. This survey will include written records and photographs. Specifically, the status of the trees, roadways, utilities, and other site characteristics will be documented to establish a pre-IM record of initial site conditions. This survey record will be used to restore the site to as close to pre-IM conditions as possible, where applicable, as well as document pre-existing conditions for contractor liability purposes.

5.3 Previously Used Equipment

All previously used equipment shall be cleaned before it is brought into a new work area, ensuring that soil residuals are removed and that egg deposits from pests are not present.

5.4 Protection of Land Resources

Removal activities will be confined to areas defined in the Organization and Technical Approach Plan, *Section 2.0*. Prior to the start of removal activities, Shaw will identify the land resources to be preserved within the work areas. Except for those areas indicated in *Section 2.0*, Shaw will not remove, cut, deface, injure, or destroy land resources including trees, shrubs, vines, grasses, top soil, and land forms without permission from ATK and the RFAAP Environmental Office. No ropes, cables, or guys will be fastened to or attached to any trees for anchorage unless authorized. When such use is permitted, Shaw will provide protection for land and vegetation resources. Stone, earth, or other material displaced into un-cleared areas will be removed.

5.4.1 Work Area Limits/Traffic Control

Prior to start of removal actions, Shaw will mark any areas that need not be disturbed. Isolated areas within the general work area, which are to be saved and protected, shall also be marked or fenced. Shaw personnel and subcontractors will be informed of the purpose for marking and/or protecting particular objects.

Outside of designated work areas, all personnel and subcontractor equipment and vehicles will remain on established or paved roadways in order to prevent damage of manicured lawns and green spaces as well as to limit the amount of mud transported onto base and public roadways.

5.4.2 Landscape

Trees, shrubs, vines, grasses, land forms, and other landscape features to be preserved shall be clearly identified by marking, fencing, or wrapping with boards, or any other approved technique.

5.4.3 Unprotected Erodible Soils

All earthwork will be completed as planned. Side slopes and back slopes shall be protected as soon as practicable upon completion of rough grading. All earthwork shall be planned and conducted to minimize the duration of exposure of unprotected soils. Except in cases where the constructed feature obscures waste material areas, these areas will not initially be totally cleared. Clearing of such areas will progress in reasonably sized increments, as needed.

5.4.4 Disturbed Areas

Erosion and sedimentation control will be effectively implemented through control of surface runoff and installation of erosion and sedimentation control devises, as needed. Runoff from the removal site or from storms shall be controlled, retarded, and diverted to protected drainage courses by means of diversion ditches, benches, berms, or other structure. Temporary erosion and sedimentation control features will be installed as needed. A detailed E&SCP is provided as *Section 6.0* to this Work Plan.

5.4.5 Staging and Work Areas

Staging areas will be located as designated in the Organization and Technical Approach Plan, *Section 2.0*. Relocation of areas will be made with approval from ATK and the RFAAP Environmental Office.

5.5 Water Resources

Removal activities will be managed and controlled to avoid pollution of surface water and groundwater. Toxic or hazardous chemicals will not be applied to soil or vegetation as part of IM actions. The management of erosion and sedimentation is presented in the E&SCP, *Section 6.0*.

5.5.1 Wastewaters

Wastewater will be generated from decontamination operations including general equipment decontamination. Wastewater will be collected in storage tanks or drums. Sampling and analysis will be performed to determine the proper disposal requirements for the wastewater.

5.5.2 Diversion Operations

Removal operations involving dewatering activities will be controlled at all times to limit the impact of water turbidity on the habitat for wildlife and on water quality for downstream use.

5.5.3 Fish and Wildlife

Interferences with, disturbances to, and damage of fish and wildlife will be minimized during removal actions. No federally listed, proposed endangered, or threatened species are known to exist in this area at RFAAP.

5.6 Air Resources

Dust particles generated from removal activities will be controlled at all times. Excavations, haul roads, work sites, and other areas will be maintained so as not to cause air pollution standards to be exceeded or which would cause a hazard or nuisance. Water sprinkling or other methods will be used to control particulates in the work areas as work proceeds and whenever a hazard or nuisance occurs. The performance of air monitoring during removal action work is described in the SSHP, *Section 8.0*.

Hydrocarbons and carbon monoxide emissions from equipment will be controlled to federal and state allowable limits.

5.7 Noise

Removal actions will be managed and controlled to minimize environment damage by noise.

5.8 Waste Disposal

Waste handling, transportation, and disposal will be performed in accordance with the WTDP, *Section 7.0*, and as specified below.

5.8.1 Solid Wastes

Solid wastes will be direct loaded in dump trucks and transported off site for disposal. Handling and disposal will be conducted to prevent contamination. Segregation measures will be employed so that no hazardous or toxic waste will become co-mingled with solid waste. Solid

waste generated as part of IM actions will be transported off site and disposed in compliance with federal, state, and local requirements.

5.8.2 Chemical Wastes

Chemicals shall be dispensed ensuring no spillage to the ground. Periodic inspections of dispensing areas to identify leakage and initiate corrective action will be performed and documented. Chemical waste will be collected in corrosion resistant, compatible containers. Collection drums shall be monitored and removed to a staging or storage area when contents are within 6 inches of the top. Waste generated as part of removal actions will be transported off site and disposed of in compliance with federal, state, and local requirements.

5.8.3 Hazardous Waste

Sufficient measures will be taken to prevent spillage of hazardous and toxic materials during dispensing and waste will be collected in suitable, compatible containers. Waste generated as part of removal actions will be transported off site and disposed of in compliance with federal, state, and local requirements. Soil containing leachable lead at a concentration greater than the TCLP regulatory level of 5 milligrams per liter will be treated as hazardous waste. Spills of hazardous or toxic materials will be immediately (within 20 minutes) reported using the spill notification procedures presented in *Section 5.13.5*.

5.9 Burning

No burning is allowed, nor will be conducted, during IM actions.

5.10 Historical, Archaeological, and Cultural Resources

There have not been any historical, archaeological, or cultural resources identified in the ARSAR area. If during excavation or other IM activity, any previously unidentified or unanticipated resources are discovered or found, all activities that may damage or alter such resources will be temporarily suspended. These resources include, but are not limited to: any human skeletal remains or burials; artifacts; shell, midden, bone, charcoal, or other deposits; rocks or coral alignments, pavings, wall, or other constructed features; and any indication of agricultural or other human activities. Upon such a discovery or find, the USACE RFAAP Project Manager will be immediately notified.

5.11 Post-Removal Cleanup

Following IM actions, all areas used as part of IM activities will be cleaned up.

5.12 Restoration of Landscape Damage

Any landscape features damaged or destroyed outside the limits of the approved work areas during IM activities will be restored.

5.13 Maintenance of Control Pollution Facilities

Permanent and/or temporary pollution control facilities and devices will be maintained for the length of time IM activities create the particular pollutant.

5.14 Training of Personnel

Shaw and subcontractor personnel will be instructed on all phases of this Environmental Protection Plan prior to starting removal work to ensure adequate and continuous environmental pollution control.

5.15 Spill Prevention and Response

The following sections describe the type/amount of potential spills that could occur during removal actions, spill prevention and control measures, spill countermeasures, spill response equipment, and spill notification procedures.

5.15.1 Potential Spill Types

Potential spill types that may occur during the ARSAR actions include waste liquids (decontamination liquids, excavation water, etc.), waste solids (soils, etc.), and materials brought on site for IM work that contain hazardous constituents.

The only hazardous liquids that will be brought and stored on site for IM actions will be small quantities of gasoline and diesel, motor oil, paints, and solvents. Throughout operations, these materials will be stored and transported in approved containers.

5.15.2 Spill Prevention

- Wastes collected from the IM actions will be properly containerized, stored, treated, and disposed in accordance with applicable federal and state regulations.
- Equipment fueling and/or lubrication will be performed utilizing drip pans to contain any spills which may occur.
- Wastes and/or chemicals will be stored in a manner to prevent contact with stormwater, including the use of tarpaulins and/or storage under a roofed structure.
- All storage containers for liquid storage will be certified for aboveground use.
- The storage drums/containers will be inventoried periodically to determine if leakage is occurring and the exterior of the tanks will be examined.
- All transport drivers will be trained in Department of Transportation (DOT) and USEPA spill prevention measures.
- The transport driver will be required to remain on duty and with his truck during filling operations to protect against spills.
- The volume of waste material will be calculated prior to filling drums or containers.
- No pump operations are to continue unless attended constantly.
- Personnel training will be conducted on spill prevention, containment, and retrieval methods at the start of IM work.
- Phone numbers will be posted regarding the report of a spill to the response agencies and the state.

5.15.3 Spill Countermeasures

- Any fuel leakage, oil drips, or hydraulic line rupture that may occur during the operation of trucks, heavy equipment, etc., will be immediately cleaned up.
- Any spill of hazardous materials will be reported through the local spill response system and addressed immediately.
- Emergency containment action will consist of placing adsorbent materials around the site of the spill.

- Accidental spills will be cleaned up immediately. The spilled medium (liquid or solid) will be collected and containerized awaiting waste characterization, transportation, and disposal.

5.15.4 Spill Mitigation Equipment

The following spill mitigation equipment will be available on site for use during the removal actions:

- Drip pans.
- Shovels.
- 55-gallon drums (for containerization).
- Absorbents.
- Personal protective equipment (PPE).

5.15.5 Notification Procedures

If a spill occurs on site, the following notification procedure will be initiated immediately (within 20 minutes max):

Steve Kritak, Shaw Site Superintendent	(540) 922-3316
Rob Davie	(540) 239-4475 (cell)
Jerry Redder	(540) 639-7536
-or-	(540) 953-8663 (pager)
Jim McKenna	(540) 731-5782
RFAAP Security Dispatcher	(540) 639-7323
-or-	(540) 639-7324
-or-	(540) 639-7325
Brad Jennings	(540) 731-5781
Timothy Leahy, Shaw RFI/IM Project Manager	(410) 612-6332
Doug Russell, Shaw H&S Manager	(865) 692-3584
Jeff Hillebrand, Shaw RFAAP RFI/IM Task Manager	(410) 612-6354
Tom Meyer, USACE RFAAP Project Manager	(410) 962-0032

6.0 EROSION AND SEDIMENT CONTROL PLAN

The purpose of this E&SCP is to provide a document that defines the steps which will be taken to minimize and/or eliminate erosion and sedimentation during completion of the ARSAR IM. This plan has been developed in accordance with the guidelines provided in 4 VAC 50-30-40, the Virginia Erosion and Sediment Control Regulations. The following five basic principles along with environmental concerns should be considered when developing an E&SCP:

- Plan the development to fit the site – areas of high erosion potential should be left undisturbed whenever possible.
- Expose the smallest practical area of land for the shortest possible time – when soil disturbances occur and the natural vegetation is removed, the extent and duration of exposure should be minimized.
- Apply erosion control as a first line of defense against on-site damage – implementing practices that prevent or minimize erosion on a construction site is called "erosion control."
- Use sediment control practices as perimeter protection to prevent off-site damage – controls placed along the perimeter of a site to collect eroded sediments must be implemented.
- Implement a thorough maintenance and follow-up operation – a site must have thorough periodic maintenance checks of soil erosion and sediment control practices.

6.1 Plan Approval

According to 4 VAC 50-30-40, an E&SCP is required for approval by VDEQ for all land clearing, grading, or other earth disturbances, with the exception of projects involving less than 1 acre of grading. As discussed below, the ARSAR IM are not anticipated to involve grading work greater than or equal to 1 acre; therefore, review and approval of this plan by VDEQ is not required.

6.2 Erosion and Sediment Control Plan

The scope of the ARSAR IM was previously described in the Organization and Technical Operations Plan (*Section 2.0*) and includes contaminated soil removal activities. The total area to be disturbed may be 6,472 ft^2 (approximately 0.15 acres). Further, all land-disturbing activities will be planned and conducted to minimize the size of the area to be exposed at any one time and the length of the time of exposure if additional areas are to be impacted.

Surface water runoff originating upgrade of the exposed areas should be controlled to reduce erosion and sediment loss during the time of exposure. If needed, temporary sump pumps will be used in excavations to control accumulation of standing water. All surface water that contacts exposed contaminated areas will be pumped into storage tanks for subsequent characterization and disposal.

The ARSAR IM will consist of excavating the target berm both vertically and horizontally to reduce soil concentrations below r-RGs for antimony and lead. Determination of whether or not removal will occur will be based on soil delineation samples. If contaminant concentrations in soil exceed the RGs, soils will be excavated and direct loaded into trucks and disposed off site.

Excavated areas will be immediately backfilled with clean soil following receipt of confirmation samples indicating removal to below the RG has been achieved. A silt fence will be required for sediment and erosion control at the ARSAR. Due to the topography of the site, movement of soil/contamination due to rain events or remediation activities from the site is anticipated. The proposed location of the downgradient silt fences are shown on **Figure 6-1**.

6.3 Dust Control

Field operations at the ARSAR will be conducted in a manner that produces minimal dust and/or air pollution. Dust control measures such as water spray will be utilized if dusty conditions exist.

6.4 Installation and Maintenance of Erosion and Sediment Control Structures

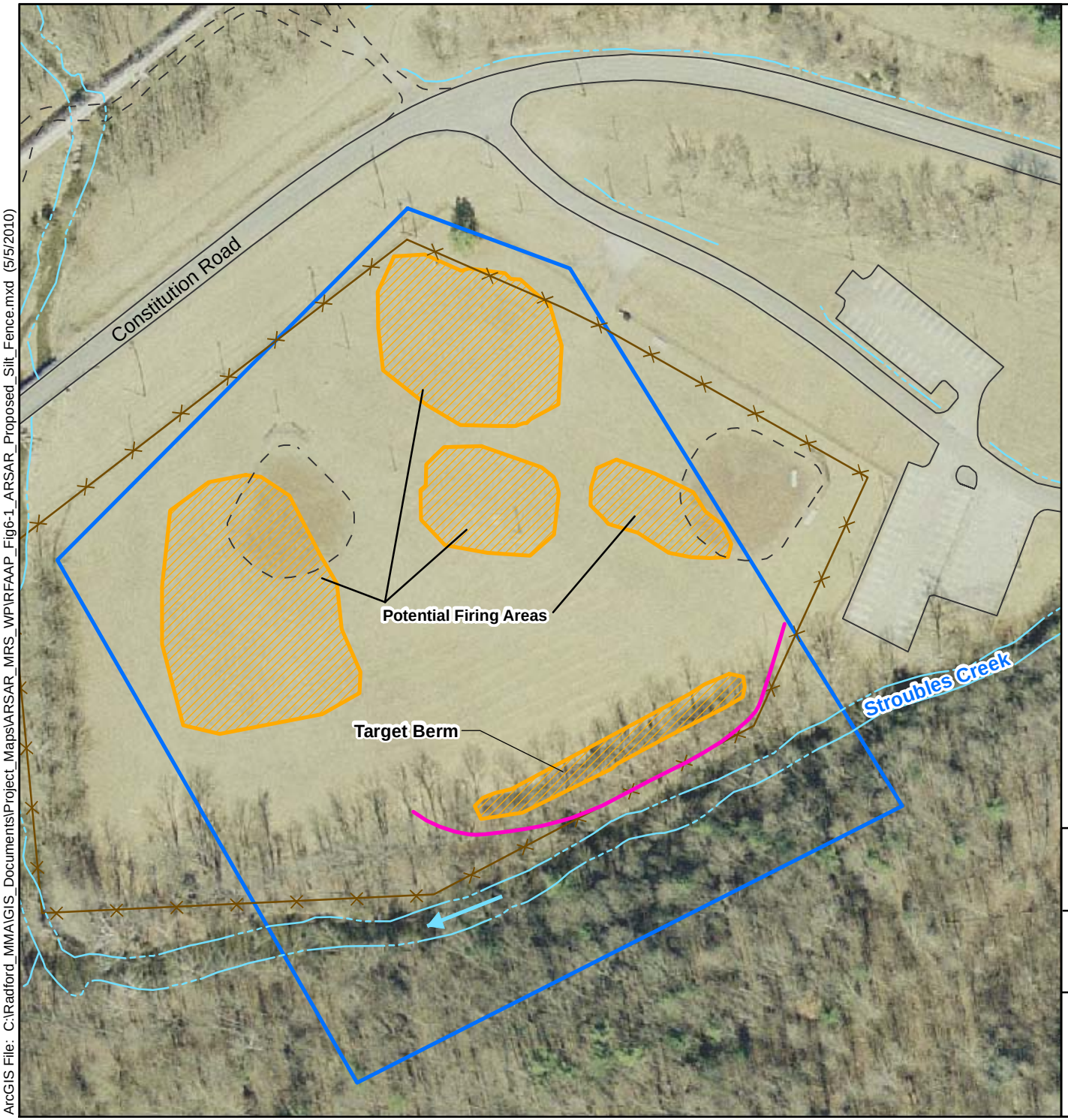
Erosion and sediment control structures shall be installed and maintained according to minimum standards and specifications of 4 VAC 50-30-40. As indicated previously, the following erosion and sediment control standards and specifications are anticipated to be used during remedial activities:

- Vegetative Stabilization – Describes vegetative stabilization methods and materials, and temporary and permanent seeding requirements.
- Erosion Control Matting – Describes use and installation of erosion control matting.
- Tree Protection – Describes applicable conditions for and use of tree protection measures.
- Dust Control – Provides temporary and permanent methods of controlling dust blowing and movement.

Erosion control measures will be established at the beginning of removal action work and maintained during the entire period of work. Erosion control measures will be repaired or replaced as needed.

Erosion and sediment control structures, disturbed areas, and areas used for storage of materials exposed to precipitation shall be inspected every 7 days and within 24 hours of the end of a storm event that has rain accumulation of 0.5 inches or greater. Cleanout or replacement of structures will be performed immediately to prevent sediments from entering a live watercourse and discharging off site.

Locations where vehicles enter or exit the sites shall be inspected for evidence of sediment tracking. Construction vehicles and equipment shall be appropriately decontaminated during the course of the IM actions, if necessary.



LEGEND

- Water Feature
- Surface Water Flow Direction
- Dirt Road
- Paved Road
- Fence Line
- Proposed Silt Fence
- Historic Feature
- MRS Boundary

Notes:
1) Aerial photo, dated 2005, was obtained from Montgomery County Planning, VA Planning & GIS Services.
2) Historic features, MRS boundary, fragment and previous soil sample locations were obtained from Final Site Screening Process Report (URS, 2009).

N

Scale:
0 65 130 260
Feet

U.S. Army Corps of Engineers

Shaw® Shaw Environmental, Inc.

FIGURE 6-1
Army Reserve Small Arms Range
Proposed Location of Silt Fence
Radford Army Ammunition Plant,
Radford, VA

ArcGIS File: C:\Radford_MMA\GIS_Documents\Project_Maps\ARSAR_MRS_WP\RFAAP_Fig6-1_ARSAR_Proposed_Silt_Fence.mxd (5/5/2010)

7.0 WASTE TRANSPORTATION AND DISPOSAL PLAN

The primary objective of this WTDP and the activities mandated by the plan is the safe handling, transportation, and disposal of contaminated materials resulting from IM actions at the ARSAR. This objective will be achieved through compliance with local, state, and federal regulations, and the requirements of this plan. The WTDP details the waste management responsibilities of Shaw and subcontractor personnel and identifies potential waste streams. It also describes the waste management practices that will be implemented for minimizing, segregating, packaging, staging, tracking, and transporting and disposing of the generated wastes.

A secondary objective of the WTDP is the handling of generated waste in a cost-effective manner. This will be accomplished by three activities:

- Waste minimization.
- Waste segregation.
- Waste classification.

These activities begin with the design of the individual removal actions and are integrated into the planning and execution of waste management activities associated with the overall project.

7.1 Regulatory Requirements

Wastes generated during IM actions at the ARSAR will be handled, staged, labeled, transported, and disposed in full compliance with local, state, and federal regulations. Applicable local, state, and federal regulations governing the treatment, storage, transportation, and disposal of wastes include, but are not necessarily limited to, the following:

- 40 CFR 261: Identification and Listing of Hazardous Waste.
- 40 CFR 262: Standards Applicable to Generators of Hazardous Waste.
- 40 CFR 263: Standards Applicable to Hazardous Waste Transporters.
- 40 CFR 268: Land Disposal Restrictions.
- 40 CFR 270: Regulations controlling the transportation, manifesting, and disposal of hazardous waste.
- 49 CFR 171-179: DOT regulations on the packaging and shipping of hazardous materials and samples.
- 9VAC 20-60-261: Standards Applicable to Generators of Hazardous Waste.
- COMAR 26.13.04: Standards Applicable to Transporters of Hazardous Waste.
- 9 VAC 20-60-268: Land Disposal Restrictions.
- 9 VAC 20-60-263: Regulations Applicable to Transporters of Hazardous Waste.
- 9 VAC 20-110: Transportation of Hazardous Materials.
- 9 VAC 20-60-264 Subparts C, Preparedness and Prevention; and Subpart D, Contingency Plan and Emergency Procedure.
- 9 VAC 20-60-264 Subpart E, Manifest System, Recordkeeping, and Reporting.

7.2 Anticipated Waste Streams

This section presents a brief overview of the anticipated wastes that may be generated during IM actions at the ARSAR. Waste can be divided into two primary categories which include:

- Remediation-derived wastes (RDW).
- Secondary waste.

A summary of anticipated wastes that will be generated from the IM actions are described below.

7.2.1 Remediation-Derived Wastes

RDW are those wastes that are generated through the removal of original, pre-existing contaminated material from the site. Anticipated RDW for each the removal action includes, but is not limited to, contaminated soil.

7.2.2 Secondary Wastes

Secondary wastes will be produced by the contractor during the course of the IM work. Examples of secondary wastes that may be produced are:

- Non-hazardous trash and potentially contaminated materials.
- IDM from sampling activities.
- PPE.
- Temporary facilities (such as decon pads, and erosion and sediment control materials).
- Decontamination water.

Production of secondary wastes will be minimized to the fullest extent possible, typically by the segregation of hazardous and non-hazardous materials. When produced, wastes will typically be co-disposed with the RDW. Where co-disposal results in significant additional costs or is not possible due to incompatibilities with the selected disposal/treatment/recycling method, alternative means of characterization/disposal for secondary wastes will be considered.

7.3 Waste Management Procedures

7.3.1 Waste Minimization

Waste minimization is a primary objective during the design and implementation of the IM actions at the ARSAR. The principal components of this program include:

- Control of waste removal to prevent over-excavation.
- Segregation of waste streams.
- Minimization or elimination of hazardous material that must be used.
- Strict inventory control of hazardous material.

Where a waste stream (such as potentially contaminated soil) has the potential to exhibit differing characteristics, each waste stream will be segregated. Wastes will be segregated into the following groupings:

- Uncontaminated material.
- Potentially contaminated material.
- Contaminated material.

Potentially contaminated and contaminated materials may be further subdivided into different groups by contaminant types such as:

- RCRA waste.
- Non-hazardous solid waste.

Waste characterization for certain waste streams will be attempted prior to or at the beginning of IM activities, in order to minimize waste storage and holding time prior to transportation and disposal.

Generation of secondary waste will typically occur prior to receipt of complete analytical results. Decisions regarding waste segregation will be based on knowledge of the waste and appearance. This segregation will minimize the mixing of contaminated and uncontaminated materials.

Each of the above steps will reduce the amount of contaminated wastes being generated. Audits may be conducted by the CQC Systems Manager to monitor the waste minimization activities.

7.3.2 On-Site Waste Labeling

Following the generation of waste, each container will be clearly labeled with the following information:

- Waste generation activity and location collected.
- Identification numbers.
- Contents of the container (type of material and expected hazard level).
- Accumulation start date.
- Comments/special handling instructions.

This information will be augmented as needed according to applicable requirements during off-site transportation and disposal.

7.3.3 Sampling and Characterization

Each waste stream generated during the IM work will be characterized within 30 days of completion of waste stream generation. Waste characterization sampling and analysis will be performed by Shaw in accordance with the provisions in the FSP (*Section 3.0*) and the QAPP (*Section 4.0*). Based on the analytical results for the waste characterization samples, the wastes will be classified in accordance with Virginia and USEPA waste classification systems. The waste classification will define the waste storage, transportation, and disposal requirements that are applicable. Waste profile sheets for the disposal of each waste will then be prepared in accordance with the requirements of the disposal facility. If required by the disposal facility for acceptance of the waste, additional waste analysis will be conducted beyond that specified in **Table 3-1**.

7.3.4 Recordkeeping

Shaw will maintain an inventory of waste on site. Excavated soil will be direct loaded into dump trucks for transport to the disposal facility and will not be stored on site. An example of the waste inventory form is provided as **Figure 7-1**. This form will be updated daily.

Figure 7-1 Waste Inventory Form
ARSAR IM Action

Waste Container ID	Container Type	Waste Description	Quantity	Date Packaged	Waste Profile	Date Shipped	Disposal Facility	Disposal Method	Disposal/ Destruction Date

Notes:

7.3.5 Spill Response Materials

Spill response materials including, but not limited to the following, will be kept on site in case of emergencies: drip pans, containers, adsorbents, shovels, and PPE. Spill response materials will be available at all times in which hazardous materials/wastes are being handled or transported, and be compatible with the wastes being handled.

7.4 Off-Site Transportation and Disposal

7.4.1 Identification of Off-Site Disposal Facility

Through a competitive bidding process, one or more waste disposal subcontracts will be awarded. Each subcontract will include several permitted disposal facilities that offer a range of disposal options (e.g., landfilling, incineration) for a variety of waste types (e.g., non-hazardous waste, hazardous waste). Based on the waste characterization results, and subsequent waste classification, an appropriate waste disposal facility will be identified. Shaw will then prepare a two-way memo, including the analytical results, estimated quantity of waste, waste profile sheet(s), and proposed method of disposition and disposal facility, to gain approval from USACE to dispose of the waste. Advanced planning and coordination by Shaw, USACE, and RFAAP/ATK will be necessary to minimize the staging of waste (non-hazardous debris only) on site.

7.4.2 Transportation of the Waste

The transport documentation and transport vehicle will be inspected prior to shipment of hazardous wastes to ensure that the packaging, marking, labeling, handling, and placarding of waste complies with federal, state, and local laws and regulations. Shaw will supervise loading activities and monitor the stages of waste handling by the disposal subcontractor.

7.5 Documentation and Reporting

7.5.1 Complete Manifest Package

Shaw will prepare manifests for the transportation and disposal of hazardous wastes in accordance with USEPA and DOT requirements. The principal components of the completed manifest package include:

- Waste profile sheets (signed by an ATK representative).
- Waste disposal characterization.
- Hazardous waste manifests.
- Hazardous material shipping papers.
- Land disposal restriction notification and certification form.

Hazardous waste manifests, waste profile sheets, and land disposal restriction notification and certification forms will list RFAAP as the generator and will be signed by an appointed representative of RFAAP. The manifests will include the shipper's license number, address and contact information, and the permit number for the disposal facility. Shaw will provide 3 days notice of shipping to the appointed representative of RFAAP and provide manifest blanks at that time. Final weight for each load will be calculated using an excavator bucket scale during truck loading. Final weights will be filled in on the manifest for signature at that time. Close coordination will be required to minimize demurrage charges.

The supporting information will contain at a minimum the following information:

- Date of initial waste generation.
- Description of process that generated the waste.
- All analytical data and/or process knowledge used to characterize the wastes, including QC data.
- Dates samples were collected.
- Description of the sampling location(s), and sampling methods and equipment utilized.
- Description of sample handling techniques, including containerization, preservation, and COC.
- Any correspondence supporting waste classification determination.
- Specific type of inner and outer packaging.
- Markings, labeling, and placards offered by the transporter.

7.5.2 Transportation and Disposal Reporting Requirements

7.5.2.1 Tabulated Waste Handling Information

Shaw will maintain a list of all waste materials going off site on the Waste Inventory Form (**Figure 7-1**). Where applicable, this list will include the description, quantity, hazardous waste classification, date the waste was shipped, disposal facility, method of disposal, and date of disposal. Copies of the Waste Inventory Form as well as other supporting documentation related to the disposal operation audit trail will be included in the ARSAR IM Summary Report following completion of the IM.

7.5.2.2 Transportation and Disposal Procedures

After the waste leaves RFAAP, Shaw will maintain a clear audit trail of the entire disposal operation including, but not limited to, the following:

- Manifest copy(s).
- Driver information and truck numbers.
- Profile sheet(s).
- Certificate of Transfer.
- Certificate of Disposal.

7.5.2.3 Discrepancies

Any discrepancies due to differences between the quantities or types of wastes designated on the manifest or shipping papers and the quantity or type of wastes a facility actually receives must be reported. Shaw will investigate these discrepancies and rectify the identified discrepancy.

7.5.2.4 Exception Reports

The following procedures will be used for determining if an exception report is needed. On or before the 35th day after the transporter signs the manifest, it will be verified that the generator or the generator's representative has received a copy of the signed manifest from the TSDF. If the generator's representative has failed to receive a signed copy of the manifest by the 44th day, an exception report will be prepared and submitted to USACE and RFAAP no later than day 45.

8.0 SITE SAFETY AND HEALTH PLAN

This section discusses safety and health concerns for the ARSAR RFI/IM actions and serves as the SSHP. The safety and health policies and procedures that will be followed during the removal actions are defined within this section. This SSHP has been prepared by the RFAAP H&S Manager. The SSHP signature approval form is provided in **Appendix D** and documents H&S and project management's acceptance of the plan for the performance of RFI/IM at the ARSAR.

This SSHP was prepared for use at the ARSAR by Shaw personnel and subcontractors performing a specific scope of work. It was prepared based on the best available information regarding the physical and chemical hazards known, or suspected, to be present on the project site. Adherence to the requirements of this Plan will significantly reduce, but not eliminate, the potential for occupational injury or illness at the project site. The guidelines contained in this SSHP were developed specifically for the project site described herein, and should not be used at any other site without the review and approval of a qualified H&S professional.

8.1 Pre-Work Meeting

Due to the potentially dangerous nature of the explosives-related work conducted at RFAAP, a Pre-Work Meeting will be conducted by ATK, the operating contractor at RFAAP. All Shaw employees and subcontractors will attend this meeting prior to initiating work on site. The ARSAR is located outside the MMA and has safety requirements that may differ from the requirements specified in this plan. Where there are differences, ATK's rules will apply. A copy of ATK's *Safety, Security and Environmental Rules for Contractors, Subcontractors, Tenants and Government Employees* (ATK, 2005) will be provided to employees and subcontractors before mobilization on site.

8.2 Introduction

This SSHP was developed to provide the field team/visitors with safe working conditions during field activities to ensure protection of personnel during the excavation, removal, waste handling, and restoration activities at the ARSAR. In addition, an objective of this SSHP is to provide site-specific safety and health controls that will prevent and minimize personal injuries, illnesses, and physical damage to equipment and property. The plan stresses management responsibilities, pre-planning for new activities, medical surveillance, training, periodic work site evaluations and audits, accident prevention and investigation recordkeeping, PPE, air monitoring requirements, site controls, decontamination procedures, and general safety requirements.

Shaw and subcontractor personnel performing field activities are responsible for the adherence to the SSHP procedures and policies during the performance of all work. Site personnel and visitors will be required to read or be instructed in the content of this SSHP and to sign the acknowledgment form (located in **Appendix D**) to document their understanding of the contents. Shaw will not, however, accept responsibility for the use of the plan by others.

Site personnel will exercise caution at all times and immediately report any site conditions to supervisory personnel which may pose safety or health and environmental hazards to workers or the public.

8.2.1 Soil Removal Activities

Site RFI/IM activities to be completed as part of this scope of work at the ARSAR include site media (soil, surface water, sediment, and groundwater) sampling and excavation and disposal of antimony and lead contaminated soil. Background site information and details on the approach and components for each of the removal actions are provided in the Organization and Technical Approach Plan (*Section 2.0*).

8.2.2 Applicable Standards and Regulations

Site activities covered by this SSHP must comply with the requirements of the following regulations and appropriate guidance including, but not limited to:

- 29 CFR Part 1910 (29 CFR 1910) Occupational Safety and Health Standards, General Industry.
- 29 CFR Part 1926 (29 CFR 1926), Safety and Health Regulations, Construction Industry.
- FAR, Clause 52.236-13, Accident Prevention.
- USEPA OSWER Directive 9355.3-01.
- USACE Safety and Health Requirements Manual EM 385-1-1.
- USACE Safety and Occupational Health Document Requirements for Hazardous, Toxic, and Radioactive Waste and Ordnance and Explosives Activities, ER 385-1-92.
- Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities [National Institute for Occupational Safety and Health (NIOSH) 85-115].
- 40 CFR Parts 260-276 (40 CFR 260-276), Hazardous Waste Management.
- 40 CFR Subchapter C, Air Programs.
- Occupational Safety and Health Guidance for Hazardous Waste Site Activities, U.S. Department of Health and Human Services, October 1985.
- Threshold Limit Values (TLVs) for Chemical Substances and Physical Agents and Biological Exposure Indices, American Conference of Governmental Industrial Hygienists (ACGIH).
- Shaw Safety and Health Requirements Program Manual.
- Alliant TechSystem's *Safety, Security and Environmental Rules for Contractors, Subcontractors, Tenants and Government Employees* (ATK, 2005).

All Shaw and subcontractor field staff will be required to follow these and other applicable federal and/or state safety and health standards, regulations, and guidance manuals.

8.2.3 Site Safety and Health Documentation

Recordkeeping requirements for safety and health are necessary to ensure accurate and complete monitoring of all personnel. Any changes to the approved SSHP will be documented using the Shaw Revision Form presented in **Appendix D**, and reviewed and approved by the USACE prior to implementation. All on-site personnel shall read or be instructed in this SSHP and sign the Acknowledgment Form (located in **Appendix D**) to document their understanding of the contents. The SSHO will keep this form on file.

8.2.4 Safety Statement

It is Shaw's plan to provide a safe work environment for all personnel involved in the RFI/IM activities at the ARSAR. Shaw considers no phase of operations or administration to be of greater importance than the prevention of personnel injury and illness at the work site.

Any authorized USACE representative has the right to notify Shaw and/or any subcontractor of any condition that poses a serious or imminent danger to H&S. Upon such notification, Shaw and/or any subcontractor shall immediately take corrective action. Furthermore, any authorized USACE representative may issue an order stopping all or part of the work until satisfactory corrective action has been taken.

This SSHP prescribes the procedures that must be followed by all site personnel. Operational changes which could affect the H&S of personnel, the community or the environment will not be made without prior approval of the USACE, Shaw Project Manager, Shaw H&S Manager, and SSHO.

The following is Shaw's corporate policy as it pertains to safety.

The Shaw Group is firmly committed to operating all of its facilities and projects in a safe, efficient manner and in compliance with applicable safety, health and environmental regulations. Its goal is to provide an injury free work environment where facilities and projects are free of recognized hazards; and people, equipment, and the environment are not placed at unreasonable risk of injury or damage.

The most valuable resource Shaw has is its people. While quality and productivity are critical to operations, they will never take precedence over the safety of personnel or protection of the environment.

Accomplishing these goals requires a unified team effort from all levels of the organization. Safety must be planned into all of our activities and receive the same level of attention as quality and productivity.

This project will be conducted under the guidance of applicable federal, state, and local requirements. It is the policy of Shaw to adhere to or exceed the minimum requirements of each governing document (see References, *Section 10.0*). When any conflict exists between referenced documents, the most stringent position of the standard will apply.

The Shaw Group believes in two fundamental principles of safety:

- All accidents, injuries, and occupational illnesses are preventable.
- If an operation cannot be done safely, it will not be done.

To put these principles into practice, all Shaw personnel and subcontractor employees will receive the appropriate training, equipment, and other resources necessary to complete their assigned tasks in a safe and efficient manner. Subcontractors must also be appropriately trained, participate in the necessary medical surveillance programs, and comply with the required policies, procedures, and regulations.

Safety, industrial hygiene, and loss prevention are the direct responsibility of all members of management, who must create an environment in which everyone shares a concern for their own safety and the safety of their associates. Safety will take precedence over expediency. It is a condition of employment that all employees work safely.

8.3 Project Organization and Personnel Qualifications and Responsibilities

The project organization and reporting structure is presented in *Section 2.0* of this Work Plan. Qualifications for key individuals are as follows:

- The H&S Manager must be a Certified Industrial Hygienist or Certified Safety Professional with experience in hazardous waste site operations.
- The SSHO must be fully trained and experienced and able to implement and continually enforce the SSHP.
- At least two site workers will be certified in first aid/cardiopulmonary resuscitation (CPR) by the Red Cross, or equivalent agency.

All personnel are responsible for the adherence to the SSHP procedures and policies during the performance of all work. Site personnel and visitors will be required to read this SSHP and to sign the Acknowledgment Form (located in **Appendix D**) to document their understanding of the contents. Failure to comply with the provisions of this Plan may lead to disciplinary action and/or dismissal from the work site. Ensuring the safe and healthful conduct of site operations is the responsibility of everyone assigned to the site; therefore, all personnel are responsible for the following:

- Complying with the SSHP and all other required safety and health guidelines.
- Taking all necessary precautions to prevent injury to themselves and to their fellow employees.
- Continually being alert to any potentially harmful situation and immediately informing the SSHO of any such conditions.
- Performing only those tasks that they believe they can do safely and have been trained to do.
- Notifying the SSHO of any special medical conditions (i.e., allergies, restrictions, diabetes, etc.) which could affect their ability to safely perform site operations.
- Notifying the SSHO of any prescription and/or over-the-counter medication which they are taking that might cause drowsiness, anxiety, or other unfavorable side effects.
- Preventing spillage and splashing of materials to the greatest extent possible.
- Practicing good housekeeping by keeping the work area neat, clean, and orderly.
- Immediately reporting all injuries, no matter how minor, to the SSHO.
- Maintaining site equipment in good working order, and reporting defective equipment to the SSHO.
- Properly inspecting and using the PPE required by the SSHP or the SSHO.

8.3.1 Subcontractor Responsibilities

In conformance with the Department of Labor, OSHA Hazardous Waste Operations (29 CFR 1910.120), each subcontractor employee proposed for on-site activities must participate in a medical monitoring program, must be certified for hazardous waste field work by a licensed physician, and must have successfully completed the required safety and health training. The

subcontractor shall also be responsible for providing equipment that is safe for operations and free from any hazards.

8.3.2 Visitor Responsibilities

Authorized visitors to IM areas on site will be briefed on the hazards present at that location by the SSHO. Visitors will be responsible for compliance with the requirements specified in this SSHP. Visitors will not be permitted to enter potentially contaminated work zones unless they have completed the appropriate training and medical surveillance requirements, and have the proper PPE. All visitors will be escorted by a member of Shaw site management.

8.4 Hazard Analysis

8.4.1 Activity Hazard Analysis

Activity Hazard Analyses define the activities being performed and identify the sequences of work, the specific hazards anticipated, and the control measures to be implemented to eliminate or reduce each hazard to an acceptable level.

8.4.1.1 Soil Removal

An activity hazard analysis for the ARSAR soil removal is included as **Tables 8-1a through 8-1c**. This activity will be performed subject to the safety provisions of 29 CFR Parts 1910 and 1926, and USACE EM 385-1-1.

8.4.2 Physical Hazards

This section discusses specific physical hazards that may be encountered at RFAAP during the removal actions. If additional hazards other than the ones listed in this section are encountered, this SSHP will be revised to address these hazards.

8.4.2.1 Heavy Equipment

Tests shall be made at the beginning of each day during which the equipment is to be used to determine that the brakes and operating systems are in proper working condition and that all required safety devices are in place. Whenever any machinery or equipment is found to be unsafe or a deficiency which affects the safe operation of equipment is observed, the equipment shall be immediately taken out of service and shall not be used until all of the unsafe conditions are corrected. Machinery and mechanized equipment shall be operated by designated qualified personnel. Equipment safety requirements must be in accordance with 29 CFR 1926 and EM 385-1-1, Section 16 and the guidelines listed below:

- Operation of heavy equipment will be limited to properly trained personnel.
- Operator's certifications, qualification letters, and necessary SOPs will be maintained on site.
- Operator shall use the safety devices provided with the equipment (i.e., seatbelts, backup warning indicators and horns).
- Visually inspect equipment daily, prior to operation, and report any deficiencies. Document observations.
- Good housekeeping practices will be maintained in the cab area of heavy equipment.

Table 8-1. Activity Hazard Analysis – Soil Removal
a. Pre-Removal Soil Characterization Sampling

Activity: Pre-Removal Soil Characterization Sampling **Analyzed by/date: _____**
Reviewed by/date: _____ (/ /) **Approved by/date: _____ (/ /)**

PRINCIPLE STEPS	POTENTIAL SAFETY/ HEALTH HAZARDS	RECOMMENDED CONTROLS
• Soil Sampling ***Stop work and notify your supervisor if you are not sure how to perform your task!***	Physical Hazards	
	• Cold or heat stress	• Wear appropriate clothing and follow recommended work schedules and monitoring controls as stated in *Sections 8.3.2.6 or 8.3.2.7*
	• Manual lifting of coolers	• Use proper lifting techniques as discussed in See *Section 8.3.2.10*
	• Slip, trip, and fall hazards	• Safety training and personal awareness • See *Section 8.3.2.11* for general slip, trip, and fall controls
	• Electrical storm	• Shut down operations, see *Section 8.3.2.12*
	• Repetitive Motion	• Stretch and flex when using hand auger, alternate auger sampling between coworker
	• Utilities	• Complete utility mark outs prior to sampling, follow Shaw Procedure HS308
	Chemical Hazards	
	• Exposure to contaminants in soil	• Minimize dust generation, wash hands and face, see *Section 8.3.3* for chemical hazard controls • Use appropriate PPE
	Biological Hazards	
	• Ticks	• Tape pant legs to boots, avoid tall grass and bushes if possible, check for ticks frequently, see *Section 8.3.4.1*
	• Stinging insects	• Watch out for and avoid stinging insects, see *Section 8.3.4.2*
	• Spiders	• Watch out for and avoid black widow and brown recluse spiders, see *Section 8.3.4.3*
	• Poisonous Plants ***Stop work and notify your supervisor if you are not sure how to perform your task!***	• Watch out for and avoid poisonous plants likely to grow near sampling locations, avoid contact with plant oils that may be present on clothes or equipment, wash hands to prevent spreading oils, see *Section 8.3.4.6* ***Stop work and notify your supervisor if you are not sure how to perform your task!***
EQUIPMENT TO BE USED	**INSPECTION REQUIREMENTS**	**TRAINING REQUIREMENTS**
Stainless steel trowels, Hand augers	• None	• All site workers must have OSHA Training in accordance with 29 CFR 1910.120. • All site workers must have MEC Awareness Training. • All site workers must attend the Daily Safety Meetings. • Hazard Communication for all site workers.

Table 8-1. Activity Hazard Analysis – Soil Removal
b. Soil Removal

Activity: Soil Removal **Analyzed by/date: _____**
Reviewed by/date: _____ (/ /) **Approved by/date: _____ (/ /)**

PRINCIPLE STEPS	POTENTIAL SAFETY/HEALTH HAZARDS	RECOMMENDED CONTROLS
• Excavate soil and direct load into dump trucks • Collect waste characterization samples ***Stop work and notify your supervisor if you are not sure how to perform your task!***	Physical Hazards	
	• General heavy equipment hazards	• Safety training, personal awareness, and safety devices • Maintain a safe equipment distance exclusion zone • Use hand signals • See *Section 8.3.2.1* for general heavy equipment controls
	• Power and hand tools hazard	• See *Section 8.3.2.2* for power and hand tool controls
	• Electrical shock	• Locate and shut down all utilities in work zone, obtain dig permit, watch out for overhead power lines, use GFCI on all temporary electrical devices
	• Noise	• Use hearing protection if noise exceeds 85 dBA, see *Section 8.3.2.8*
	• Cold or heat stress	• Wear appropriate clothing and follow recommended work schedules and monitoring controls as stated in *Sections 8.3.2.6 or 8.3.2.7*
	• Manual lifting	• Use proper lifting techniques as discussed in See *Section 8.3.2.10*
	• Slip, trip, and fall hazards	• Safety training and personal and situational awareness • See *Section 8.3.2.11*for general slip, trip, and fall controls
	• Electrical storm	• Shut down operations, follow the 30/30 rule, see *Section 8.3.2.12*
	Chemical Hazards	
	• Exposure to contaminants in soil, primarily antimony and lead.	• Minimize dust generation, wash hands and face, see *Section 8.3.3* for chemical hazard controls • Modified Level D PPE will be required, see *Section 8.6*
	• Cross-contamination	• Avoid spillage from excavator bucket, utilize plastic sheeting where spillage may occur
	Biological Hazards	
	• Ticks	• Tape pant legs to boots, avoid tall grass and bushes if possible, check for ticks frequently, see *Section 8.3.4.1*
	• Stinging insects	• Watch out for and avoid stinging insects, see *Section 8.3.4.2*
	• Spiders	• Watch out for and avoid black widow and brown recluse spiders, see *Section 8.3.4.3*
	• Poisonous Plants ***Stop work and notify your supervisor if you are not sure how to perform your task!***	• Watch out for and avoid poisonous plants, avoid contact with plant oils that may be present on clothes or equipment, wash hands to prevent spreading oils, see *Section 8.3.4.6* ***Stop work and notify your supervisor if you are not sure how to perform your task!***
EQUIPMENT TO BE USED	**INSPECTION REQUIREMENTS**	**TRAINING REQUIREMENTS**
Excavator, shovels	• Daily inspection and maintenance of equipment	• All site workers must have OSHA Training in accordance with 29 CFR 1910.120 • All site workers must have MEC Awareness Training • All site workers must attend the Daily Safety Meetings • Hazard Communication for all site workers • Appropriate heavy equipment and/or power tools training

Table 8-1. Activity Hazard Analysis – Soil Removal
c. Backfill and Site Restoration

Activity: Backfill and Site Restoration **Analyzed by/date: _____**
Reviewed by/date: _____ (/ /) **Approved by/date: _____ (/ /)**

PRINCIPLE STEPS	POTENTIAL SAFETY/HEALTH HAZARDS	RECOMMENDED CONTROLS
• Backfill excavation • Re-seed ***Stop work and notify your supervisor if you are not sure how to perform your task!***	Physical Hazards	
	• General heavy equipment hazards	• Safety training, personal awareness, and safety devices • Maintain a safe exclusion zone • Use hand signals • See *Section 8.3.2.1* for general heavy equipment controls
	• Electrical shock	• Watch for overhead power lines
	• Cold or heat stress	• Wear appropriate clothing and follow recommended work schedules and monitoring controls as stated in *Sections 8.3.2.6 or 8.3.2.7*
	• Manual lifting	• Use proper lifting techniques as discussed in *Section 8.3.2.10*
	• Slip, trip, and fall hazards	• Safety training and personal awareness • *See Section 8.3.2.11* for general slip, trip, and fall controls
	• Electrical storm	• Shut down operations, see *Section 8.3.2.12*
	Chemical Hazards – The potential for exposure to chemical hazards will be minimal	
	Biological Hazards	
	• Ticks	• Tape pant legs to boots, avoid tall grass and bushes if possible, check for ticks frequently, see *Section 8.3.4.1*
	• Stinging insects	• Watch out for and avoid stinging insects, see *Section 8.3.4.2*
	• Spiders	• Watch out for and avoid black widow and brown recluse spiders, see *Section 8.3.4.3*
	• Poisonous Plants ***Stop work and notify your supervisor if you are not sure how to perform your task!***	• Watch out for and avoid poisonous plants, avoid contact with plant oils that may be present on clothes or equipment, wash hands to prevent spreading oils, see *Section 8.3.4.6* ***Stop work and notify your supervisor if you are not sure how to perform your task!***
EQUIPMENT TO BE USED	**INSPECTION REQUIREMENTS**	**TRAINING REQUIREMENTS**
Excavator, shovels	• Daily inspection and maintenance of equipment	• All site workers must have OSHA Training in accordance with 29 CFR 1910.120 • All site workers must have MEC Awareness Training • All site workers must attend the Daily Safety Meetings • Hazard Communication for all site workers • Appropriate heavy equipment training

- Additional riders shall not be allowed on equipment, unless it is specifically designed for that purpose.

As presented in **Appendix E**, Shaw Procedure HS810, Commercial Motor Vehicle Operation and Maintenance, will be implemented.

8.4.2.2 Power and Hand Tools

By their very nature, power tools have great capability for inflicting serious injury upon site personnel if they are not used and maintained properly. Use of improper or defective tools can contribute significantly to the occurrence of accidents on site. To control the hazards associated with power and hand tool operation, the requirements outlined in EM 385-1-1, and the safe work practices listed below shall be observed when using these tools:

- Operation/use will be conducted by authorized and experienced personnel.
- Tools will be inspected prior to use, and defective equipment will be removed from service until repaired.
- Tools will be selected and used in the manner for which they were designed and in accordance with manufacturer's recommendations.
- Be sure of footing and grip before using any tool.
- Power tools designed to accommodate guards will have such guards properly in place prior to use.
- Do not use tools that have split handles, mushroom heads, and worn parts.
- Safety glasses or a face shield will be used if use of tools presents an eye or face hazard.
- Do not use makeshift tools or other improper tools.
- Use non-sparking tools in the presence of explosive vapors, gases, or residue.
- Loose-fitting clothing or long hair will not be permitted around moving parts.
- Hands, feet, etc. will be kept away from moving parts.
- Maintenance and adjustments to equipment will not be made while equipment is in operation. Power will be disconnected prior to maintenance.
- An adequate operating area will be provided, allowing sufficient clearance and access for operation.
- Proper PPE in accordance with equipment operating manual will be used (i.e., chain saw chaps, leather gloves, hard hats, hearing protection, shin guards, face shield, safety glasses, etc.).

8.4.2.3 Fire and Explosion Hazards

Shaw employees and subcontractors MUST strictly follow ATK's protocols to prevent fires and/or explosions.

Although fires and explosions may arise spontaneously, they are more commonly the result of carelessness during the conduct of site activities such as moving drums, mixing/bulking of site chemicals, and during refueling of heavy or hand held equipment. Some potential causes of explosions and fires include:

- Mixing of incompatible chemicals, which cause reactions that spontaneously ignite due to the production of both flammable vapors and heat.
- Ignition of explosive or flammable chemical gases or vapors by external ignition sources.
- Ignition of materials due to oxygen enrichment.
- Agitation of shock or friction-sensitive compounds.
- Sudden release of materials under pressure.
- Improper labeling of flammable and combustible material containers.

Explosions and fires not only pose the obvious hazards of intense heat, open flames, smoke inhalation, and flying objects, but may also cause the release of toxic chemicals into the environment. Such releases can threaten both personnel on site and members of the general public living or working nearby. Site personnel involved with potentially flammable material or operations will follow the guidelines listed below and EM 385-1-1, Section 9, to prevent fires and explosions:

- Potentially explosive/flammable atmospheres involving gases or vapors will be monitored using a combustible gas indicator/oxygen (CGI/O_2) meter.
- Prior to initiation of site activities involving explosive/flammable materials, all potential ignition sources will be removed or extinguished.
- Non-sparking and explosion-proof equipment will be used whenever the potential for ignition of flammable/explosive gases/vapors/liquids exists.
- Dilution or induced ventilation may be used to decrease the airborne concentration of explosive/flammable atmospheres.
- Smoking will be prohibited in the vicinity of operations which may present a fire hazard.
- Flammable and/or combustible liquids must be handled only in approved, properly labeled metal safety cans equipped with flash arresters and self-closing lids.
- Transfer of flammable liquids from one metal container to another will be done only when the containers are electrically interconnected (bonded).
- The motors of all equipment being fueled will be shut off during the fueling operations.
- Spark or flame producing operations will require a hot work permit in accordance with Shaw Procedure HS314.

8.4.2.4 Electrical

While it is anticipated that all electrical hookups at the ARSAR have been terminated, this section is included as this will be verified prior to the commencement of work at the ARSAR. All electrical work performed shall comply with applicable National Electric Safety Code, National Electronics Council, and National Fire Protection Association requirements. All electrical work shall be performed by qualified personnel familiar with applicable code requirements. All safe guarding of hazardous energy sources will comply with Shaw Procedure HS315.

Above or below ground utilities may pose a hazard to team members during field activities. Below ground utilities will need to be located by Department of Public Works personnel prior to

excavation activities. As presented in **Appendix E**, Shaw Procedure HS308, Underground and Overhead Utilities will be followed to prevent utility damage. A safe distance between all equipment and overhead power lines must be maintained at all times. Minimum safe clearances are as follows:

Nominal System Voltage	Minimum Rated Clearance
0 to 50 kilovolts (kV)	9.8 ft (3 meters)
51 to 200 kV	14.7 ft (4.5 meters)
201 to 300 kV	19.7 ft (6 meters)
301 to 500 kV	24.6 ft (7.5 meters)
501 to 750 kV	34.4 ft (105 meters)
751 to 1000 kV	44.3 ft (135 meters)

8.4.2.5 Excavations and Trenching

Excavation activities will be conducted in accordance with EM 385-1-1, Section 25 and Subpart P of 29 CFR 1926. As presented in **Appendix E**, Shaw Procedure HS307, Excavation and Trenching, will be implemented during excavation and trenching operations. The guidelines below are intended to reflect minimum requirements to be followed on this site.

- Prior to initiation of any excavation or trenching activity, the location of underground utility installations will be determined in accordance with Shaw Procedure HS308.
- The excavation(s) will be inspected and inspection documented daily by the SSHO or by the Competent Excavation and Trenching person prior to commencement of work activities.
- Evidence of cave-ins, slides, sloughing, or surface cracks will be cause for work to cease until necessary precautions are taken to safeguard workers.
- Excavations 5 ft or deeper where employees must enter and cannot be sloped, will require a registered civil engineer to design a protective system.
- Protective systems shall be selected from OSHA 29 CFR 1926 Subpart P and/or designed by a registered professional civil engineer.
- Spoils and other materials will be placed 2 ft or more from the edge of the excavation.
- Materials used for sheeting, shoring, or bracing will be in good condition.
- Timbers will be sound, free of large or loose knots, and of appropriate dimensions for the excavation.
- Safe access will be provided into the excavation(s) by means of a gradually sloped personnel access/egress ramp or ladders.
- Excavations 4 ft bgs or more in depth will have a means of egress at a frequency such that lateral travel to the egress point does not exceed 25 ft.

8.4.2.6 Heat Stress

Heat stress is caused by a number of interacting factors, including environmental conditions, clothing, workload, and the individual characteristics of the worker. Because heat stress is probably one of the most common illnesses at a site, regular monitoring and other preventive measures are vital.

Heat stress manifests itself in progressive stages (listed below), each increasing in severity, and if not remedied, can threaten life or health. Factors which may predispose a worker to heat stress include: lack of physical fitness, lack of acclimatization to hot weather, degree of hydration, current health status, alcohol or drug use, and the worker's age and sex. Therefore, it is important that all workers be able to recognize symptoms of these conditions and be capable of arresting the problem as quickly as possible.

As with any illness, the best cure for heat stress is avoidance/prevention. Heat stress is most likely to occur early in the summer, prior to acclimatization. Full acclimatization takes 5 to 7 days of consecutive controlled exertion in heat. Individual physical conditioning, pre-existing illnesses and use of alcohol contribute significantly to the potential for heat stress. Avoidance includes drinking plenty of fluids, taking frequent breaks, revising work schedule around hot periods of the day, and assuring that workers are acclimated before allowing them to work for extended periods of time. **Table 8-2** shows an example work/rest schedule to be implemented as it relates to the work load and regimen. The SSHO will determine when work/rest schedules will be implemented based on temperature and work load.

As presented in **Appendix E**, Shaw Procedure HS400, Working in Hot Environments, will be implemented to control heat-related illness. The SSHO will determine the potential for heat stress based on planned activities and weather forecasts.

Table 8-2
Examples of Permissible Heat Exposure Threshold Limit Values

Work – Rest Regimen	*Work Load		
	Light	Moderate	Heavy
Continuous Work	30.0 (86)	26.7 (80)	25.0 (77)
75% Work - 25% Rest, each hour	30.6 (87)	28.0 (82)	25.9 (78)
50% Work - 50% Rest, each hour	31.4 (89)	29.4 (85)	27.9 (82)
25% Work - 75% Rest, each hour	32.2 (90)	31.1 (88)	30.0 (86)

*Consult the ACGIH TLV booklet for definitions of Light, Moderate and Heavy workloads. Values are given in °C and [degrees Fahrenheit (°F)] WBGT, and are intended for workers wearing single layer summer type clothing. As workload increases, the heat stress impact on an un-acclimatized worker is exacerbated. For un-acclimatized workers performing a moderate level of work, the permissible heat exposure TLV should be reduced by approximately 2.5°C.

Heat Rash

Heat rash is caused by continuous exposure to heat and humid air and is aggravated by wet chafing clothes. This condition can decrease a worker's ability to tolerate hot environments.

Symptoms – Symptoms of heat rash include a mild red rash, especially in areas of the body which sweat heavily.

Treatment – Treatment includes decreasing the amount of time in protective gear and providing powder (such as corn starch or baby powder) to help absorb moisture and decrease chafing. Maintain good personal hygiene standards and change into dry clothes if needed.

Heat Fatigue

Heat fatigue is characterized by discomfort and reduced mental awareness, with a greater effect in un-acclimated workers. Medical treatment is usually not needed. Heat fatigue usually affects people who work in hot environments and perspire a great deal. Loss of salt from the body causes very painful cramps of the leg and abdominal muscles. Heat fatigue also may result from drinking iced water or other drinks too quickly or in too large a quantity.

Symptoms – Heat fatigue symptoms include muscle cramps in legs and abdomen, pain accompanying the cramps, faintness, and profuse perspiration.

Treatment – Treatment includes removing a victim to a cool area and loosening clothing, stretching and massaging affected muscle, drinking 1 to 2 cups of water immediately, and every 20 minutes thereafter.

Heat Exhaustion

Heat exhaustion results from sustained exertion in heat, combined with failure to replace water and salts lost in sweat. Heat syncope results in fainting and can occur when standing immobile in heat. It is caused by the pooling of venous blood in the dilated vessels of the skin and lower body.

Symptoms – Symptoms include weak pulse, rapid and shallow breathing, fatigue, nausea, headache, profuse perspiration, dizziness, unconsciousness, and clammy, moist skin which may be flushed or pale.

Treatment – Replacement of water is required to recover. Electrolyte replacement fluids should be taken until urine volume increases. Recovery is complete and rapid following rest in a recumbent position at a cool location. Treat the person for shock if necessary, and remove him/her to a medical facility if there is any indication of a more serious problem.

Heat Stroke

The most serious heat injury is *heat stroke*. Heat stroke is a medical emergency, treatment must be immediate and professional medical attention must be obtained. Heat stroke is caused by a combination of factors including heavy exertion heat, inadequate replacement of fluids, poor physical condition, and individual susceptibility.

Symptoms – Failure of sweat response occurs, leading to a rapidly accelerated increase in core temperature. The victim usually has hot, dry red skin and if conscious, is confused;

convulsions may be present. Additional symptoms include dilated pupils, and a full and fast pulse.

Treatment – The victim must be cooled immediately; heat stroke is fatal if treatment is incomplete or delayed. Emergency care includes transportation to a medical facility, placing person in a cool environment, assure an open airway, reduce the body temperature (wrap in wet sheet or douse body with water), and if available, place cold packs under arms, around neck, at the ankles, or any place where blood vessel lie close to skin.

8.4.2.7 Cold Stress

As with high temperatures, outdoor work in low temperatures can result in risks to the health of employees exposed without adequate preparation. The combined temperature/wind chill affect is shown in **Table 8-3**. To minimize impacts from cold stress, the information and precautions given below shall be observed.

Table 8-3
Wind Chill

COOLING POWER OF WIND ON EXPOSED FLESH EXPRESSED AS EQUIVALENT TEMPERATURE												
	Actual Temperature Reading (°F)											
Estimated Wind Speed (in mph)	50	40	30	20	10	0	-10	-20	-30	-40	-50	-60
	Equivalent Chill Temperature (°F)											
Calm	50	40	30	20	10	0	-10	-20	-30	-40	-50	-60
5	48	37	27	16	6	-5	-15	-26	-36	-47	-57	-68
10	40	28	16	4	-9	-24	-33	-46	-58	-70	-83	-95
15	36	22	9	-5	-18	-32	-45	-58	-72	-85	-99	-112
20	32	18	4	-10	-25	-39	-53	-67	-82	-96	-110	-121
25	30	16	0	-15	-29	-44	-59	-74	-88	-104	-118	-133
30	28	13	-2	-18	-33	-48	-63	-79	-94	-109	-125	-140
35	27	11	-4	-20	-35	-51	-67	-82	-98	-113	-129	-145
40	26	10	-6	-21	-37	-53	-69	-85	-100	-116	-132	-148
(Wind speeds greater than 40 mph have little additional effect)	***LITTLE DANGER*** In<hr with dry skin. Maximum danger of false sense of security.				***INCREASING DANGER*** Danger from freezing of Exposed flesh within One minute.				***GREAT DANGER*** Flesh may freeze within 30 seconds.			
	Trenchfoot and immersion foot may occur at any point on this chart.											

Cold-related worker fatalities have resulted from failure to escape low environmental air temperatures, or from immersion in low temperature water. Most hypothermia cases develop in air temperatures between 30-50°F. The single most important aspect of life-threatening hypothermia is a fall in the deep core temperature of the body. Lower body temperature will very likely result in reduced mental alertness, reduction in rational decision making, or loss of consciousness with the threat of fatal consequences.

Persons working outdoors in temperatures at or below freezing may be frostbitten. Extreme cold for a short time may cause severe injury to the surface of the body, or result in profound generalized cooling, causing death. Areas of the body that have high surface-area-to-volume ratio, such as fingers, toes, and ears, are the most susceptible.

Local injury resulting from cold is included in the generic term frostbite. There are several degrees of damage. Frostbite of the extremities can be categorized into:

- Frost Nip or Initial Frostbite: Characterized by sudden blanching or whitening of skin.
- Superficial Frostbite: Skin has a waxy or white appearance and is firm to the touch, but tissue beneath is resilient.
- Deep Frostbite: Tissues are cold, pale, and solid; extremely serious injury.
- Systemic Hypothermia: This condition is caused by exposure to freezing or rapidly dropping temperature. Its symptoms are usually exhibited in five stages: 1) shivering; 2) apathy, listlessness, sleepiness, and sometimes rapid cooling of the body to less than 95°F; 3) unconsciousness, glassy stare, slow pulse, and slow respiratory rate; 4) freezing of the extremities; and finally 5) death.

Treatment of cold stress includes bringing the body core temperature back to its normal temperature of 98.6°F. Personnel exhibiting symptoms of cold stress should be brought into a warm area and allowed to rest and warm up. Warm, non-alcoholic, decaffeinated drinks (not coffee) or soup should be given to increase body temperature, and rewarming should be gradual.

For frostbite emergency treatment, the victim should be sheltered from the wind and cold and given warm drinks. If superficial, the frozen area should be covered with extra clothing or warmed against the body. One should not use direct heat, and not pour hot water over or rub the affected area. Warming should be gentle and gradual. If the frostbite is deep (area is frozen and hard to the touch), immediate medical attention should be obtained.

For hypothermia emergency treatment, all stages are treated by either passive or active rewarming. This is accomplished by better conservation of the patient's body heat. It is important to note that if a victim is found in a remote area, despite the death-like appearance, the person may be saved. All attempts should be made to revive the victim. Active rewarming means heat is applied to the victim by an external source, either to the skin surface and/or through the core. Treatment includes:

- Preventing further heat loss. Remove the victim to a warm, dry place.
- Remove wet clothing piece-by-piece and dry underlying skin.
- Dress in several layers of warm, dry clothing, giving preference to the central body core rather than the extremities.
- Cover the victims head, then wrap the victim in blankets.
- If the victim is conscious, ask him/her to drink hot fluids.
- Monitor oral body temperature every 15 minutes. If the body temperature falls below 98.6°F, the team member should not be allowed outside until the body temperature returns to normal.

- In more severe cases of hypothermia, implement the above actions, but also institute some type of active re-warming, including:
  - Electric pads or blankets.
  - Hot-air blowers or heaters.
  - Heated blankets or clothes.
  - Use of human body heat.
- It is important to watch for signs of return of the normal thermoregulatory mechanisms (shivering, teeth chattering, etc.) and to monitor mental status.
- The victim should be transferred to a medical facility after the emergency care steps have been initiated and should not be allowed to return to work for at least 48 hours.
- Perform CPR if the victim is pulse-less and not breathing.
- Avoidance of cold stress emergencies can be performed by the general practices stated below:
  - Wear layered clothing, including a water-repellent outer layer.
  - Wear gloves, socks, and a hat that are synthetic or wool insulated.
  - Remove outer layers of clothing during breaks to prevent inner layer from getting wet from perspiration.
  - Eat well balance meals and maintain an adequate intake of fluids.
  - Seek shelter in a warm protected area when signs and symptoms of cold stress become evident.

Table 8-4 provides a work/warm-up schedule for a 4-hour shift as it relates to temperature and wind speed. This schedule will be applied during all field work.

Table 8-4
Threshold Limit Values Work/Warm-Up Schedule for 4-Hour Shift*

Air Temperature-Sunny Sky		No Wind		5 MPH Wind		10 MPH Wind		15 MPH Wind		20 MPH Wind	
°C (approx.)	°F (approx.)	Max. Work Period	No. of Breaks	Max. Work Period	No. of Breaks	Max. Work Period	No. of Breaks	Max. Work Period	No. of Breaks	Max. Work Period	No. of Breaks
-26° to -28°	-15° to -19°	Normal	1	Normal	1	75 min.	2	55 min.	3	40 min.	4
-29° to -31°	-20° to -24°	Normal	1	75 min.	2	55 min.	3	40 min.	4	30 min.	5
-32° to 34°	-25° to -29°	75 min.	2	55 min.	3	40 min.	4	30 min.	5		
-35° to -37°	-30° to -34°	55 min.	3	40 min.	4	30 min.	5				
-38° to -39°	-35° to -39°	40 min.	4	30 min.	5						
-40° to -42°	-40° to -44°	30 min.	5								
-43° to below	-45° & Below	Non-emergency work should cease		Non-emergency work should cease		Non-emergency work should cease		Non-emergency work should cease		Non-emergency work should cease	

Notes for Table 8-4:

1. Schedule applies to any 4-hour work period with moderate to heavy work activity, with warm-up periods of 10 minutes in a warm location and with an extended break (e.g., lunch) at the end of the 4-hour work period in a warm location. For Light-to-Moderate Work (limited physical movement): apply the schedule one step lower. For example, at -35°C (-30°F) with no noticeable wind (Step 4), a worker at a job with little physical movement should have a maximum work period of 40 minutes with 4 breaks in a 4-hour period (Step 5).
2. The following is suggested as a guide for estimating wind velocity if accurate information is not available:

   mph: light flag moves; 10 mph: light flag fully extended; 15 mph: raises newspaper sheet; 20 mph: blowing and drifting snow.
3. If only the wind chill cooling rate is available, a rough rule of thumb for applying it rather than the temperature and wind velocity factors given above would be: 1) special warm-up breaks should be initiated at a wind chill cooling rate of about 1750 W/m^2; 2) all non-emergency work should have ceased at or before a wind chill of 2250 W/m^2. In general, the warm-up schedule provided above slightly under-compensates for the wind at the warmer temperatures, assuming acclimatization and clothing appropriate for winter work. On the other hand, the chart slightly over-compensates for the actual temperatures in the colder ranges because windy conditions rarely prevail at extremely low temperatures.
4. TLVs apply only for workers in dry clothing.

* Adapted from the "1995-1996 Threshold Limit Values and Biological Exposure Indices," American Conference of Governmental Industrial Hygienist. Cincinnati, OH.

As presented in **Appendix E**, Shaw Procedure HS401, Cold Stress, will be implemented to control cold related illness.

8.4.2.8 Noise

Hearing protection may be required during certain noisy activities. Hearing protection will be required when sound pressure levels in work areas or on equipment exceed 85 dBA, the TLV for noise. Permissible noise exposure levels for different durations are shown in **Table 8-5**. A field guideline for knowing when hearing protection is recommended is if people 3 ft apart must raise their voices to be heard in normal conversation.

Table 8-5
Permissible Noise Exposure

A-Weighted Sound Level (dB)	Permitted Duration Per Workday (Hours)	A-Weighted Sound Level (dB)	Permitted Duration Per Workday (Hours)
80	32.0	106	0.87
81	27.9	107	0.76
82	24.3	108	0.66
83	21.1	109	0.57
84	18.4	110	0.50
85	16.0	111	0.44
86	13.9	112	0.38
87	12.1	113	0.33
88	10.6	114	0.29
89	9.2	115	0.25
90	8.0	116	0.22
91	7.0	117	0.19

Table 8-5 (Continued)
Permissible Noise Exposure

A-Weighted Sound Level (dB)	Permitted Duration Per Workday (Hours)	A-Weighted Sound Level (dB)	Permitted Duration Per Workday (Hours)
92	6.2	118	0.16
93	5.3	119	0.14
94	4.6	120	0.125
95	4.0	121	0.11
97	3.0	123	0.082
98	2.6	124	0.072
99	2.3	125	0.063
100	2.0	126	0.054
101	1.7	127	0.047
102	1.5	128	0.041
103	1.3	129	0.038
104	1.1	130	0.031
105	1.0		

Source: Shaw Procedure HS402.

As presented in **Appendix E**, Shaw Procedure HS402, Hearing Conservation Program, will be implemented when elevated noise levels exist. The SSHO will provide training on the proper use of hearing protection in accordance with 29 CFR 1910.95. The training will be conducted as a part of the pre-work safety and health briefing and documented in the safety files.

8.4.2.9 Dust

It is possible that dust could be generated during soil excavation and load out operations. In such cases, a water spray will be used to minimize dust generation. Real-time dust monitors may be used if necessary to protect site personnel (*Section 8.6*).

8.4.2.10 Manual Lifting

Investigation and IM activities may require personnel to move large, heavy objects by hand. The human body is subject to severe damage in the forms of back injury and hernia if caution is not observed when handling, lifting, or moving these large, heavy objects.

The following fundamentals should be followed while manual lifting objects:

- The size, shape, and weight of the object to be lifted must be considered. Site personnel will not lift more than they can handle comfortably. No individual employee is permitted to lift any object that weighs over 60 pounds. Multiple employees or the use of mechanical lifting devices are required for objects over the 60-pound limit.
- A firm grip on the object is essential; therefore, the hands and objects shall be free of oil, grease, and water.
- The hands and fingers shall be kept away from any points that could cause them to be pinched or crushed, especially when setting the object down.

- The item shall be inspected for metal slivers, jagged edges, burrs, and pinch points, and gloves shall be used to protect the hands.
- The feet will be placed far enough apart for good balance and stability.
- Personnel will ensure that solid footing is available prior to lifting the object.
- To lift the object, the legs are straightened from their bending position.
- Never carry a load that you cannot see around.
- When placing an object down, the stance and position are identical to that for lifting.
- If needed, back support devices will be provided to aid in preventing back injury.

The following steps will be followed during manual lifting:

- Ensure the route you will carry the object is clear and free from trip hazards.
- Get a good footing.
- Place feet about one shoulder width apart.
- Bend at knees to grasp weight.
- Keep the back straight.
- Get a firm hold.
- Lift gradually by straightening the legs.
- If weight is uncomfortable to lift, get help.

8.4.2.11 Slips, Trips, Falls

Field operations may place personnel in situations where they may be exposed to slip, trip, and fall hazards. Slipping hazards will exist when the ground is wet, or on steep slopes. Tripping hazards will exist on rough, uneven terrain, or if the work area is cluttered with tools, equipment, debris, soil piles, etc. Falling hazards will exist as a result of slip or trip hazards, or in elevated work areas with inadequate railing.

The following precautions should be followed by all site personnel:

- Field personnel shall become familiar with the general terrain of the site and potential physical hazards (i.e., rocky conditions, uneven terrain) that would be associated with accidental slips, trips, and falls.
- Be cautious after periods of heavy rainfall, which may cause earth movement and slides.
- Be attentive where you walk since pits, holes, or similar hazards may be partially covered or visually obstructed.
- Be cautious around soil or terrain which recently may have been disturbed, relocated, or otherwise made less stable.
- Avoid the top edges of drop-off areas whether they have been disturbed or not.
- Use the three-point rule when getting on and off heavy equipment.

8.4.2.12 Lightning

Electrical storms commonly occur during Spring and Fall. The resulting lightning poses a safety hazard to field personnel. Since the storms are sometimes fast moving, field personnel should watch for indications of electrical storms. The distance to an electrical storm can be estimated by observing the interval between the lightning flash and the sound of thunder. Since sound travels approximately 1,100 ft per second, an interval of 5 seconds corresponds to a storm distance of approximately 1 mile. This is also referred to as the flash/bang process. If lightning is observed and thunder is heard within 30 seconds work shall be suspended. Work will not resume for 30 minutes or until the flash/bang time exceeds 30 seconds (30:30 rule).

If an electrical storm is observed within 6 miles of the site, field personnel shall cease outside activities and proceed to the site office for further instructions and all heavy equipment will be shut down. If caught in the open by an electrical storm, all personnel will immediately seek shelter in their vehicle and proceed as above. In the event that their vehicle is inaccessible, they will move to a topographically low area away from tall objects and conductors (e.g., transformer, power lines, metal sheds) and wait for the storm to leave the area.

8.4.2.13 Drum Handling

Hazardous materials are often shipped, stored, or disposed in 55-gallon drums. If a drum or other container is encountered with unknown contents, caution will be exercised to avoid explosion or chemical hazards. The discovery of unknown drums shall require immediate notification to the H&S Manager. Unknown drums will not be handled until appropriate precautions and PPE are in place.

8.4.3 Chemical Hazards

This section discusses chemical hazards that may be encountered at RFAAP during the IM at the ARSAR. Chemical hazards can be encountered either from chemicals brought on site by the contractor for use during activities, chemicals stored at the site, or chemicals that have been released to the environment and are present in various media such as air, soil, or water.

8.4.3.1 Site-Related Chemicals

As shown on **Table 1-1**, antimony was identified equal to or above the r-SL of 3.1 mg/kg and lead was identified equal to or above the r-RGs of 400 mg/kg in the target berm during the SSP investigation at the ARSAR (URS, 2009). In addition, arsenic was detected at concentrations above the established RFAAP background concentration of 15.8 mg/kg in surface soil samples collected along the hillside southeast of the target berm (**Table 1-1**).

8.4.3.2 Exposure Pathways

Chemicals may pose a hazard to humans when inhaled, ingested, or through dermal absorption. Inhalation can occur when chemicals are present as vapors, aerosols, or attached to airborne dust particles. Ingestion usually occurs incidentally, as chemicals present in the air enter the mouth or nose, or from hand to mouth activities such as eating, drinking, and smoking. Dermal absorption occurs when chemicals contact unprotected skin.

8.4.3.3 Exposure Assessment

The toxic hazards to site personnel associated with chemicals can be assessed through comparison of actual exposures with several established occupational exposure limits using

quantitative collection and analysis through real-time and/or time-integrated personal air sampling.

Permissible exposure limits (PELs) are established by OSHA. TLVs are established by the ACGIH. Immediately Dangerous to Life or Health (IDLH) values are established by NIOSH. **Table 8-6** presents occupational exposure limits (if available) for potential chemicals, including OSHA PELs, ACGIH TLVs, and NIOSH IDLH values. The table also indicates if there are potential significant contributions to the overall exposure for the chemical of concern through dermal contact, and identifies the acute symptoms resulting from exposure.

Table 8-6
Occupational Health Exposure Guidelines for Potential Contaminants

Contaminant	Acute Symptoms of Exposure	PEL (TWA unless otherwise noted)	TLV-TWA	Skin Notation (Yes/No)	IDLH
Antimony	Irritation of eyes, skin, nose, throat, mouth; cough; dizziness; headache; nausea, vomiting, diarrhea; stomach cramps; insomnia; anorexia; unable to smell properly	0.05 mg/m^3	0.05 mg/m^3	Y	50 mg/m^3
Arsenic	Ulceration of nasal septum, dermatitis, gastrointestinal disturbances, peripheral neuropathy, respiratory irritation, hyperpigmentation of skin, [potential occupational carcinogen]	0.01 mg/m^3	0.01 mg/m^3	Y	5 mg/m^3
Lead	Lassitude (weakness, exhaustion), insomnia; facial pallor; anorexia, weight loss, malnutrition; constipation, abdominal pain, colic; anemia; gingival lead line; tremor; paralysis wrist, ankles; encephalopathy; kidney disease; irritation eyes; hypotension	0.05 mg/m^3	0.05 mg/m^3	Y	100 mg/m^3

The occupational exposure limits are described as follows:

PELs may be expressed as an 8-hour time-weighted average (TWA), a short-term exposure limit (STEL), or a ceiling limit. Ceiling limits may not be exceeded at any time. PELs are enforceable by law. STELs are allowable exposure limits for durations ranging from 5 to 15 minutes, without causing the 8-hour TWA to be exceeded.

The ACGIH TLV is defined as the TWA concentrations for a substance to which nearly all workers (8 hours/day, 40 hours/week) may be repeatedly exposed, day after day, without experiencing adverse health effects. For some substances, the overall exposure to a substance is enhanced by skin, mucous membrane, or eye contact. These substances are identified by "yes" in the skin notation column.

The IDLH values represent the maximum concentrations from which, in the event of respirator failure, one could escape within 30 minutes without a respirator and without experiencing any escape-impairing symptoms or any irreversible health effects.

8.4.3.4 Chemical Hazard Communication

In order to comply with Shaw Procedure HS060 and the OSHA Hazard Communication Standard 29 CFR 1910.1200, to ensure that site personnel are informed of the hazards associated with the materials with which they work the following requirements will apply to all commercial products containing hazardous substances which are brought on site.

- Material Safety Data Sheets (MSDSs) will be maintained for each product containing a hazardous substance that will be used on site. MSDSs will also be maintained for contaminants of interest (COIs) identified in site soil. MSDSs are included in **Appendix F**.
- All containers not supplied with adequate hazard labeling will have a hazard communication label affixed to the container providing the health and physical hazards associated with the material.
- All personnel, including subcontractors who work with products containing hazardous substances, will be trained in accordance with the requirements of 29 CFR 1910.1200. This training will be performed and documented by the SSHO and maintained on site in the safety files.
- An inventory of all products containing hazardous substances used on site will be maintained using a site-specific Chemical Inventory.

8.4.4 Biological Hazards

Biological hazards that may be found at the ARSAR include ticks, spiders, snakes, and poisonous plants. The following sections discuss the potential biological hazards that may be encountered at the ARSAR during the RFI/IM.

8.4.4.1 Ticks

From April through October, particular caution will be exercised to prevent site workers from being bitten by deer ticks and potentially contracting Lyme Disease. The Centers for Disease Control has noted an increase of Lyme Disease and Rocky Mountain Spotted Fever (RMSF), which are caused by tick bites. Ticks are small, ranging from the size of a comma up to about

1/4-inch; when embedded in the skin, they may look like a freckle. Ticks live in and near wooded areas, tall grass, and brush.

Lyme Disease – Lyme Disease is caused by deer ticks and lone star ticks that have become infected with spirochetes. Female deer ticks are about 1/4-inch in size, and are black and brick red in color. Male deer ticks are smaller, and completely black. Lone star ticks are larger and chestnut brown in color. The illness typically occurs in the summer and is characterized by a slowly expanding red rash that develops in a few days to a few weeks after the bite of an infected tick. This may be accompanied by flu-like symptoms along with headache, stiff neck, fever, muscle aches, and/or general malaise. At this stage, treatment by a physician usually is effective. If left alone, these early symptoms may disappear, but more serious problems may follow. The most common late symptom of the untreated disease is arthritis. Other problems which may occur include meningitis, neurological abnormalities, and cardiac abnormalities. It is important to note that some people do not get the characteristic rash and may have diminished progress to the later manifestations. Treatment of later symptoms is more difficult than early symptoms and is not always successful.

Rocky Mountain Spotted Fever – RMSF has occurred in this area of the country. It is caused by Rocky Mountain wood ticks and dog ticks which have become infected with rickettsia. Both are black in color.

RMSF disease is transmitted by the infected dog tick, *Dermacentor variabilis*, and is common in the western U.S. It is important to note that the dog tick is significantly larger than the deer tick, previously discussed. Nearly all cases of RMSF occur in the spring and summer, generally several days after exposure to infected ticks. The onset of illness is abrupt, often with high fever, headache, chills, and severe weakness. After the fourth day of fever, victims develop a spotted pink rash, which usually starts at the hands and feet and gradually extends to most of the body.

The first symptoms of either disease are flu-like chills, fever, headache, dizziness, fatigue, stiff neck, and bone pain. If immediately treated by a physician, most individuals recover fully in a short period of time. If not treated, more serious symptoms can occur.

If a site employee believes they have been bitten by a tick, or if any of the signs and symptoms noted above appear, the employee will contact the SSHO, who will authorize the employee to visit a physician for an examination and possible treatment.

The following precautions should be taken when working in areas that might be infested with ticks:

- Cover your body as much as possible. Wear long pants and long-sleeved shirts. Light color clothing makes spotting of ticks easier.
- Try to eliminate possible paths by which the deer tick may reach unprotected skin. For example, tuck bottoms of pants into socks or boots and sleeves into gloves. (Duct tape may be used to help seal cuffs and ankles.) If heavy concentrations of ticks or insects are anticipated or encountered, Tyvek® coveralls may be used for added protection.
- Conduct periodic and frequent (e.g., hourly) surveys of your clothing for the presence of ticks. Remove any ticks and insects that become attached to clothing.

- Spray outer clothing, particularly your pant legs and socks, but not your skin, with an insect repellent that contains permethrin or permanone, or use a repellent with DEET, which can be applied to the skin.
- When walking in wooded areas, avoid contact with bushes, tall grass, or brush as much as possible.
- Tuck pant legs into boot tops or tape pants to boot tops to prevent ticks from crawling up the pant leg (this may not be an option at sites where extreme heat stress is anticipated).
- If dressed in Level D or Modified Level D and no other head protection is required, wear a hat to prevent ticks from getting into the hair.

The following actions should be taken if a tick is found:

- If you find a tick, remove it by pulling on it gently with tweezers.
- If the tick resists, cover the tick with salad oil for about 15 minutes to asphyxiate it, then remove it with tweezers.
- Do not use matches, a lit cigarette, nail polish, or any other type of chemical to "coax" the tick out.
- Be sure to remove all parts of the tick's body and disinfect the area with alcohol or a similar antiseptic after removal.
- For several days to several weeks after removal of the tick, look for the signs of the onset of Lyme Disease, such as a rash that looks like a bulls-eye or an expanding red circle surrounding a light area.
- Look for the signs of the onset of RMSF, such as a rash-like inflammation consisting of red spots under the skin that appear 3 to 10 days after the tick bite.

Removal of ticks is best accomplished using small tweezers. Do not squeeze the tick's body. Grasp it where the mouth parts enter the skin and tug gently, but firmly, until it releases its hold on the skin. Save the tick in a jar labeled with a date, body location of the bite, and place it where it may have been acquired.

Wipe the bite thoroughly with an antiseptic and notify the safety officer as soon as possible. The various stages and symptoms are well recognized and, if detected, can be treated with antibiotics. Early detection and treatment with antibiotics significantly reduces the severity of Lyme Disease and RMSF. If necessary, seek medical attention.

8.4.4.2 Ants, Bees, Wasps, Hornets, and Yellow Jackets

Contact with stinging insects like bees, hornets, and wasps may result in site personnel experiencing adverse health affects that range from being mild discomfort to life threatening. Therefore, stinging insects present a serious hazard to site personnel, and extreme caution must be exercised whenever site and weather conditions increase the risk of encountering stinging insects.

Nests and hives for bees, wasps, hornets, and yellow jackets often occur in ground, trees, and brush. The area will be checked for obvious nests and hives before it is cleared. If a nest or hive is found, the SSHO will be contacted before the nest is disturbed or removed; and, if possible, an alternate sampling location will be selected. Bites and stings can be painful and may elicit an

allergic reaction. Medical surveillance will identify any individuals with life threatening allergies. These individuals will not work in areas where there is a great potential for insect stings. If simple first aid measures do not alleviate the symptoms, the victim will be taken to the nearest medical center. An attempt will be made to kill the offending insect and take it to the emergency room with the victim if this can be done quickly and without endangering personnel.

Some of the factors related to stinging insects that increase the degree of risk associated with accidental contact are as follows:

- The nests for these insects are frequently found in remote, wooded, grassy areas.
- The nests can be situated in trees, rocks, bushes, or in the ground, and are usually difficult to see.
- Accidental contact with these insects is highly probable, especially during warm weather conditions when the insects are most active.
- If a site worker accidentally disturbs a nest, the worker may be inflicted with multiple stings, causing extreme pain and swelling which can leave the worker incapacitated and in need of medical attention.
- Some people are hypersensitive to the toxins injected by a sting, and when stung, experience a violent and immediate allergic reaction resulting in a life-threatening condition known as anaphylactic shock.
- Anaphylactic shock manifests itself very rapidly and is characterized by extreme swelling of the body, eyes, face, mouth, and respiratory passages.
- The hypersensitivity needed to cause anaphylactic shock, can in some people, accumulate over time and exposure; therefore, even if someone has been stung previously, and has not experienced an allergic reaction, there is no guarantee that they will not have an allergic reaction upon receipt of another sting.

With these things in mind and with the high probability of contact with stinging insects, all site personnel shall comply with the following safe work practices:

- If a worker knows that he is hypersensitive to bee, wasp, or hornet stings, they must inform the SSHO of this condition prior to participation in site activities. The SSHO will question all site personnel concerning allergies or sensitivities prior to initiating work on site.
- All site personnel will be watchful for the presence of stinging insects and their nests, and shall advise the SSHO if a stinging insect nest is located or suspected in the area.
- Any nests located on site shall be flagged off and site personnel shall be notified of its presence.
- If stung, site personnel shall immediately notify the SSHO to obtain treatment and allow the SSHO to observe them for signs of allergic reaction.
- Site personnel with a known hypersensitivity to stinging insects shall keep required emergency medication on or near their person at all times.

Stings of these insects are responsible for more deaths in the U.S. than bites and stings of all venomous creatures. This is due to the sensitization by the victim to the venom from repeated

stings, which can result in anaphylactic reactions. The stinger may remain in the skin and should be removed by teasing or scraping rather than pulling. An ice cube placed over the sting will reduce pain. An analgesic-corticosteroid lotion is often used. People with known hypersensitivity to such stings should carry a kit containing antihistamine and epinephrine.

8.4.4.3 Spiders

The biting insects of greatest concern are spiders, especially the black widow and the brown recluse. These spiders are of special concern due to the significant adverse health effects that can be caused by their bite.

Black Widow – The black widow is a coal-black, bulbous spider 3/4 to 1-1/2 inches in length, with a bright red hourglass on the underside of the abdomen. The black widow is usually found in dark moist locations, especially under rocks and rotting logs and may even be found in outdoor toilets where they inhabit the underside of the seat. Victims of a black widow bite may exhibit the following signs or symptoms:

- Sensation of pinprick or minor burning at the time of the bite.
- Appearance of small punctures (sometimes none are visible).
- After 15 to 60 minutes, intense pain is felt at the site of the bite which spreads quickly and is followed by profuse sweating, rigid abdominal muscles, muscle spasms, breathing difficulty, slurred speech, poor coordination, dilated pupils, and generalized swelling of face and extremities.

Brown Recluse – The brown recluse is brownish to tan in color, rather flat, 1/2 to 5/8 inches long with a dark brown "violin" shape on the underside. It may be found in trees or in dark locations. Victims of a brown recluse bite may exhibit the following signs or symptoms:

- Blistering at the site of the bite, followed by a local burning at the site 30 to 60 minutes after the bite.
- Formation of a large, red, swollen, pustulating lesion with a bull's-eye appearance.
- Systemic effects may include a generalized rash, joint pain, chills, fever, nausea, and vomiting.
- Pain may become severe after 8 hours with the onset of tissue necrosis.

There is no effective first aid treatment for either of these bites. Except for very young, very old, or weak victims, these spider bites are not considered to be life threatening; however, medical treatment must be sought to reduce the extent of damage caused by the injected toxins. If either of these spiders are suspected or known to be on site, the SSHO shall brief the site personnel as to the identification and avoidance of the spiders. Site personnel should notify the SSHO if they locate either of these spiders.

8.4.4.4 Snakes

The possibility for encountering snakes exists. Although rare in the southwestern Virginia area, the species of greatest concern is the copperhead *(Agkistrodon contortix)*. Copperheads grow to 36 inches and can be recognized by the copper-color head and a reddish-brown hourglass pattern

on the body. Copperheads are normally lethargic; once aroused, however, they strike vigorously and may rapidly vibrate their tails. Rocky hillsides are favorite habitats.

To minimize the threat of snake bites, all personnel walking through the brush will be aware of the potential for encountering snakes and will avoid actions that increase the likelihood of encounters (e.g., turning over logs). Additional caution will be exercised around sawdust or rock piles, which are known to support copperheads. In the event of a snake bite, the following rules should be followed:

- Do no cut "X's" over the bite area as this will intensify the effect of the venom.
- Do not apply suction to the wound since this has a minimal effect in removing venom.
- Do not apply a tourniquet since this will concentrate the venom and increase the amount of tissue damage in the immediate area.
- If possible, kill the snake, bag it, and transport it with the victim. Try to identify the snake for proper selection of anti-venom.
- Do not allow the victim to run for help since running increases the heart rate and will increase the spread of the venom throughout the body.
- Keep the victim calm and immobile.
- Have the victim hold the affected extremity lower than the body while waiting for medical assistance.
- Transport the victim to a medical facility immediately.

8.4.4.5 Animals

Normally, wildlife avoid people and areas where activities are ongoing. Small animals such as raccoons infected with rabies or when cornered may become aggressive. When working remain alert for likely locations that animals inhabit. Avoid nests, dens, and holes in the ground that may be the animal's home.

The only effective measure to preclude animal bites is avoidance. Contact with all wild animals at the ARSAR will be avoided at all times. Persons bitten by an animal should seek medical assistance immediately, especially if it is suspected that the animal is rabid. Aggressive or disoriented behavior as well as foaming of the mouth can be signs of rabid animals. Until medical assistance can be reached, persons should watch for symptoms of severe swelling, nausea, and shock.

8.4.4.6 Poison Ivy, Poison Oak, Poison Sumac

Poison ivy thrives in all types of light and usually grows in the form of a trailing vine; however, it can also grow as a bush and can attain heights of 10 ft or more. Poison ivy has shiny, pointed

Summer Poison Ivy

Poison Oak

Poison Sumac

leaves that grow in clusters of three. Poison sumac is a tall shrub or slender tree that usually grows along swampy areas or ponds in wooded areas. Each poison sumac leaf stalk has 7 to 13 leaflets which have smooth edges. Poison oak is mostly found in the southeast and west. Poison oak resembles poison ivy, with one important difference. Poison oak leaves are more rounded than jagged like poison ivy, and the underside of poison oak leaves are covered with hair.

All personnel should become familiar with and be able to recognize poison ivy, poison oak, and poison sumac in the field. All personnel that know they are over-sensitive to poison ivy or poison sumac will notify their Site Superintendent or the SSHO. They will not be allowed to work in the area until the poison ivy/sumac has been removed. This information will be noted on their medical data sheet. Reaction to poison ivy can be prevented if the exposed skin is washed with mild soap and water within 10 minutes of contact. Contact can be prevented by site workers wearing appropriate clothing. Preventive measures which can prove effective for most site personnel are:

- Avoid contact with any poisonous plants on site and keep a steady watch to identify, report, and mark poisonous plants found outside.
- Wash hands, face, or other exposed areas at the beginning of each break period and at the end of each work day.
- Avoid contact with, and wash on a daily basis, contaminated tools, equipment, and clothing.
- Barrier creams, detoxification/wash solutions, and orally administered desensitization may prove effective and should be tried to find the best preventive solution.
- Avoid spreading oils from these plants to hands and other parts of the body.

The skin reaction associated with contacting these plants is caused by the body's allergic reaction to toxins contained in the oils produced by the plant. Contamination from the oils of these plants may occur through contact with leaves, branches, stems or berries, or contact with contaminated items such as tools and clothing. The allergic reaction associated with exposure to these plants will generally cause the following signs and symptoms:

- Blistering at the site of contact, usually occurring within 12 to 48 hours after contact.
- Reddening, swelling, itching, and burning at the site of contact.
- Pain, if the reaction is severe.
- Conjunctivitis, asthma, and other allergic reactions if the person is extremely sensitive to the poisonous plant toxin.

Blisters form during the subsequent 24 to 36 hours. Crusting and scaling occurs within a few days. Signs and symptoms included redness, swelling, and sometimes intense itching. Symptoms usually disappear in 1 to 2 weeks in cases of mild exposure and up to 3 weeks when exposure is severe.

8.4.4.7 Biological Agents

Microbial hazards can potentially occur when workers handle materials with biological contamination. One source of infection for response workers is poor sanitation. Waterborne and foodborne diseases can be a problem if adequate precautions are not taken to keep food and

drinking water properly stored and isolated. An example of such a disease is salmonellosis. Workers must also avoid creating any sanitation problems by making sure that properly designed lavatory facilities are available at the work site.

Tetanus is another biological hazard encountered on hazardous materials sites. Workers must avoid puncture hazards, wear appropriate protective clothing, and should be current in Tetanus Inoculations.

8.4.4.8 Bloodborne Pathogens

In July of 1992, OSHA issued a final Standard for Protection of Workers Potentially Exposed to Bloodborne Pathogens (29 CFR 1910.1030). This primarily involves medical and research personnel. Bloodborne pathogens are pathogenic microorganisms which may be present in human blood and can cause disease in humans. These pathogens include, but are not limited to, hepatitis B virus (HBV) and human immunodeficiency virus (HIV).

Potential exposure during site activities results from workers who are infected. The OSHA Standard specifically includes first aid providers and is enforceable on site subject to the Hazardous Waste Site Work and Emergency Response Standard (29 CFR 1910.120). The basic concept of this standard is that medical care workers and first aiders must take the "Universal Precaution" of assuming that any blood-containing fluid or person bleeding or contaminated with blood-containing fluid is positive (infected) with both viruses.

Protection involves the use of personal protection such as gloves, eye shields, one-way valve rescue breather devices, and training. In order to effectively protect against any hazards, workers must have a basic understanding of the hazard. This is particularly true of Site Supervisors and SSHOs and others expected to administer first aid if necessary.

8.5 Site Control Procedures

8.5.1 Site Control

To protect the public and maintain security at the ARSAR during working hours, the site will be controlled as follows:

- Work areas and support areas will be established prior to the start of activities.
- Only authorized workers will be permitted in work areas.
- Work will cease if unauthorized personnel enter work areas.
- Temporary fencing will be utilized around excavations to protect site visitors.

8.5.2 Site Work Zones

If site conditions dictate an upgrade in PPE due to the presence of contaminants at high concentrations, work zones will be established to ensure against the accidental spread of hazardous substances by workers from contaminated areas to clean areas. Zones will be delineated on site where removal activities occur, and the flow of personnel in these zones will be controlled. The establishment of site work zones will help ensure that personnel are properly protected against the hazards present where they are working, work activities and contamination are confined to the appropriate areas, and personnel can be located and evacuated in an emergency. The site work zones that will be used during site activities, as deemed necessary by the SSHO, will include:

- Exclusion Zone (EZ) – the contaminated area.
- Contamination Reduction Zone (CRZ) – the area where decontamination of PPE takes place.
- Support Zone (SZ) – the uncontaminated area where workers should not be exposed to hazardous conditions.

A "hotline" where personnel routinely enter or exit the EZ will be located upwind of the work activities. Site work zones, including hotlines, will be established as deemed necessary by the SSHO during field activities. All site work zones will be adequately marked using traffic cones or banner guard.

Access to the EZ and CRZ will be strictly limited to individuals who meet all medical monitoring, training, and PPE requirements of the site. Visitors who have received the appropriate training, are medically qualified, and are wearing the appropriate level of protection must receive a site safety briefing and will be escorted within these zones by the SSHO. Visitors who do not meet the specified requirements will remain in the SZ.

8.5.3 Buddy System

The buddy system will be employed by all personnel entering a hazardous waste operation. This system requires that a partner, or buddy, accompany each worker. The buddy provides the co-worker/partner with assistance, observes the partner for signs of exposure, periodically checks the integrity of the partner's PPE, and notifies the SSHO if help is needed. The buddy must be in a line of sight or hearing of the partner and be prepared to enter any area the partner enters. The buddy must be fully certified to work in the level of protection that the employee is working in, and must have the appropriate PPE available.

8.5.4 Communications

This section describes the on- and off-site communications that are required during operations at the ARSAR. At the ARSAR, at least one cellular telephone will be available at each work site for off-site transmissions and emergency response.

8.6 Personal Protective Equipment

PPE consistent with Shaw Procedure HS600 (**Appendix E**) will be required during field work at the ARSAR. **Table 8-7** presents the PPE requirements for the RFI/IM activities planned at the ARSAR. The SSHO will review the required level of protection and safety equipment with each work crew. The ultimate decision on which protective level is most appropriate will be made by the SSHO. The level of protection selected will be based on:

- The type and measured concentration of the chemical substance having the lowest PEL, TLV, and/or IDLH concentration in the ambient atmosphere, its range of toxic properties and lower explosive limit, and the evaluated degree of hazard.
- Potential for exposure to substances in the air, liquid splashes, or other direct contact with hazardous materials.

Table 8-7
Personal Protective Equipment Requirements

Activity/Location	PPE Level	Comment
Media Sampling and Soil Removal	Level D/ Modified D	Modified Level D when in contact with contaminated material. Upgrade to Level C if action levels warrant.
Site Set-up and Restoration	Level D	Level D when no contact with contaminated material exists.

In situations where the chemical identity, concentrations, and possibility of contact are not well-characterized, the appropriate level of protection will be one level higher than the suspected level of protection, based on professional experience and judgment, until the hazards can be better identified.

PPE shields the body against contact with a known or suspected chemical. OSHA specifies four PPE levels: A, B, C, and D. The minimum level of protection for all Shaw sites is Level D. It is not expected that the type and level of contaminant exposure during activities performed under this task will require either Level A or B protection. If unforeseen conditions arise which would require Level A or B, work will halt so that the task can be reevaluated and this SSHP can be revised or replaced.

8.6.1 Level D

Level D protection will be worn only as a work uniform and not on any site with respiratory or skin hazards. It provides minimal protection and consists of:

- Coveralls or work clothes (dictated by weather).
- Leather safety boots/shoes with chemical-resistant soles, steel toes, and shanks.
- Nitrile surgical gloves: non-latex or non-powdered, low-protein latex gloves (when necessary).
- Work gloves: cotton or leather (when necessary).
- Eye protection (safety glasses or goggles).
- Hearing protection (when necessary).
- Hard hat.

8.6.2 Modified Level D

- Cotton, Saranex, Chemrel (or equivalent), or polycoated Tyvek® or regular Tyvek® coveralls (dependent upon location and splash potential).
- Rain suit or Saranex apron, and face shield (when there is a splash hazard).
- Leather safety boots/shoes with chemical-resistant soles, steel toes, and shanks with chemical resistant (disposable latex) boot covers (outer).
- Inner gloves: non-latex or non-powdered, low-protein latex gloves.
- Outer gloves: chemical-resistant butyl/neoprene or Viton/neoprene gloves.

- Eye protection (safety glasses or goggles).
- Hearing protection (when necessary).
- Hard hat.

8.6.3 Level C

Level C protection will be worn when the criteria for using air-purifying respirators are met. Level C consists of:

- Tyvek® or Saranex coveralls (dependent upon location and splash potential).
- Full-face air-purifying respirator (NIOSH-approved) or Powered air-purifying respirator w/High Efficiency Particulate Air cartridge.
- Prescription insert for workers who require corrective lenses (individuals will not be permitted to wear contact lenses).
- Leather safety boots/shoes with chemical-resistant soles, steel toes, and shanks.
- Latex boot covers or pullover slush boots (dependent upon location and splash potential).
- Inner gloves: chemical-resistant nitrile or non-latex surgical gloves.
- Outer gloves: chemical-resistant butyl or neoprene gloves.
- Other PPE such as hearing protection (dependent upon the activities performed).
- Hard hat.

8.6.4 Respirator Selection and Fit Test

Shaw's Safety and Health Program Requirements Manual requires that all personnel who work on potentially hazardous sites participate in Shaw's Respiratory Protection Program (Shaw Procedure HS600 provided in **Appendix E**). A qualitative fit test will be performed on each individual required to wear respiratory protection at least once per year. Training on use, maintenance and cleaning and sanitizing of respiratory protective equipment is included as part of the employee's 8-hour annual refresher training course. Each person receives documentation of the size, brand, and model number of the air purifying respirator that he or she is approved to use. This information is retained in Shaw's corporate safety and health files and also in the site safety files.

8.7 Air Monitoring Requirements

Environmental monitoring equipment to be used at the ARSAR is discussed in this section, along with action levels for each monitoring instrument. Based on these action levels, the SSHO, or designated alternate, will authorize downgrades or upgrades in the level of PPE, as appropriate. One or more of the following instruments may be used as directed/needed by task:

- A CGI/O_2 Meter.
- A Real-Time Dust Monitor.
- A photoionization detector (PID).

Initial air monitoring instruments for the RFI/IM activity are presented in **Table 8-8**.

Table 8-8
Air Monitoring Requirements

Activity/Location	Air Monitoring Instrument Required
Media Sampling	Photoionization Detector
Soil Removal	CGI/O_2; Real-Time Dust Monitor

Air monitoring data from these instruments will be recorded in field logbooks. The use of this equipment is intended to provide warning and allow appropriate action to be taken to prevent exposure to contaminants released into the atmosphere. Instruments are calibrated annually by the manufacturers. In addition, calibration and maintenance checks of monitoring equipment will be performed daily prior to each use according to the manufacturer's specifications.

8.7.1 Real-Time Particulate Monitor

A real-time particulate monitoring instrument is used to determine the concentration of total particulate in the breathing zone. Dust monitoring will not initially be required during the ARSAR IM, as justified in this section. This instrument will be employed during ground intrusive activities where heavy metals are the point of contact. A water spray will be used to minimize dust generation during soil removal activities.

The following calculation represents the total particulate in milligrams per cubic meter (mg/m^3), which must be detected in the breathing zone of site workers to potentially exceed the PEL for inorganic chemicals:

$$\frac{10^6 \text{ mg/kg} \times \text{PEL in mg/m}^3}{\text{maximum soil concentration (mg/kg)}} = \text{Calculated Action Level}$$

Using this equation and sampling results for soil from the ARSAR, action levels were calculated for antimony and lead. The calculated action levels are as follows:

COI	PEL	Max. Concentration in Soil	Calculated Action Level
Antimony	0.05 mg/m^3	24.4 mg/kg	2,049 mg/m^3
Lead	0.05 mg/m^3	1,630 mg/kg	30.7 mg/m^3

In addition to these concentrations, the 15 mg/m^3 OSHA PEL for "particulates not otherwise regulated" applies to this site. This action level is shown in **Table 8-9**.

Table 8-9
Air Monitoring Action Levels for Particulate Not Otherwise Regulated (PNOR)

Readings	Level of Protection/Action
Real-Time Particulate Monitor	
≤ 15 mg/m^3	Normal Operations
> 15 mg/m^3	Use engineering controls to reduce dust levels

Since the OSHA PEL for the ARSAR contaminants is lower than the calculated dust action level, the real-time particulate monitor action level has been based on the sum of the maximum contaminant concentrations in soil. The dust exposure level as a mixture of the compounds and safety factor of 4 as recommended by ACGIH is 0.95 mg/m^3 and this will be considered the dust action level for the site. Water spray shall be used for dust control when the real-time particulate monitor measures 0.95 mg/m^3 or greater for 5 minutes sustained or 5 separate measurements within a 15-minute period (**Table 8-10**).

Table 8-10
Air Monitoring Action Levels for the ARSAR

Readings	Level of Protection/Action
Real-Time Particulate Monitor	
≤ 2.3 mg/m^3	Normal Operations, Modified Level D PPE
> 2.3 mg/m^3	Use engineering controls to reduce dust levels. Upgrade to Level C PPE if engineering controls are not effective.

Water spray shall be used for dust control when the real-time particulate monitor measures > 2.3 mg/m^3 for 5 minutes sustained or five separate measurements > 2.3 mg/m^3 within a 15-minute period.

Readings	Level of Protection/Action
Combustible Gas/Oxygen Meter	
≤ 10% LEL	Normal Operations, Modified Level D PPE
> 10% LEL	Stop work, eliminate ignition sources and locate source of elevated combustible gases.

Four instantaneous peaks in any 15-minute period or a sustained reading for 5 minutes in excess of the action level will trigger a response.

Readings	Level of Protection/Action
PID	
≤ 2.0 ppm	Normal Operations, Modified Level D PPE
> 2.0 ppm	Use engineering controls to reduce VOC levels. Allow area to passively volatilize. Upgrade to Level C PPE if engineering controls are not effective.

Four instantaneous peaks in any 15-minute period or a sustained reading for 5 minutes in excess of the action level will trigger a response.

8.7.2 Time-Integrated Air Sampling

Time-integrated air sampling may be performed during activities when site characterization data and real-time instrumentation indicate that chemical and/or dust exposures to personnel are suspected to be approaching established limits (PEL/TLV) for target compounds such as antimony and lead. Initially, personal air samples will be collected for each craft job classification to determine if an employee may be exposed to these chemicals/materials at or above the action levels. Additional periodic monitoring may be performed based on the results of the initial monitoring. Samples will be collected and analyzed following OSHA or NIOSH methods. All time-integrated, personal air samples for chemical constituents will be analyzed using a laboratory accredited by the American Industrial Hygiene Association. Employees who are subject to time-integrated air sampling will be informed of the results in accordance with Shaw Procedure HS104.

8.8 Decontamination Procedures

Decontamination procedures are necessary to protect field personnel and control the spread of contamination by either personnel or equipment. Decontamination procedures to be followed are discussed below, and additional information is provided in Shaw SOP 80.1 (**Appendix B**).

8.8.1 Personnel Decontamination Procedures

During site activities, personnel will attempt to minimize the degree of contact with contaminated materials. This involves a conscientious effort to keep "clean" during site activities. Personnel will minimize physical contact with contamination (when possible). This may ultimately minimize the degree of decontamination required and the generation of waste materials from site operations.

A step-by-step description of decontamination procedures for contaminated personnel for Levels C and Modified D is as follows:

- Segregated Equipment Drop – All monitoring instruments, samples, hand tools, and notebooks are dropped in this area to be decontaminated by one of the decontamination team members. To aid in decontamination, instruments can be sealed in plastic bags or wrapped in polyethylene. This will also protect the instruments against contaminants.
- Outer Boot Cover and Outer Glove Wash and Rinse – Scrub the outer disposable boot covers and outer gloves with a brush, soap, and water. Rinse the boot covers and glove covers.
- Tape Removal – Remove all sealing tape from around boots, gloves, zippers, etc. Place in the disposable clothing drum.
- Outer Boot Cover and Outer Glove Cover Removal – Remove the outer boots and gloves by pulling down the items and exposing the clean inner lining. Place the boots and gloves in the disposable equipment drum.
- Outer Coverall Removal – Unzip and remove the outer coverall. Remove protective clothing in an "inside out" manner. Do not remove contaminants from clothing by blowing, shaking, or any other means that may disperse material into the air. Secure disposable PPE in plastic bags placed in 55-gallon drums designated for PPE.

- Facepiece Removal – Remove facepiece and place in a designated area for further cleaning.
- Inner Glove Removal – Remove inner gloves and place in the disposable clothing drum. Remove inner coverall, if one is used, and wash hands and face.

The decontamination line will be oriented so that the SZ and CRZ exit is upwind from the EZ and the first stages of decontamination. The decontamination line will be assembled so that it can be easily moved in case of a significant change in wind direction. All receptacles for contaminated protective clothing will be equipped with a lid that can be closed to prevent the release of contaminants.

The SSHO will determine whether conditions warrant wet or dry personnel decontamination procedures based on weather conditions, contaminant risk, and experience.

8.8.1.1 Decontamination During Medical Emergencies

If immediate life-saving first aid or medical treatment is required, decontamination procedures will be omitted. Outer garments can be removed as long as it does not delay giving the proper care or aggravate the condition. Grossly-contaminated clothing should be removed carefully, because clothing can transfer contaminants to people administering first aid. If the outer contaminated garments cannot be safely removed, the individual will be wrapped in plastic, rubber, or blankets to help prevent the spread of contamination to emergency personnel. On-site personnel will accompany contaminated victims to the medical facility to provide advice on matters involving decontamination.

8.8.2 Equipment Decontamination Procedures

Equipment used to excavate contaminated soil will be decontaminated after use to minimize the spread of contaminants. Decontamination procedures will vary depending upon the contaminant involved, but may include sweeping, wiping, scraping, hosing, or steaming the exterior of the equipment. Personnel performing this task will wear the proper PPE as prescribed by the SSHO.

8.9 Emergency Response Plan

8.9.1 General

The frequency and severity of emergency situations can be dramatically reduced through proper implementation of the SSHP Emergency Response Plan. If an emergency does occur, quick, decisive action is required since delays in minutes can create or escalate life-threatening situations. In an emergency situation, site personnel involved in emergency response and rescue must be prepared to respond immediately and all required equipment must be on hand, in proper working order, and ready to use. To ensure rapid, effective response to a site emergency, the procedures and contingency plans outlined in this section are implemented prior to and during the conduct of any site activities involving exposure to safety and health hazards.

8.9.2 Pre-Emergency Planning

8.9.2.1 Identification of Local Emergency Services

Prior to the conduct of site operations, Shaw contacted and/or gathered information/phone numbers of the local and site emergency response authorities. The authorities contacted were informed of the nature of the site activities to be performed under this SSHP, and the potential hazards that the conduct of these activities poses to investigation personnel, the environment and

the general public. Shaw personnel were informed as to the type of emergency services available through the local authorities and were given the contact phone numbers for these services. In the event that evacuation of the general public is required due to either normal site operations or an emergency event, the SSHO is responsible for contacting the appropriate local authorities who execute and coordinate an evacuation. The phone numbers for local and site emergency services, as well as key personnel involved with the investigation, are listed in **Table 8-11**.

8.9.2.2 Identification of Potential Emergencies

During the development of this SSHP, great attention has been given to identifying potential H&S hazards associated with the conduct of site activities. Once identified, these hazards were assessed to determine the risk that these hazards could result in an emergency situation. Contingency plans for responding to the potential emergency situations have been developed and are included in this section. The potential emergencies which may result during the conduct of site activities are as follows:

- Injury or illness.
- Fire/explosion.
- Adverse weather conditions.

8.9.2.3 Other Hazard Information

In the event that additional site or task hazard information becomes available during the conduct of site investigation activities, this information will be assessed by the SSHO to determine if the contingency plans in this section need to be updated.

8.9.3 Personnel Responsibilities

8.9.3.1 On-Scene Incident Commander

In the event of an emergency, the SSHO assumes the responsibility of On-Scene Incident Commander (OSIC). The alternate person to assume this role, in the event that the SSHO is unavailable or incapacitated, is the task supervisor. The OSIC has responsibility for directing all on-site and off-site response personnel.

8.9.3.2 On-Site Emergency Response Services

Shaw personnel/subcontractor personnel are trained to provide first aid treatment for minor injuries. At least two persons on site at all times are first aid and CPR certified.

The SSHO will determine if the injury requires further treatment. If emergency response is needed, the SSHO, or other designee, will call emergency response personnel by dialing 911.

8.9.3.3 Off-Site Emergency Response Services

Off-site emergency response services that may be needed in the event of a site emergency, such as fire, medical, and police personnel, are listed in **Table 8-11**.

8.9.3.4 Medical Evacuation

Medical evacuation (MedEvac) requirements are determined by the emergency first responder. Personnel requiring additional treatment are evacuated to the New River Valley Medical Center by ambulance. Helicopter MedEvac will be initiated by the emergency first responder, if necessary.

Table 8-11
Emergency Assistance Information
RFAAP, Radford, Virginia

Contact	Phone Number
Tom Meyer (USACE)	(410) 962-0032 (office)
Steve Bowers, C.C.M. (USACE ERRO Project Officer)	(410) 671-6003 (office)
Jim McKenna (Environmental Coordinator and Site Contact)	(540) 731-5782 (office)
Jerry Redder, P.E. (ATK Environmental Manager)	(540) 639-7536 (office)
Tim Leahy, PMP (Shaw RFAAP Project Manager)	(410) 612-6332 (office)
Bob Culbertson, P.E. (Shaw LMARC Program Manager)	(865) 694-7402 (office)
RFAAP Field Office (Site Superintendent/SSHO)	(540) 922-3316 (cellular)
Doug Russell (Shaw H&S Manager)	(865) 692-3584 (office) (865) 414-9545 (cellular)
Shaw Help Desk	(866) 299-3445
Health Resources	800-350-4511
Emergency Response Services	
Installation Fire Department	7457 (On Post)
Installation Security Police	7325 (On Post) (540) 639-7325 (Off Post)
Installation Safety Department	7294 (On Post) (540) 639-7294 (Off Post)
Installation Spill Response	7323, 7324 or 7325 (On Post) (540) 639-7323, 7324, or 7325 (Off Post)
Installation Medical Facility (Occupational Medicine Services)	7123 (On Post) (540) 639-7123 (Off Post)
Installation Ambulatory Services	7323 (On Post) (540) 639-7323 (Off Post)
Local Non-Emergency Clinic (Occupational Medical Services)	540-961-4675
Local Police Department	911
National Poison Control Center	(800) 492-2414
National Response Center	(800) 424-8802
Regional USEPA Emergency Response	(215) 597-9800
Chemical Manufacturers Association Chemical Referral Center	(800) 262-8200

Non-Emergency Services:
Occupational Medical Services
3700 South Main Street
Blacksburg, VA 24060
Hours of Operation: M-F 8:30 am - 3:30 pm; closed 12-1 pm for lunch

Directions to Occupational Medical Services From RFAAP (see Figure 8-1):

Turn Left out of RFAAP onto Route 114 (Pepper's Ferry Road), go 6.5 miles
Turn Left onto Route 460 Business (Franklin Street), go 1.0 miles
Make a U-turn at Yellow Sulphur Rd, Hightop Rd onto S Main St [US-460-Business], go 0.2 mi
Arrive at 3700 S Main Street, on the Right

- Comfort Inn and Cinco de Mayo restaurant will be on the right

Table 8-11 (Continued)
Emergency Assistance Information
RFAAP, Radford, Virginia

Emergency Services:
RFAAP Installation Hospital
Alliant Techsystems, Inc.
Rt. 114
PO Box 1
Radford, VA 24141

Directions from the Main Gate to the Radford Army Ammunition Plant Hospital:

Enter through Main Gate
Turn Left at Building 220, Administrative Building
Proceed down hill through gate house at Gate 1
White building on left through gate house (Building 205)

Directions from the ARSAR to the Radford Army Ammunition Plant Hospital (see Figure 8-2):

Follow Contractor Route back to Gate No. 1
Hospital is white building on left just inside of the gate (Building 205)

Figure 8-1
Directions to Occupational Medical Services

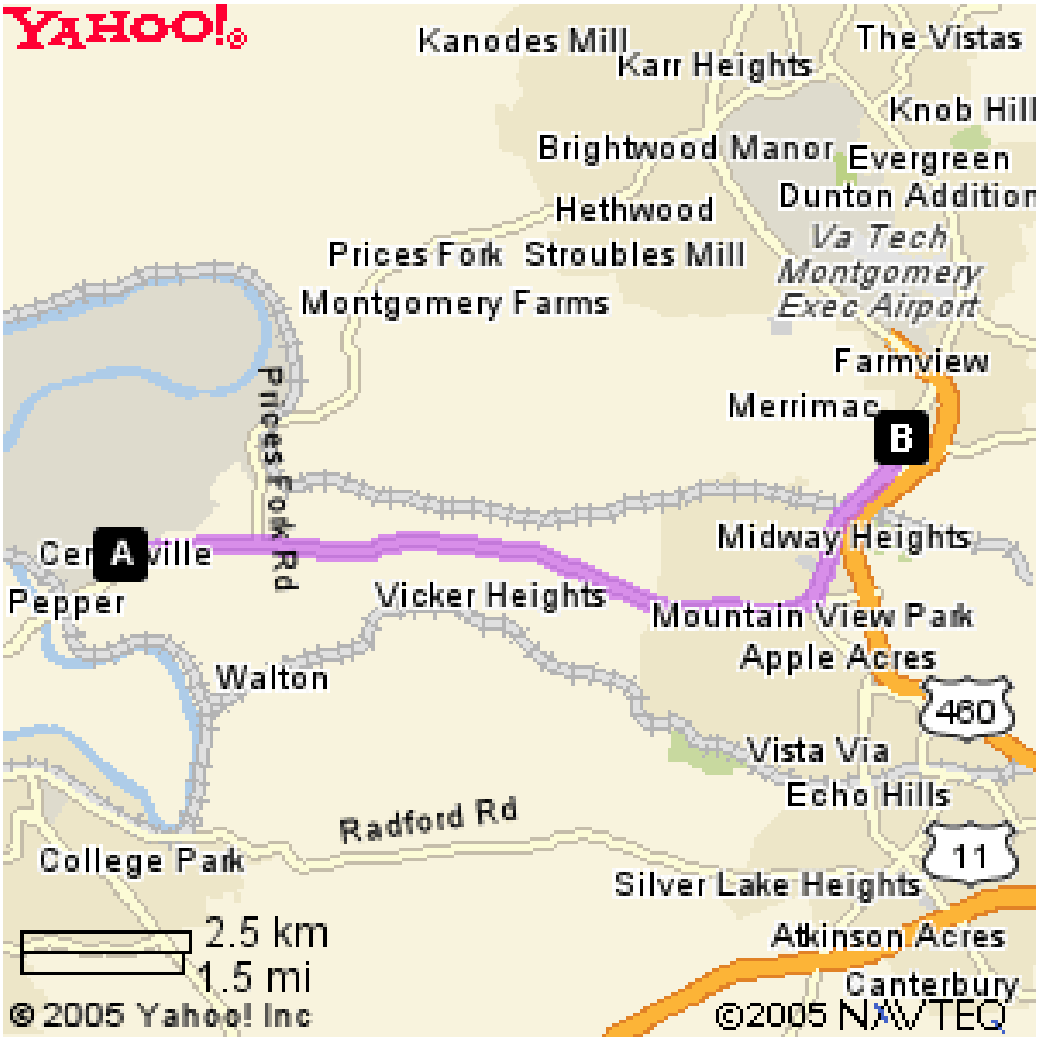
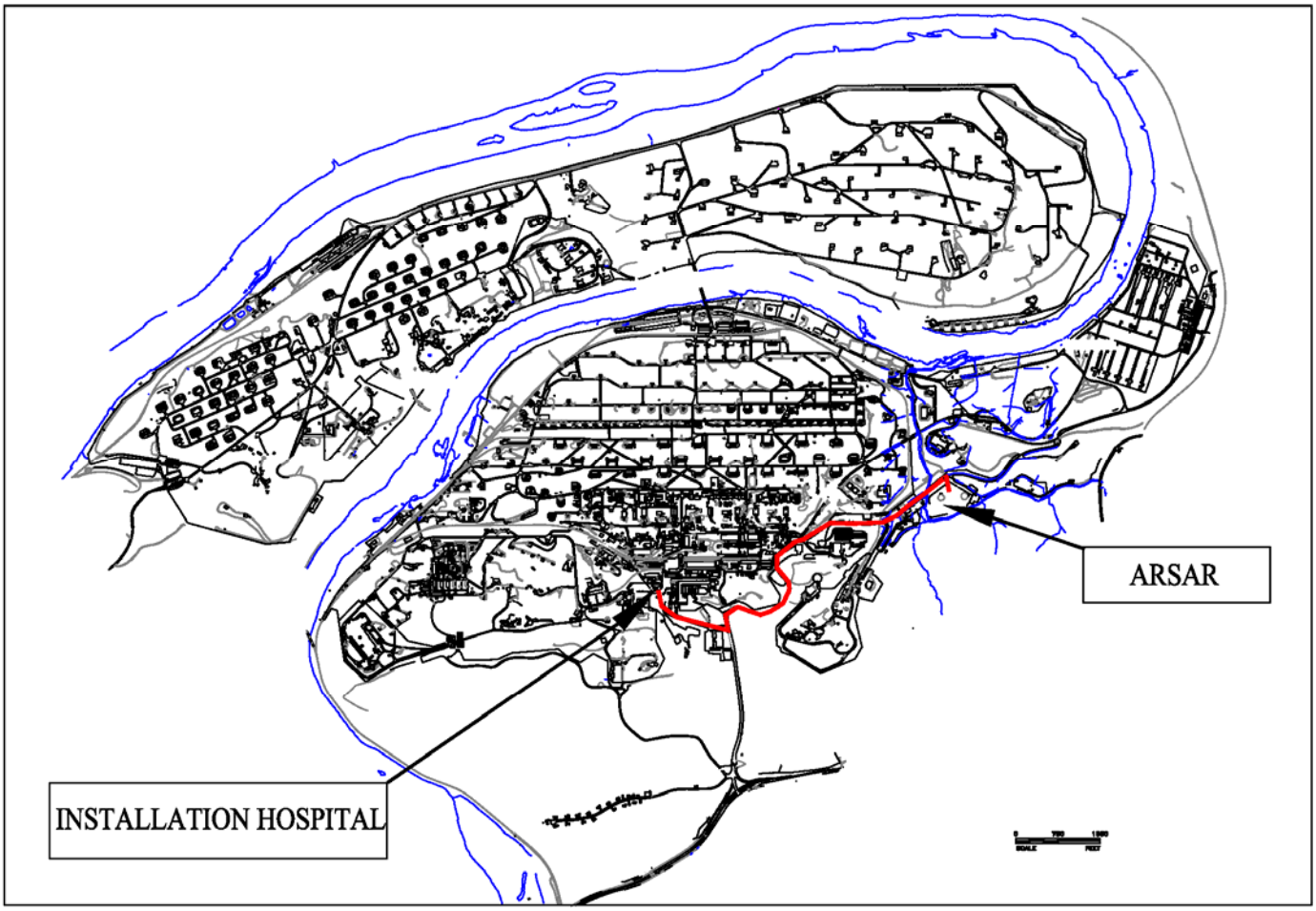


Figure 8-2
Directions to Radford Army Ammunition Plant Hospital



8.9.4 Emergency Site Control and Security

In an emergency, it is imperative that site control and security be maintained. To control site personnel, the OSIC will utilize the Site Entry/Exit Log to ensure all personnel are present or accounted for at the assembly point(s). Depending upon site size and configuration, weather and wind conditions and the nature of the emergency the following will, as applicable, be used to maintain site security:

- Close, but do no lock, gates as evacuation occurs.
- Erect flagging or barrier tape to prevent accidental entry.
- Use a megaphone, walkie-talkies, and/or cell phones to alert personnel to stay clear of the site.
- Use vehicles to block access routes to the site, but ensure they can be moved rapidly if emergency vehicles must use the access route.

8.9.5 Medical Facilities

The directions to the Occupational Medical Facilities and RFAAP Hospital are presented on **Figure 8-1** and **Figure 8-2**, respectively. Directions for emergency services at the RFAAP Installation Hospital are presented in **Table 8-11**.

8.9.6 General Emergency Procedures

Emergency response procedures include all steps to be taken for notifying, evaluating, reacting to, documenting, and following-up on a given emergency situation. To ensure all necessary elements are covered, the procedural steps outlined in this paragraph are implemented for each emergency, regardless of its nature.

8.9.6.1 Notification

Once the OSIC has been informed of the emergency, the OSIC alerts site personnel to the presence of the emergency by way of radio. This is done to:

- Notify personnel and get their attention.
- Stop all work activity as required.
- Lower noise levels in order to speed and simplify communication.
- Begin emergency and/or evacuation procedures.

If on-site Shaw personnel/subcontractors or off-site emergency personnel are to enter the site in response to the emergency, the OSIC, to the extent possible, will notify response personnel about the nature of the emergency, to include:

- What happened and when it happened.
- Where on site the emergency situation occurred.
- Who is involved and, if possible, the cause of the emergency.
- The extent of damage and what hazards may be involved.
- What actions should be taken.

8.9.6.2 Assessing the Emergency

Available information related to the emergency and the on-site response capabilities should be evaluated and the information listed below obtained to the extent possible:

- What happened.
- Type of incident.
- Casualties involved.
- Victims (number, location, and condition).
- Treatment required.
- Missing personnel.
- Cause of incident.
- Extent of damage to structures, equipment, and terrain.
- What could happen from this point.
- Potential for fire or explosion.
- Location of all personnel in relation to hazardous areas.
- Potential for emergency affecting the general public or the environment.
- What can be done to remediate the situation.
- Equipment and personnel needed for rescue and hazard mitigation.
- Number of uninjured personnel available for response.
- Resources available on site.
- Resources available from off-site response groups and agencies.
- Time needed for off-site response to reach the site.
- Hazards involved in rescue and response.

8.9.6.3 Rescue and Response Actions

Based on the information collected during the emergency assessment, the general actions listed below are taken, with some actions being conducted concurrently. No one is to attempt emergency response/rescue until the situation has been assessed and the appropriate response outlined by the OSIC.

- Enforce the Buddy System.
- Allow no one to enter a hazardous area without a partner.
- Personnel in the EZ should be in line-of-sight or in communication with the OSIC or his designee.
- Survey Casualties.
- Locate all victims and assess their condition.
- Determine resources needed for stabilization and transport.

- Assess Existing and Potential Hazards and Determine.
- Whether and how to respond.
- The need for evacuation of site personnel and off-site population.
- The resources needed for evacuation and response.
- Request Aid.
- Contact the required off-site and on-site personnel or facilities, such as ambulance, fire department, police, etc.
- Allocate Resources.
- Allocate on-site personnel and equipment to rescue and initiate incident response operations.
- Control.
- Assist in bringing the hazardous situation under complete or temporary control and use measures to prevent the spread of the emergency (i.e., control fire, secure site, etc.).
- Extricate.
- Remove or assist victims from the area.
- Stabilize.
- Administer any medical procedures that are necessary before the victims can be moved.
- Stabilize or permanently fix the hazardous condition.
- Attend to what caused the emergency and anything damaged or endangered by the emergency (e.g., drums, tanks, etc.).
- Transport.
- Using either on-site or off-site assets.
- Casualty Logging.
- Record who, time, destination and condition upon transport.
- Evacuate.
- Move site personnel to the rally point, a safe distance upwind of the incident.
- Monitor the incident for significant changes; the hazards may diminish, permitting personnel to re-enter the site, or hazards may increase and require public evacuation.
- Casualty Tracking.
- Record disposition, condition and location.

8.9.6.4 Post Emergency Follow-up

Immediately following an emergency, it is imperative that all federal, state, and local regulatory agencies be notified of the emergency. The following activities will be conducted:

- Notify all appropriate governmental agencies as required. Accidents will be reported immediately by telephone to USACE and in writing within 2 working days of occurrence.

Complete the USACE Accident Investigation Report (Eng Form 3394). Any chemical exposure or occupational injuries and illnesses also will be reported and recorded, if recordable per 29 CFR 1904, on an OSHA Form No. 300 Log. Any incident will be reported to OSHA by Shaw's H&S Manager as soon as possible. Any incident or accident will be reported to the LMARC Safety Manager and the Shaw Corporate Help Desk. If a person is injured, Health Resources need to be notified prior to/during transportation of the injured party to the emergency room or the Health Clinic. Any damage to government or contractor property (which occurs during the performance of the contract at the project site) in excess of $2,000 will be reported to USACE within 8 hours of occurrence.

- Complete a Shaw Accident Report (see **Appendix E**). Any recommended hazard control will be discussed with the Shaw H&S Manager for approval prior to implementing the control. The SSHO will maintain records of all site accidents and first aid treatments. Accident investigation and injury/illness recordkeeping procedures are outlined in Shaw Procedure HS020 (**Appendix E**).
- Conduct an accident investigation and root cause analysis of the emergency and what preventive measures could be taken to ensure the emergency does not occur again.
- Review and revise, as needed, the site operational procedures, and if necessary, update the SSHP to reflect the new procedures.
- Restock and clean all equipment and supplies utilized or damaged in the emergency.

8.9.6.5 Documentation

Documentation related to the emergency will be recorded in an accurate, authentic and complete fashion. Documentation shall be recorded as soon as possible after the emergency to ensure it is recorded while the events are vivid in the minds of the personnel involved. The information recorded will include:

- A chronological record of events.
- A listing of the personnel involved, including personnel on site, site personnel who responded, personnel in charge, and off-site groups or agencies that responded.
- A listing of the actions taken to minimize the effects of or mitigate the emergency.
- An assessment of the potential exposures received by site personnel and the surrounding public.
- A recording of the injuries or illnesses which occurred as a result of the emergency. All information gathered will be forwarded to the LMARC Safety Manager and to the Corporate Safety Group in Louisiana.

8.9.7 On-Site Emergency Equipment

The emergency equipment listed in **Table 8-12** below will be available at each work site. The team support vehicle is designated as an emergency vehicle. All emergency equipment will be maintained in proper working order and inspected by the SSHO to ensure completeness and proper working order. The results of the inspection will be documented in the safety log. In the event that any of the disposable items are utilized, the SSHO will ensure they are replaced immediately. Site operations will not be conducted if the required emergency equipment is not available on site.

Table 8-12
Emergency Response Equipment

Emergency Equipment	Number per Location	Location where Emergency Equipment is Stored
First Aid/Burn Kit	1 each	Team Support Vehicle
Eye Wash	1 each	All First Aid Kits
CPR Pocket Mask	1 each	All First Aid Kits
Disposable Latex Gloves	5 each	All First Aid Kits
Fire Extinguisher 10 BC Rated	1 each	Team Support Vehicle

8.9.8 Contingency Plans

The following paragraphs contain emergency specific contingency plans. These plans outline the procedures for mitigating each of the potential emergency situations that were identified in the pre-emergency planning. These contingency plans specify the minimum emergency procedures and may be subject to alteration by the SSHO, based on actual or changing site conditions.

8.9.8.1 Injury or Illness

In the event of an emergency involving personal injury or illness, immediate response is key in preventing further injury/illness and providing comfort to the affect party. When personnel are injured or overcome by illness, the following procedure is followed:

- Upon notification of the occurrence and nature of the injury/illness, the OSIC, if deemed necessary, summon emergency personnel.
- Administer life support if necessary until emergency response personnel arrive.

8.9.8.2 Fires and Explosions

The occurrence of a fire on site presents a serious threat to all site personnel, the environment, and the general public. In the event that a fire or explosion occurs, it is imperative that RFAAP's emergency services be notified immediately [(540) 639-7325 – from cell phone; x7325 from installation phone]. To ensure immediate, aggressive response to emergencies dry-chemical-type fire extinguishers will be available at each individual work site. Dry chemical fire extinguishers are also provided at any other site location where flammable materials may present a fire risk. Additionally, a fire extinguisher rated at least 2A:10B:C will be located with each piece of heavy equipment and in each site vehicle.

Small Fires

A small fire is defined as a fire that can be extinguished with a 4A:20B:C type fire extinguisher. In the event of a small fire, site personnel take the following actions:

- All personnel are evacuated from the site, to an upwind location.
- Extinguish the fire using portable fire extinguishers or by smothering from an upwind location.

- 911 Emergency response services (ambulance, fire, police) will be notified by the OSIC immediately.
- Do not attempt to extinguish a fire, even a small one, involving explosives.
- Notify the SSHO and Site Supervisor.

Large Fires

In the event of a large fire or small fire which cannot be extinguished, the following actions are taken:

- All personnel will be evacuated from the site, to an upwind location.
- The 911 emergency response services (police, ambulance, hospital, etc.) will be notified by the OSIC immediately.
- If it can be conducted safely, the OSIC will direct personnel to move vital equipment/ supplies from the fire path.
- Do not attempt to extinguish a fire involving explosives.
- Notify the SSHO and site supervisor.

Explosion

In the event of an explosion, all personnel evacuate, the OSIC requests the required support equipment and personnel, and the USACE and ATK representatives are notified. It is essential that the site be evacuated and no one allowed to re-enter until an ATK representative authorizes re-entry. The OSIC determines what actions are appropriate.

8.9.8.3 Inclement Weather

In the event of inclement weather [i.e., high winds, electrical storms, tornadoes, extremely hot weather (>100°F), or extremely cold weather (<0°F)], it may be necessary to cease operations and evacuate the site.

8.9.8.4 Spill Containment

A spill containment program will be implemented during all site activities that meet drum and container handling requirements in accordance with 29 CFR 1910.120. Hazardous substances and contaminated soils, liquids, and other residues also will be handled, transported, labeled, and disposed of in accordance with this regulation. If a spill occurs, Shaw will follow the *Spill Notification Procedures* in *Section 5.15.5* of this Work Plan and, if possible, implement controls to contain and isolate the spilled substance.

8.10 Personnel Training and Medical Surveillance Program

8.10.1 General

Work at RFAAP will be performed in accordance with the *RFAAP MWP* (URS, 2003). Section 8 of the MWP details the security and entry requirements for the Installation. All Shaw employees, managers, supervisors, consultants, and subcontractors who perform field activities at RFAAP are required to have received the following:

- OSHA 1910.120 initial 40-hour training or OSHA 1910.120 annual 8-hour refresher training within the last year. In addition, 3 days of documented field experience under the direct supervision of a trained, experienced supervisor is required.
- Managers and supervisors directly responsible for site activities must complete an 8-hour supervisor training course in addition to the 40-hour training and 8-hour refresher course. Training certificates for all personnel (including subcontractor personnel) conducting site activities will be maintained in the Project File or Shaw's corporate safety and health file.
- An occupational medical surveillance examination (in compliance with OSHA 1910.120) within the last year, which demonstrates no restrictions for hazardous waste site work, and ability to wear a respirator.
- Site-specific safety and health training that specifically addresses the activities, procedures, monitoring, and equipment applicable to ongoing field activities.
- At least two members of the team are required to have first aid and CPR certification. These personnel will be on site with the team at all times.

8.10.2 Site-Specific Training

To ensure that all personnel understand the hazards associated with this specific project, the SSHO will conduct initial site-specific training for personnel before participating in the field activities. The SSHO will use the following outline for the initial training of personnel:

- Names of personnel and alternates responsible for site safety and health.
- Safety, health, and hazards present at the site.
- Contingency Plans Training.
- Hazard Communications Training.
- Use of PPE.
- Work practices by which the employee can minimize risks from hazards.
- Safe use of engineering controls and equipment on site.
- Medical surveillance requirements.
- Decontamination procedures.
- Emergency response plan.
- Spill containment.

8.10.2.1 Activity/Hazard Specific Training

Prior to initiating soil remediation activities, all personnel will receive additional training in antimony, arsenic, and lead awareness.

Although MEC is not anticipated at the site, MEC awareness training will be provided to all field personnel prior to the initiation of field activities. The intention of the MEC training is to prepare a previously untrained person to recognize MEC and to properly respond to the discovery of MEC. The training will cover the following topics, at a minimum:

Ordnance Types. Describe the basic characteristics, deployment, and functioning of the following ordnance:

- Bombs.
- Rockets/missiles.
- Projectiles.
- Mines.
- Grenades.
- Pyrotechnic devices.
- Small arms.

MEC Identification. Describe the typical identification features of MEC:

- What to look for (general shapes, lines that indicate venturi, rotating bands, ogives, etc.)
- Natural camouflage of MEC and RCWM caused by rust, vegetation, and partial burial.
- Procedures to use upon finding a suspected MEC.

8.10.3 Daily Safety Meetings

Safety meetings/training will be held each morning on site at the daily safety meeting. This meeting will be conducted by the SSHO. Attendance is mandatory for all site personnel and will be documented in a logbook. The safety and health considerations for the day's activities will be reviewed at this meeting. Additional training, Job Safety Analysis creation, and review of safety concerns will be conducted when circumstances dictate. The meeting will re-affirm safety issues, specific hazards, and emergency procedures including:

- Notification procedures and phone numbers.
- Rally points and safe areas.
- Hospital and evacuation routes.
- Emergency equipment.

The SSHO will conduct tailgate safety meetings and new employee orientation at the beginning of each shift, whenever new personnel arrive at the site, as site conditions change, or as needed.

8.10.4 Medical Monitoring Program

Shaw employees who conduct field activities at the ARSAR must participate in Shaw's medical surveillance program. Personnel performing site work must have received a medical baseline or follow-up examination within the past 12 months. A physician's statement declaring that each Shaw field team member is medically qualified to perform hazardous waste related activities, including medical qualification to wear a respirator, will be maintained on site and in the Shaw corporate safety and health files.

Subcontractor employees must participate in their employer's medical monitoring program consistent with 29 CFR 1910.120. The SSHO must ensure that all subcontractors participate in a medical monitoring program and that subcontractors provide appropriate documentation. Documentation will be maintained on site and should include a statement declaring that each

subcontractor employee is medically qualified to perform hazardous waste site work, including medical qualification to wear a respirator.

8.11 General Safety Items

Additional safety items include the following:

- Safety and health audits will be conducted by the SSHO to ensure that all site activities are being performed in accordance with the SSHP, USACE requirements, OSHA regulations, Shaw procedures, and contract requirements.
- The SSHO will ensure that appropriate PPE is available for personnel and is used as directed in this SSHP. The SSHO will be responsible for ensuring that job site hazards are properly controlled to provide safe ingress and egress from the sites. Cones and high-visibility banner guard (when deemed necessary by the SSHO) will be used to control traffic and limit access to hazardous and restricted areas.
- A tailgate safety meeting will be conducted to discuss pertinent site safety topics at the beginning of each shift, whenever new personnel arrive at the job site, as site conditions change, and whenever otherwise deemed necessary. These meetings will be conducted by the SSHO, and all relevant information will be recorded in the site logbooks. Site personnel and visitors are required to attend these meetings. Proof of attendance will be documented. Necessary information from these meetings will be forwarded to the SSHO.
- Shaw and its subcontractors will emphasize compliance with state, local, and Installation motor vehicle laws, regulations, and safety guidelines as part of each daily safety briefing. Special considerations, such as current or anticipated hazardous road conditions, will be addressed at the daily safety briefings.
- Emergency telephone numbers will be posted for the fire department, emergency medical response, and the nearest emergency medical clinic/hospital. These numbers are listed in this SSHP.
- At least one copy of this SSHP shall be available at each work site.
- Horseplay, practical joking, or any other actions that jeopardize safety will not be tolerated.
- Running is not permitted.
- Alcoholic beverages and non-medicinal drugs are not permitted at the project site. Personnel suspected of being under the influence of alcohol or drugs will be removed from the site.
- Radios (excepting two-way radios), tape players, or other forms of entertainment devices are prohibited during work.
- Legible and understandable precautionary labels shall be affixed prominently to containers of contaminated scrap, waste, debris, and clothing.
- Removal of contaminated soil from protective clothing or equipment by blowing, shaking or any other means which disperse contaminants into the air is prohibited.

- Transportation and disposal of contaminated materials shall comply with all applicable local, state, and federal regulations. These items will be addressed by the generator, transporter, and disposer.
- Containers shall be moved only with the proper equipment and shall be secured to prevent dropping or loss of control during transport.
- Emergency equipment (including first aid equipment, emergency-use respirators, spill control materials, and fire extinguishers) shall be located in readily accessible locations.
- All trenching, shoring, and excavation work must comply with all federal OSHA rules and Shaw Procedure HS307.
- No food or beverages shall be present or consumed in the EZ. No tobacco products shall be present or used and cosmetics shall not be applied in the EZ.
- All personnel shall avoid contact with potentially contaminated substances. Walking through puddles or mud, kneeling on the ground, or leaning against drums shall be avoided.
- Monitoring equipment shall not be placed on potentially contaminated surfaces.

Field personnel must observe each other for signs of toxic exposure. Indications of adverse effects include, but are not limited to:

- Changes in complexion and skin discoloration.
- Changes in coordination.
- Changed in demeanor.
- Excessive salivation and papillary response.
- Changes in speech pattern.

Field personnel shall be cautioned to inform each other of non-visual effects of toxic exposure such as:

- Headaches or dizziness.
- Nausea.
- Blurred vision.
- Cramps.
- Irritation of eyes, skin, or respiratory tract.

9.0 CONTRACTOR QUALITY CONTROL PLAN

This CQCP describes the QC organization and program for RFI/IM activities at the ARSAR. The requirements and systems herein, are relevant and applicable to project work performed by Shaw and its subcontractors and suppliers. Chemical quality management aspects of this QC program are addressed in the QAPP (*Section 4.0*).

The objective of this CQCP is to establish procedures to verify that the quality of work meets the applicable requirements of the contract, and is suitably well documented. Specifically, this plan:

- Identifies the qualifications, authority, duty and responsibility of the CQC System Manager and staff.
- Establishes QC procedures for inspection and test activities, including the performance of 3-phase control, deficiency, and daily QC reporting.
- Defines project communication, documentation, and recordkeeping procedures.

References used for the development of this plan include USACE ER 1180-1-6: *Construction Quality Management* (USACE, 1995); USACE ER 1110-1-12: *Engineering and Design Quality Management* (USACE, 1993); and USACE ER 415-1-10: *Contractor Submittal Procedures* (USACE, 1997).

The sponsoring/monitoring agency for this project is the USACE, Baltimore District. Therefore, USACE's acceptance of this CQCP is required prior to the start of on-site operations under definable features of work listed in *Section 9.10* of this CQCP. Work outside these definable features is not to be performed without USACE documented approval.

Once accepted by the USACE, the distribution of plans, drawings, procedures and instructions shall be controlled to ensure that the most recent revision is available for use at all locations where work is to be performed. Within the Shaw's project team, initial distribution will include the Program Manager, Project Manager, ARSAR RFI/IM Task Manager, QC Manager, CQC System Manager, Site Superintendent, and subcontractors.

The USACE is to be notified by the CQC System Manager in writing a minimum of seven calendar days prior to any proposed changes to a USACE-accepted CQCP. Any revisions or changes to the accepted CQCP, CQC staff, or their responsibilities must be approved by the USACE prior to being implemented by the CQC System Manager or other project personnel.

Revisions to this plan will require the same level of review and approval as the original document.

9.1 Project Background

A detailed discussion of the project background was presented in the Organization and Technical Approach Plan (*Section 2.0*).

9.1.1 Project Scope of Work

The project scope of work and detailed approach for completion of the ARSAR RFI/IM is provided in the Organization and Technical Approach Plan (*Section 2.0*).

9.2 Project Organization

The quality related responsibilities and authority of the key members of the organization are outlined below. Additional QC staff may be added as necessary to meet QC requirements to complete the definable features of work. Changes in project management and QC personnel require USACE approval.

9.2.1 Project Manager

Mr. Tim Leahy, PMP, the Project Manager, reports to the Program Manager, Mr. Bob Culbertson. Mr. Leahy is responsible for coordinating all activities performed by Shaw at RFAAP and for communicating with the USACE.

9.2.2 ARSAR RFI/IM Task Manager

Mr. Jeff Hillebrand, the ARSAR RFI/IM Task Manager, reports to the RFAAP Project Manager, Mr. Tim Leahy. Mr. Hillebrand is responsible for the quality and timeliness of all project activities, including those performed by subcontractors. Essentially, the Task Manager is responsible for task accomplishment, administration of all instructions, and on-site customer interface.

9.2.3 Site Superintendent/CQC System Manager

Mr. Steve Kritak is the designated Site Superintendent and CQC System Manager for this project. As Site Superintendent, Mr. Kritak reports to the ARSAR RFI/IM Task Manager regarding daily site operations. The Site Superintendent is responsible for supporting the implementation of the CQCP and efforts of the CQC Manager and his staff.

As CQC System Manager, Mr. Kritak will report to Mr. Kenneth Martinez, QC Manager, and will coordinate activities with the ARSAR RFI/IM Task Manager. As CQC System Manager, Mr. Kritak has authority to enforce the procedures defined in this CQCP. In alignment with this authority, Mr. Kritak has the authority to stop work, if necessary, to ensure that project activities comply with the requirements of this CQCP, the contract, and the Task Order. This authority applies equally to all project activities, whether performed by Shaw or its subcontractors and suppliers.

The CQC System Manager is responsible for planning and executing QC monitoring, inspection, and oversight of project operations to verify compliance with applicable requirements.

Specifically, the CQC System Manager is responsible for: 1) developing, implementing, and maintaining this CQCP and its related procedures; 2) planning and conducting preparatory, initial, follow-up, and final/completion inspections for each definable feature of work; 3) identifying quality deficiencies and verifying that appropriate corrective actions are implemented; 4) verifying that the requisite QC records including submittals are generated and retained as prescribed in this CQCP ; and 5) verifying that subcontracted laboratories have appropriate USACE certifications and a documented QC program that complies with the applicable requirements of the contract and Task Order.

The CQC System Manager is to be physically on site whenever project-related fieldwork is in progress. If the CQC System Manager is to be absent from the site, with USACE approval, an alternately qualified CQC System Manager will be provided for USACE acceptance and assigned during the absence.

Mr. Kritak has successfully completed the USACE Quality Management Training Course for Contractors. Any alternate CQC System Manager must also complete this training prior to assignment.

9.2.4 Project Chemist

Mr. Eric Malarek, the Project Chemist, will be responsible for analytical sampling, reviewing results for acceptance, and ensuring analytical data is validated at the level required by the DQOs. The Project Chemist will be responsible for coordinating analysis and data package production with the laboratory. The Project Chemist will report to the ARSAR RFI/IM Task Manager and assist the CQC System Manager, as needed.

9.2.5 Subcontractors

Shaw will procure subcontractors for waste transportation and disposal and laboratory services from USACE-certified laboratories.

9.3 Personnel Qualification and Training

Project staff shall be qualified to perform their assigned jobs in accordance with terms outlined by the LMARC contract. This will be accomplished by establishing and enforcing minimum qualification requirements for key positions, verifying initial and continued personnel proficiency, and implementing on-the-job training, as necessary.

9.3.1 Project Personnel

Shaw has established minimum qualification requirements for key positions on this project through review of contractual and other project-related requirements. The ARSAR RFI/IM Task Manger is responsible for reviewing personnel qualifications, and providing for any additional training required for this site. In the event that additional assignments are made for this project, the qualifications of assigned personnel are to be evaluated and documented. Project personnel are not to be assigned a position or job for which they do not meet the minimum qualifications.

Senior technical staff shall provide on-the-job training to newly-assigned technical staff related to their job requirements and techniques and with particular emphasis on problem prevention. Work performed by newly assigned staff is to be monitored by senior staff. When newly assigned personnel arrive, the individual's demonstrated proficiency to perform his or her assigned duties must be thoroughly documented prior to his or her release from senior staff monitoring. Training will be documented with training records maintained on file.

9.3.2 QC Personnel

QC personnel will be qualified to perform their assigned jobs. Minimum education and experience standards shall be in compliance with Shaw policies and procedures. Qualifications for key technical, management, and additional QC staff (if required) will be documented as outlined in the LMARC contract vehicle.

9.3.3 Subcontractors

As described in *Section 9.2.5*, Shaw will procure the necessary subcontractors for the ARSAR RFI/IM. Anticipated subcontractor organizations are identified in *Section 9.2.5* of this CQCP. The Project Manager is responsible for ensuring that subcontractors possess the requisite qualifications prior to procurement. Subcontractors to Shaw shall not subcontract their responsibilities on this project to a third party or organization without prior and written approval

of the Shaw Project Manager. The Shaw Project Manager will ensure that each subcontractor agrees to comply with this CQCP or develops and implements a QC program that meets all contract requirements and is reviewed and accepted by Shaw and the USACE, prior to performing work.

9.3.4 Health and Safety Training

H&S training requirements for on-site project personnel have been established in accordance with OSHA requirements for hazardous site workers (29 CFR 1910.120) and Shaw policies and procedures. These training requirements are specified in the SSHP and are to be met before project personnel can begin site work. As a minimum, site workers and visitors who may encounter hazardous substances are to have completed the OSHA Hazardous Material Site Worker Training (40-hour initial training and 8-hour annual refreshers). Site managers are to have completed the 8-hour Supervisor Training also.

9.4 Letter of Authority

The letter of authority describes responsibilities and delegates the authority of the CQC System Manager. A copy of this letter will be furnished to the USACE and provided in **Appendix G**.

A letter of authority has been signed by the Shaw LMARC QC Manager and acknowledged by the designated CQC System Manager for this project. This letter describes the responsibilities of, and delegates authority to, this function, including the authority to stop work that is not in compliance with project requirements.

9.5 Submittal Management

The Project Manager has the sole responsibility for ensuring submittals fully comply with project requirements and shall establish and designate an individual to maintain the project Submittal Register. Submittal control is required to regulate the timely flow of materials and work, to ensure problem prevention, and to demonstrate that materials and work are in compliance with applicable requirements. Project submittal procedures are to be implemented as prescribed herein and in accordance with the project Submittal Register.

9.5.1 General Requirements

The Site Superintendent is responsible for submittal scheduling and tracking. The CQC System Manager is responsible for ensuring, through detailed review, that submittals, as well as the materials and the work they represent, are verified in full compliance with applicable requirements.

9.5.1.1 Project Submittals

Submittals are to be listed and tracked using USACE Engineering Form (ENG) 4288, Submittal Register. Submittals include deliverables generated on site or off site by Shaw, subcontractors, fabricators, manufacturers, suppliers, or purchasing agents. Procurement documents for subcontracted services and materials are to list the submittals required of the subcontractor. The CQC System Manager is to review the list to verify its completeness. The approved ENG 4288 becomes the scheduling document used to track and control submittals throughout the project. Submittals will be transmitted using form ENG 4025 with a unique tracking number assigned from the Submittal Register.

9.5.1.2 Project Records

The CQC System Manager is to establish and maintain an on-site project file in accordance with contract requirements. The purpose of this file is to maintain a complete set of all documents, reports, certifications, and other records that provide information on project plans, contract agreements, and project activities. The initial file will be structured to include a record copy of the following documents:

- Construction schedule and progress reports.
- Technical specifications, including addenda and modifications thereof.
- Change orders and other contract modifications.
- Engineer Field Orders.
- Manufacturer's certificates.
- Daily work activity summary reports, including:
  - Daily QC report (including QC log).
  - Daily H&S Report.
  - Daily Superintendent Report (including activity log).
  - Reports on any emergency response actions.
  - Test records.
  - Records of site work.
  - COC records.
  - Reports on any spill incidents.
  - Truck load tickets and shipping papers.
  - Laboratory results.
  - Records on quantities of soil treated.
- Other items as required by the Contracting Officer's Representative.
- Conversation logs.
- Meeting minutes and agenda.
- Inspection logs and schedules.
- Photo documentation.
- Site maps.
- As-built drawings.

9.5.2 Submittal Scheduling

The Site Superintendent is to establish and maintain a project submittal schedule that reflects the status on ENG 4288. Submittal activities are to be incorporated into the construction schedule so that submittal progress can be tracked in conjunction with overall progress. Submittal schedules are to allow for evaluation, approval, procurement, and delivery prior to the preparatory phase

and before the item is needed. The Site Superintendent is responsible for monitoring the progress of project submittals and keeping the Project Manager apprised. The submittal schedule is to be updated by the Site Superintendent on a weekly basis. Submittals covering component items that form a system or items that are interrelated are to be scheduled and submitted concurrently. Adequate time is to be allowed for required reviews and approvals.

9.5.3 Review of Plans and Specifications

During the preparatory phase for a construction feature of work, the Project Manager or his designee is responsible for reviewing the construction drawings and specifications and requesting clarification from USACE, where necessary. The primary purposes of this review are to identify and resolve potential conflicts prior to initiating work operations. In the interest of minimizing adverse impacts on project schedules, this review is to be performed as early in the process as practical to allow sufficient time for evaluation and response. The Project Manager is responsible for ensuring that construction plans, drawings, and specifications 1) have been approved by USACE for implementation on the particular feature of work; 2) are clear and complete; and 3) are executable, cost-effective, and practical. The review should include items such as identifying discrepancies between plans and specifications, assessing and verifying site conditions and restraints, verifying that proper allowances are made for maintenance space and access, etc.

9.5.4 Review and Approval of Submittals

Prior to client delivery or use, project submittals are to be reviewed and accepted by Shaw. The CQC System Manager certification and signature are required on each submittal. He is to review submittals prepared by Shaw, subcontractors, and suppliers for completeness and compliance with the specifications of the Task Order and contract. Submittals related to construction equipment or materials are to be reviewed for contractual compliance, including compliance with the *Buy American Act* (FAR 52.225-0005 and 52.225-15). Noncompliant submittals are to be returned to the originator for corrective action and re-submittal to the CQC System Manager.

Prior to submittal to the CQC System Manager for certification, technical documents (e.g., reports, plans, and engineering drawings) are to be reviewed by qualified staff. Although part of the QC process, technical reviewers may include but are not limited to the QC staff.

9.5.5 Documentation

In addition to the documentation requirements specified above, the following requirements apply to this project. The QC file is to be maintained by the CQC System Manager and is to be controlled as an integral component of the project files. Shop drawings, work orders, and change orders issued for remedial actions are to be provided to the CQC System Manager. It is the responsibility of the CQC System Manager to maintain this technical information and keep it current and recorded as it is revised. Technical information is not to be replaced or revised without receipt of a properly authorized change order or revision. Copies of purchase orders or subcontracts requiring inspection are to be provided to the CQC System Manager for receiving and recording purposes. Copies of required certifications received are to be maintained in the QC file and are to be submitted to the client in accordance with agreements made at the coordination meeting. Changes in submittal progress and QC activities related to submittals are to be summarized in the Daily QC Report.

9.6 Inspection Phases

The CQC System Manager is responsible for verifying compliance with this CQCP through implementation of the 3-phase control process. This process ensures that project activities comply with the approved plans and procedures. The specific QC monitoring requirements for the definable features of work for the ARSAR IM actions are discussed below. This section specifies the minimum requirements that must be met and to what extent QC monitoring must be conducted by the CQC System Manager.

9.6.1 Implementation of the 3-Phase Inspection Process

The CQC System Manager is to ensure that the 3-phase control process is implemented for each definable feature of work listed in *Section 9.10* of this CQCP, regardless of whether they are performed by Shaw or its subcontractors. Each control phase is important for obtaining a quality product. However, the preparatory and initial inspections are particularly invaluable in preventing problems. Production work is not to be performed on a definable feature of work until a successful preparatory and initial phase inspection has been completed.

9.6.1.1 Preparatory Phase Inspection

The CQC System Manager or designee will perform a Preparatory Phase Inspection prior to beginning each definable feature of work. The purposes of this inspection are to review applicable specifications and verify that the necessary resources, conditions, and controls are in place and compliant before the start of work activities. To conduct and document the inspection, the CQC System Manager shall use the Preparatory Inspection Checklist provided in **Appendix H**.

The CQC System Manager or designee will review work plans and operating procedures to ensure that they describe pre-qualifying requirements or conditions, equipment and materials, appropriate sequence, methodology, hold/witness points, and QC provisions. He is to verify that the required plans and procedures have been prepared and approved and are available to the field staff; field equipment is appropriate for its intended use, available, functional, and properly calibrated; staff responsibilities have been assigned and communicated; staff have the necessary knowledge, expertise, and information to perform their jobs; arrangements for support services (such as test laboratories) have been made; and prerequisite site work has been completed. As part of the Preparatory Phase Inspection, the CQC System Manager is to verify that lessons learned during previous similar work have been incorporated as appropriate into the project procedures to prevent recurrence of past problems.

Project staff must correct or resolve discrepancies between existing conditions and the approved plans/procedures identified by the CQC System Manager during a Preparatory Inspection. The CQC System Manager or designee must then verify that unsatisfactory and nonconforming conditions have been corrected prior to granting approval to begin work. Client notification is required at least 24 hours in advance. Results are to be documented in the Preparatory Inspection Checklist and summarized in the Daily QC Report, which is provided in **Appendix H**.

9.6.1.2 Initial Phase Inspection

The CQC System Manager is to perform an Initial Phase Inspection the first time a definable feature of work is performed. To conduct and document the inspection, the CQC System Manager shall use the Initial Phase Inspection Checklist provided in **Appendix H**. The purposes of this inspection is to check preliminary work for compliance with procedures and

specifications, establish the acceptable level of workmanship, and check for omissions and resolve differences of interpretation. The CQC System Manager, or his designee, is responsible for ensuring that discrepancies between site practices and approved specifications are identified and resolved. Initial inspection results are to be documented by the CQC System Manager and summarized in the Daily QC Report. Discrepancies between site practices and approved plans/procedures are to be resolved and corrective actions for unsatisfactory and nonconforming conditions or practices are to be verified by the CQC System Manager or his designee, prior to granting approval to proceed. Client notification is required at least 24 hours in advance.

9.6.1.3 Follow-up Phase Inspection

The CQC System Manager or designee will perform a Follow-up Phase Inspection each day a definable feature of work is performed. The purpose is to ensure continuous compliance and the level of workmanship. To conduct and document these inspections, the CQC System Manager shall develop inspection checklists to accommodate the inspection of both routine and complex inspection activities. The CQC System Manager is responsible for on-site monitoring of the practices and operations taking place and verifying continued compliance with the specifications and requirements of the contract, Task Order, and approved project plans and procedures. He is also responsible for verifying that a daily H&S inspection is performed and documented as prescribed in the project SSHP. Discrepancies between site practices and approved plans/procedures are to be reported and corrective actions for unsatisfactory and nonconforming conditions or practices are to be verified by the CQC System Manager, or his designee, prior to granting approval to continue work. Follow-up inspection results are to be documented using a suitable checklist, as necessary, and summarized in the Daily QC Report.

9.6.1.4 Additional Inspections

Additional inspections performed on the same definable feature of work may be required at the discretion of the client or the CQC System Manager with approval by the client. Additional preparatory and initial inspections are generally warranted under any of the following conditions: unsatisfactory work, as determined by Shaw or the client; changes in key personnel; resumption of work after a substantial period of inactivity (e.g., 2 weeks or more); or changes to the project scope of work/specifications.

9.6.1.5 Completion/Acceptance Inspection

A Completion/Acceptance Inspection shall be performed, upon conclusion of the feature of work and prior to closeout, to verify that project requirements relevant to the particular feature of work are satisfied. Outstanding and nonconforming items are to be identified and documented on a punch list. As each item is resolved, it is to be so noted on the punch list. Client acceptance and closeout of each definable feature of work is a prerequisite to project closeout.

9.6.2 Inspection Procedures

9.6.2.1 Receiving and Storage

The CQC System Manager or designee is to inspect construction materials upon receipt and prior to use. Visual inspection criteria include identification, signs of damage or distortion, completeness, evidence of compliance with specifications, and associated documentation. Results of receiving inspections are to be documented and summarized in the Daily QC Report.

9.6.2.2 Off-Site Control

Source inspections at supplier facilities, if necessary, shall be performed to verify compliance with contract and Task Order requirements.

9.6.2.3 Material Certification

Copies of purchase orders or subcontracts requiring receiving inspection are to be provided to the CQC System Manager for scheduling inspection and recordkeeping purposes. Copies of supplier certifications are to be maintained in the project QC file and made available to the USACE upon request or submitted in accordance with contract requirements.

9.6.2.4 Inspection of Workmanship

Standards for good workmanship shall be established and documented. The CQC System Manager shall discuss these standards during the preparatory phase meeting for each definable feature of work and verify the presence of good workmanship during each initial phase inspection, and follow-up phase inspection thereafter. Identified deficiencies are to be reported to the responsible organization and documented. Corrective actions are to be verified by the CQC System Manager and documented.

9.6.2.5 Surveillance of Subcontractor Operations

The CQC System Manager is responsible for performing monitoring, inspection, and oversight of project activities conducted by Shaw and its subcontractors. Deficiencies associated with subcontractor work are to be reported to the appropriate level of management for resolution.

9.6.3 Documentation of Inspections

The Shaw Inspection Schedule & Tracking Form (**Appendix H**) is to be used by the CQC System Manager for planning, scheduling, and tracking the progress of inspections for this project. The information on the form is to be kept up to date.

9.7 Testing

Testing will be performed as required to confirm that specifications are met. Testing in support of remediation activities generally includes on-site tests of items and materials, and off-site testing by laboratories, manufacturers, and suppliers.

9.7.1 Test Plan Application

Testing will be conducted and reported in accordance with project specifications, drawings, codes, standards, and procedures. The CQC System Manager and the subcontract laboratory will use this plan as a guide and checklist throughout the project. A preparatory meeting will be held for each definable feature of work where the testing and frequency of tests are to be reviewed. The QC staff is responsible for verifying that the tests are performed and that the results are summarized in and provided with the Daily QC report. Test failures will be documented on a Nonconformance Report (NCR) and tracked until such time as rework and re-testing can be performed and corrective action is verified.

9.7.2 Testing Procedures

The QC staff shall verify the proper selection of measuring and test equipment (M&TE) and verify that approved procedures and protocols are identified and available for use. QC shall also confirm that test personnel have a working knowledge of the test and instruments to be used.

Upon satisfactory verification of the stated requirements, the test may proceed. Each reading is to be verified and documented by a member of the QC staff. As a minimum, test reports will reflect the date of performance, type of test conducted, the item tested, the procedure/protocol used (including revision), actual test results, identification of any M&TE used (including calibration status), identification and signature of the individual performing the test. Copies of test reports will be maintained in the project files and submitted to the USACE, as required.

9.7.3 Test Organizations

The CQC System Manager will verify the performance of sampling, sample handling, and shipping in accordance with the applicable sections of this plan. The sampling technicians will perform the required sampling. The Project Chemist will be responsible for ensuring analytical data is validated at the level required by the DQOs.

Data reports are to include sufficient information to verify the effectiveness and implementation of laboratory QC systems. Requisite information includes raw data, instrument printouts, preparation logs, calibration records, test results for associated QC samples, dilution factors, instrument settings, equations used in data reduction, and any observed deviations or problems.

9.7.4 M&TE Calibration and Maintenance

The selection, control, and use of M&TE shall be as specified within procedures and specifications. M&TE shall be calibrated or verified at specific intervals or prior to use, against measurement standards traceable to nationally recognized standards. M&TE shall be stored, handled, and maintained in accordance with the manufacturer's instructions. Records of these activities are to be generated by the individual performing the activity with copies provided to the CQC System Manager for retention in the project QC file. The Work Plan lists the M&TE for this project and provides calibration and maintenance responsibilities, schedules, and procedures.

9.7.5 Validation of Test Results

Prior to their use in decision-making, test data are to be reviewed and validated by the Project Chemist or his designee. Validation is to include:

- Verification that all required documentation was submitted.
- Verification that specified test procedures and conditions were followed.
- Review of QC data and comparison of achieved results against specified limits of acceptability.

9.7.6 Documentation of Testing

Test results are to be documented by the individual performing the test. Calibration and maintenance records associated with the M&TE are to be generated by the individual performing the activity. Documentation for calibration and maintenance of M&TE is to be made available to the USACE upon request.

Test results are to be retained in the project file and summarized in the Daily QC Report. These results will additionally be compiled into a report to the CQC System Manager that includes the name of the test, the items tested, test conditions and procedures, units of measurement, the resulting test data for all submitted samples (both passing and failing), and associated QC information (e.g., equipment calibration and maintenance, duplicate measurements, and use of

certified reference standards). A copy of each test report is to be attached to the Daily QC Report.

9.8 Nonconformance Reporting & Corrective Action

The Shaw system for reporting deficiencies and implementing effective corrective action provides for two distinct reporting mechanisms which are procedurally addressed. The NCR shall be used for reporting and correcting deficient items and materials, and the Corrective Action Request (CAR) shall be used to report and correct programmatic deficiencies, negative quality trends, breakdowns in the quality program, and/or the more serious or significant deficiencies requiring management attention and action.

9.8.1 Identification and Control of Nonconforming Conditions

Any deficiency in characteristic, documentation, or procedure, which renders an item or material unsatisfactory or unacceptable, is required to be identified, reported, and corrected. The CQC System Manager will document item and material deficiencies using an NCR, following form instructions and those instructions delineated within Shaw SOP–EI-Q-007; Nonconformance Reporting. The NCR form is provided in **Appendix H**. Each NCR will be logged within the NCR Tracking Log (**Appendix H**) and issued to the responsible organization for timely disposition and corrective action. Each NCR response shall identify one of the following four categories for disposition:

- Rework – The act of bringing the item into compliance with the original requirements.
- Repair – The act of making the item perform to its original requirements and function.
- Scrap – Removing the item from the project site for disposal.
- Use-As-Is – Permits the item to be utilized based on a documented and acceptable technical justification.

When possible, each NCR disposition will include the following within its corrective action:

- Identification of the cause.
- Steps taken to preclude recurrence.
- Date of disposition performance and corrective action completion.

Each NCR disposition and its corrective action will be verified by the CQC System Manager and documented by signature and date. This will include all re-inspection and re-testing, as appropriate.

NCR forms may be supplemented by completed checklists, photographs, sketches, drawings or other renderings to assist in identifying the deficiency. All such data will become a part of the NCR and shall be maintained with the NCR on file.

9.8.2 Corrective Action Requests

In the case of a programmatic deficiency, or recurrence of a nonconforming condition (attributed to ineffective corrective action), the CQC System Manager will issue a CAR to the responsible organization. A CAR form is provided in **Appendix H**. The CAR will be processed in accordance with Shaw SOP-EI-Q-008; Corrective Action Requests. The CAR is a document used to report deficiencies of a significant nature and shall be distributed to upper management

for their attention and any subsequent action. The CAR is generally reserved for serious or major deficiencies and requires the responsible organization to:

- Take immediate corrective action to remedy the condition.
- Investigate and identify the root cause through analysis.
- Identify steps taken to preclude recurrence.
- Implement effective corrective action in a timely manner.

For each CAR, the responsible organization shall prepare and submit a formal response to the CQC System Manager for evaluation and acceptance, prior to the established due date. Failure to respond and/or provide effective corrective action will generally result in the issuance of a stop work order.

Each CAR corrective action will be verified by the CQC System Manager and documented. The completed CAR and any related documentation will be maintained in the project quality files.

9.9 Reports

The CQC System Manager is responsible for preparing and submitting the Daily QC Report to the USACE, the Site Superintendent for the project file, and providing concurrent courtesy copies to the Project Manager. The original and one copy of the Daily QC Report with attachments are to be submitted to the USACE on the first work day following the date covered by the report. All calendar days, including weekends and holidays, are to be accounted for throughout this project. As a minimum, one report is to be prepared and submitted for every continuous seven days of no work.

As a primary component of the Daily Activity Summary Report, the Daily QC Report is to provide an overview of QC activities performed each day, including those performed for subcontractor and supplier activities. The QC reports are to present an accurate and complete picture of QC activities. They are to report both conforming and deficient conditions, and should be precise, factual, legible, and objective. Copies of supporting documentation such as checklists and surveillance reports are to be attached. The format to be used is provided in **Appendix H**.

A field QC log is to be maintained by the CQC System Manager and assigned to each member of the QC staff for use in documenting details of field activities during QC monitoring activities. At the end of each day, a copy of the log entries is to be attached to the Daily QC Report. The information in the QC log provides backup information and is intended to serve as a phone log and memory aide in the preparation of the Daily QC Report and in addressing follow-up questions that may arise.

QC and H&S staff input for the Daily QC Report is to be provided in writing to the CQC System Manager at a previously agreed upon time and place, generally no later than about 1 hour before normal close of business. For the sake of simplicity and completeness, the format for QC staff input should follow the same as for the Daily QC report with only the relevant sections completed.

Each Daily QC Report is to be assigned and tracked by a unique number comprised of the Delivery Order number followed by the date expressed as DDMMYY. In the case of "no work day" reports, the report number is to comprise the Delivery Order, the last date covered, the

number of days covered, and the initials "NW." For example, DO #0025-090610 is the report for this delivery order related to site work performed on 09 June 2010, and DO #0025-200710-3NW is the report for this delivery order related to three no work days from 18 July 2010 through 20 July 2010. Copies of Daily QC Reports with attachments and QC logs no longer in use are to be maintained in the project QC file. Upon project closeout, all QC logs are to be included in the project QC file.

9.10 Definable Features of Work

Below, the definable features of work are identified and briefly described for the ARSAR IM action.

9.10.1 Mobilization

This definable feature of work includes all pre-mobilization activities such as notifications and preparation of manifests; mobilization activities, mobilization of personnel, and mobilization of materials and equipment; and a kick-off/safety meeting to include a walk-through orientation of the removal action site, review of the work plan and removal action tasks, and review and acknowledgement of the SSHP (*Section 8.0*) by all site personnel.

9.10.2 Site Preparation

This definable feature of work includes all required activities associated with preparing the site for contaminated soil removal activities. This includes delineation of work and support zones, and installation of sediment and erosion control measures, if necessary.

9.10.3 Delineation and Soil Characterization Sampling

This definable feature of work includes all required activities associated with establishing excavation area boundaries at the ARSAR, and collecting discrete soil samples to determine the areas in the target berm where elevated levels of antimony and lead are present.

9.10.4 Soil Removal and Confirmation Sampling

This definable feature of work includes all required activities associated with: 1) the excavation, transport, and disposal of contaminated soil from the ARSAR; and 2) the collection of confirmation soil samples to ensure all contaminated soil has been removed.

9.10.5 Backfill and Site Restoration

This definable feature of work includes all required activities associated with backfilling the site and restoring vegetation at the ARSAR.

9.10.6 Demobilization

This definable feature of work includes the removal of all equipment and materials from the jobsite and staging areas that were utilized during, or generated as a result of the soil removal activities at the ARSAR.

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