DEPARTMENT OF THE ARMY
US ARMY INSTITUTE OF PUBLIC HEALTH
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MCHB-IP-REH

18 FEB 2011

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

SUBJECT: Internal Draft Remedial Action Work Plan for the Western Burning Ground, New River Unit (RAAP-044), Radford Army Ammunition Plant, Virginia, February 2011

1. The Army Institute of Public Health 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 concur with the remedial action planned for this site as being protective of human health and the environment.

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 DIRECTOR:

JEFFREY S. KIRKPATRICK
Portfolio Director, Health Risk Management

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

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

www.atk.com

March 8, 2011

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

Subject: Transmittal Acknowledgement, Draft Remedial Action Work Plan for the Western Burning Ground, New River Unit (RAAP-044) November 2010

Dear Mr. Cutler:

This letter is to acknowledge transmittal of the subject document that was sent to you on March 2, 2011. Enclosed is a copy of the 2 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

11-815-40
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

11-815-40
JMcKenna

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

Coordination: J. McKenna

11-815-40
JMcKenna

Greene, Anne

From: McKenna, Jim
Sent: Wednesday, March 02, 2011 1:27 PM
To: Greene, Anne; Cutler,Jim; dennis.druck@us.army.mil; diane.wisbeck@arcadis-us.com; Redder, Jerome; Lohman,Elizabeth; Mendoza, Rich; Meyer, Tom NAB02; Sismour,Karen
Cc: Davie, Robert; Holt, Paige; Flint, Jeremy
Subject: FW: Draft Remedial Action Work Plan for the Western Burning Ground (UNCLASSIFIED)

Importance: High

Classification: UNCLASSIFIED
Caveats: FOUO

All,

The contractor will ship the Draft Remedial Action Work Plan for the Western Burning Ground, New River Unit (RAAP-044) today (March 2, 2011).
Below are the POCs and their respective Fed Ex numbers.

Thank you for your support of the Radford AAP Installation Restoration Program

Jim McKenna

Mr. James McKenna, Tracking No: 7968-2118-5534 (2 copies +2 CDs)

Mr. Richard Mendoza, Tracking No: 7944-8372-8745 (1 Copy +1 CD)

Ms. Susan Ryan, Tracking No: 7968-2120-9086, (1 CD)

Mr. Tom Meyers, Tracking No: 7944-8374-5623, (1 Copy + 1 CD)

Mr. Dennis Druck, Tracking No: 7968-2125-0716, (1 Copy)

Mr. James Cutler, Tracking No: 7968-2126-1356 (1 Copy)

Ms. Karen Sismour, Tracking No: 7968-2127-7046 (1 Copy)

Ms. Elizabeth Lohman, Tracking No: 7944-8382-2669 (1 CD)

Classification: UNCLASSIFIED
Caveats: FOUO

ATK Armament Systems
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Radford, VA 24143-0100

www.atk.com

April 25, 2011

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

Subject: Transmittal Acknowledgement, Final Remedial Action Work Plan for the Western Burning Ground, New River Unit (RAAP-044) April 2011

Dear Mr. Cutler:

This letter is to acknowledge transmittal of the subject document that was sent to you on April 21, 2011. Enclosed is a copy of the 21April 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
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Tom Meyer
Corps of Engineers, Baltimore District
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10 South Howard Street
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11-815-68
JMcKenna

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

Coordination: J. McKenna

11-815-68
JMcKenna

Greene, Anne

From: McKenna, Jim
Sent: Thursday, April 21, 2011 1:50 PM
To: Greene, Anne; Cutler,Jim; dennis.druck@us.army.mil; diane.wisbeck@arcadis-us.com; Redder, Jerome; Lohman,Elizabeth; Mendoza, Rich; Meyer, Tom NAB02; Sismour,Karen
Cc: Davie, Robert; Holt, Paige; Flint, Jeremy
Subject: Radford NRU: Western Burning Ground Remedial Action Work Plan (UNCLASSIFIED)

Importance: High

Classification: UNCLASSIFIED
Caveats: FOUO

All,

The contractor will ship the Final Remedial Action Work Plan for the Western Burning Ground, New River Unit (RAAP-044) today (April 21, 2011). Below are the POCs and their respective Fed Ex numbers.

Thank you for your support of the Radford AAP Installation Restoration Program.

Jim McKenna

MR. JAMES MCKENNA	794677268150	2 HARD COPIES AND 2 CDS
MR. RICHARD MENDOZA	794677335702	1 HARD COPY AND 1 CD
MS. SUSAN RYAN	794677340517	1 CD
MR. TOM MEYER	797015986704	1 HARD COPY AND 1 CD
MR. JAMES CUTLER	794677356229	1 HARD COPY
MS. KAREN SISMOUR	797016004279	1 HARD COPY
MS. ELIZABETH LOHMAN	797016010642	1 CD
MR. JEFFREY LEACH	797016040781	1 HARD COPY

Classification: UNCLASSIFIED
Caveats: FOUO

COMMONWEALTH of VIRGINIA

DEPARTMENT OF ENVIRONMENTAL QUALITY
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Douglas W. Domenech
Secretary of Natural Resources

David K. Paylor
Director

(804) 698-4000
1-800-592-5482

April 27, 2011

Mr. Jim McKenna
Radford Army Ammunition Plant
Route 114, P.O. Box 1
Radford, Virginia 24143-0100

Re: Remedial Action Work Plan - WBG/NRU - Radford Army Ammunition Plant

Dear Mr. McKenna:

The Virginia Department of Environmental Quality (VDEQ) has reviewed the Remedial Action Work Plan for the Western Burning Ground New River Unit (RAAP-044) dated March 2011 and approves the work plan as revised (new Drawing 1).

Please contact me at (804) 698-4498 if you have any questions or comments regarding the above site.

James L. Cutler, Jr., CPG
Federal Facilities Project Manager

cc: Paige Holt, ATK
Aziz Farahmand, VDEQ-BRRO

ARCADIS
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Baltimore District

FINAL

Remedial Action Work Plan for the Western Burning Ground

New River Unit (RAAP-044)

Prepared for:
Radford Army Ammunition Plant

April 2011

FINAL

Remedial Action Work Plan for the Western Burning Ground New River Unit (RAAP-044)

Radford Army Ammunition Plant

Radford, Virginia

April 2011

Draft Remedial Action Work Plan for the Western Burning Ground
New River Unit (RAAP-044)

Radford Army Ammunition Plant

Diane Wisbeck
Project Manager

Chris Kalinowski, P.E.
Assistant Project Manager

Prepared for:
U.S. Army Environmental Command

Prepared by:
ARCADIS U.S., Inc.
1114 Benfield Blvd Ste A
Millersville, Maryland 21108
Tel 919.854.1282
Fax 919.854.5448

Our Ref.:
GP08RAAP.4WBG

Date:
April 2011

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Acronyms and Abbreviations

CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CM	Construction Manager
COCs	Constituents of Concern
CQA	Construction Quality Assurance
cy	Cubic Yard
DOT	Department of Transportation
DQO	Data Quality Objective
EU	Exposure Units
ft	feet
FS	Feasibility Study
HHRA	Human Health Risk Assessment
HSPA	Health and Safety Plan Addendum
IRP	Installation Restoration Program
JSA	Job Safety Analysis
MMA	Main Manufacturing Area
mg/kg	milligram per kilogram
MWP	Master Work Plan
NRU	New River Unit
PRG	Preliminary Remediation Goal
QAPA	Quality Assurance Plan Addendum
QAPP	Quality Assurance Project Plan
QA/QC	Quality Assurance/Quality Control
RAL	Remedial Action Level
RAOs	Remedial Action Objectives
RAWP	Remedial Action Work Plan
RFAAP	Radford Army Ammunition Plant
RI	Remedial Investigation
RSL	Regional Screening Levels
sf	square feet
SOPs	Standard Operating Procedures
USAEC	U.S. Army Environmental Command
USEPA	United States of Environmental Protection Agency
VA WQS	Virginia Water Quality Standards
VDEQ	Virginia Department of Environmental Quality
WBG	Western Burning Ground
XRF	X-Ray Fluorescence

1. Introduction

ARCADIS U.S, Inc. (ARCADIS) has been retained by the United States Army Environmental Command (USAEC) to perform Installation Restoration Program (IRP) activities at the Radford Army Ammunition Plant (RFAAP). The RFAAP facility is located in Montgomery and Pulaski Counties in southwestern Virginia and consists of two noncontiguous units: the New River Unit (NRU) and the Main Manufacturing Area (MMA). The RFAAP-MMA is located approximately 5 miles northeast of the City of Radford, Virginia. The RFAAP-NRU is located about six miles southwest of the RFAAP-MMA, near the town of Dublin, Virginia. IRP activities for both the RFAAP-MMA and the RFAAP-NRU are being conducted as part of a Performance Based Contract awarded to ARCADIS under contract W91ZLK-05-D-0015: Task 0002. The RFAAP-NRU is managed under the Comprehensive Environmental Response and Compensation Liability Act (CERCLA).

This site-specific Remedial Action Work Plan (RAWP) has been prepared to outline the scope of work for the remedial activities that will be conducted at the Western Burning Ground (WBG).

As presented in the Feasibility Study (FS) Report (ARCADIS, 2010b) and the Proposed Plan (RFAAP, 2010) for RFAAP-NRU, sediment excavation and off-site disposal has been recommended as the response action for the WBG.

This Work Plan incorporates by reference applicable sections of the Master Work Plan (MWP) (URS, 2003) and Standard Operating Procedures (SOPs). The general health and safety requirements for fieldwork at the RFAAP-NRU are included in the Final Health and Safety Plan Addendum (HSPA) (ARCADIS, 2008a).. Updates to the HSPA are provided in Appendix A. The Quality Assurance Plan Addendum (QAPA) (ARCADIS, 2008b) for the MWP, has been attached as Appendix B.

1.1 Purpose and Scope

The purpose of the RAWP is to define the scope for the remedial activities that will be performed at the site. This RAWP provides a detailed description of the design and specifications for the selected WBG at RFAAP-NRU, including:

- Excavation of sediment at the WBG to meet residential level cleanup goals.
- Transportation and disposal of the sediment from the WBG to an appropriately licensed off-site disposal facility.

- Restoration of the site as necessary.

In addition to the technical details for the physical removal action, this RAWP also discusses the administrative activities required to complete the work such as construction management, quality assurance, and health and safety.

1.2 Report Organization

This report includes the following sections:

- Section 2, RFAAP-NRU Facility Background, provides a physical location, historical description of the Site, and a summary of previous investigations;
- Section 3, Remedial Action Objectives and Cleanup Levels, presents the overall objectives and site cleanup levels that will guide the remedial activities;
- Section 4, Remedial Construction Activities, discusses the full scope of activities that will be completed during implementation of the remedial action, including: Site preparation, sediment excavation, transportation and disposal of removed sediment, Site restoration, and other Site activities;
- Section 5, Construction Quality Assurance, outlines the quality assurance activities that will be performed during implementation of the remedial actions;
- Section 6, Health and Safety, describes the health and safety procedures developed for the Site;
- Section 7, Reporting and Schedule, outlines the Remedial Action Completion Report that will be prepared upon completion of the Remedial Action and an anticipated schedule of the remedial activities; and
- Section 8, References, lists all documents referenced in this report.

2. RFAAP-NRU Facility Background

This section provides a brief summary of the site background information, including a history of the site investigations and risk assessments completed at the WBG. The information presented in this section is discussed in much greater detail within the

Remedial Investigation (RI) Report (ARCADIS, 2010a) and FS Report (ARCADIS, 2010b) for RFAAP-NRU.

2.1 Facility Location and History

The RFAAP-NRU facility is located in the mountains of southwestern Virginia in the Great Valley subprovince of the Valley and Ridge Physiographic Province. The RFAAP-NRU encompasses approximately 3,000 acres of Pulaski County, Virginia, near the town of Dublin. Active manufacturing operations at the facility ended in 1945, at the completion of World War II. The RFAAP-NRU currently serves as a storage facility for operations at the MMA. The storage facilities consist of magazine type buildings that are primarily located throughout the eastern portion of the RFAAP-NRU. Paved surface roads run throughout the facility to provide access to the storage magazines and areas utilized during historical operations at the site.

Despite the historical manufacturing operations that took place at the RFAAP-NRU, and its current use as a storage facility for the MMA, the majority of the land area consists of undeveloped grasslands, heavily forested areas, and agricultural tracts. A portion of the property has recently been converted for use as a military cemetery. The WBG is located in the western half of the RFAAP-NRU facility.

The WBG is a former burning ground located in the southwestern portion of the RFAAP-NRU, south of the Igniter Assembly Area. The WBG was used as a burning ground to decontaminate explosives contaminated material and to dispose of excess and off-specification explosives/energetics. The main burn area was approximately 170 feet (ft) long by 100 ft wide and is surrounded on three sides by an approximately 4 ft high earthen berm. A dirt road runs parallel to the open side of the former burn area, leading north to Alger Road, and south to the top of a steep slope above an unnamed pond. The dirt road was reportedly constructed on top of an ashy layer of material extending from the burning ground at the time of the pond construction. The site is surrounded with wooded areas, and is no longer active. A site map depicting an aerial photograph of the WBG site and a primary site access route is presented as Figure 1.

Surface water runoff from the former burn area is expected to flow to the southwest based on site topography. A small, unlined drainage ditch captures some runoff, channeling flow to the northwest before intersecting a second ditch that drains into the pond. The unnamed pond, which is approximately 3.6 acres in size, was constructed south of the WBG during the early 1990s. The pond is fed by Wiggins Spring, a natural spring located at the head (i.e., northwest corner) of the pond. The pond also

collects surface water drainage from the surrounding area. The pond drains under an earthen dam via a constant level drain on the southeastern side of the pond. The effluent flows into a tributary of the unnamed creek that flows through the southwest portion of the RFAAP-NRU.

With the exception of the storage magazines and a few maintenance/support buildings, very few active structures remain at the RFAAP-NRU. There are no buildings located at the WBG.

2.2 Nature and Extent of Contamination

Multiple phases of environmental investigations were performed at WBG between 1997 and 2010 and were presented in detail in the RI Report for RFAAP-NRU (ARCADIS, 2010a). A brief history of these investigations is presented in Table 1. The investigations provided for a comprehensive evaluation of the environmental conditions at the Site through sampling of surface soil, subsurface soil, sediment, surface water, and groundwater and the results were evaluated in human health and ecological risk assessments. The findings of the human health risk assessment (HHRA) indicated that chromium and lead present in the sediment poses an unacceptable potential risk to future residential receptors. Although the environmental risk assessment identified a few constituents with hazard quotients above the benchmark value of 1 in surface soils, sediment, and surface water, the limited spatial distribution of the constituents led to the overall conclusion that adverse effects are not expected for wildlife at the WBG. The following subsections will present a brief discussion of the nature and extent of lead and chromium in sediment, the constituents that were determined to be risk drivers for human health.

- Lead was detected in pond sediments at concentrations ranging from 20.6 milligram per kilogram (mg/kg) to 109,000 mg/kg. The lead concentrations were above the industrial regional screening level (RSL) in 4 of the 26 sediment samples, and above the residential RSL in 2 other samples. The samples with lead concentrations above the RSLs (WBGSD5, WBGSD10, WBGSD17, WBG-SE001, WBG-SE002, and WBG-SE003) were generally confined to a 2,100 square feet (sf) area along the north-central bank of the pond in an area that may have been a preferential flow path prior to road construction. Several large boulders are present in the pond in this area. Delineation sampling using both laboratory analytical samples and X-Ray Fluorescence (XRF) field screening confirmed that lead concentrations decrease with distance from the northern edge of the pond (Figure 2).

- Chromium was detected in 5 of 24 samples at concentrations above background and residential RSLs; although the majority of the detected concentrations were only slightly above background. The highest detected concentration of chromium (15,400 mg/kg) occurred at sample location WBGSD10, which also had the highest concentration of lead. The elevated chromium detections were confined to the same area where lead was detected above the RSLs.

- On October 19, 2010 a sample was collected and analyzed for TCLP metals. Leachable lead (1.28 mg/L) and chromium (<0.1 mg/L) levels are less than regulatory standards (each 5 mg/L), therefore, sediment will be handled as non-hazardous material. The laboratory report is provided in Appendix C.

3. Remedial Action Objectives and Clean-up Levels

This section presents the remedial action objectives (RAOs) and the numerical cleanup levels that will be utilized to guide the Remedial Actions at the WBG.

3.1 Remedial Action Objectives

Lead and chromium in sediment at the WBG pond pose an elevated risk under a hypothetical future residential child exposure scenario. The goal of the remedial action at the WBG is to effectively mitigate lead and chromium levels in sediment in a manner that provides short- and long-term protection of human health to the extent practicable. Therefore, the RAOs for the WBG include:

- Prevent human exposure to constituents of concern (COCs) in sediment that would result in unacceptable risk or hazard for the designated use; and
- Minimize the potential for COCs migration to other areas.

3.2 Scope of the Response Actions

As presented in the FS (ARCADIS, 2010b) and the Proposed Plan (RFAAP, 2010), the Army selected Response Action Alternative SD-3: Excavation, Transportation, and Off-Site Disposal of sediment. The implementation of the selected response action will consist of the following general actions:

- Removal and off-site disposal of sediment that contains lead and chromium at concentrations that have been determined to present unacceptable risks to current or hypothetical future receptors. The removal activities will achieve the RAOs of preventing unacceptable human exposure to COCs and minimizing COC migration and are discussed in Section 4.3.
- Confirmation sampling to verify that the cleanup goals have been achieved.
- Site restoration activities to the extent practicable to restore the site to pre-existing conditions.

3.3 Identification of Numerical Remedial Action Levels for Sediment

Numerical Remedial Action Levels (RALs) have been established for chromium and lead in sediment to guide the response action. The RALs are intended to serve as the

sediment cleanup levels that will be achieved in order to meet the RAOs that have been established for the Site. The Preliminary Remediation Goals (PRGs) that were presented in the FS and Proposed Plan for RFAAP-NRU have been adopted as the RALs. Promulgated cleanup levels are unavailable for sediment and therefore PRGs were calculated using the site-specific exposure assumptions developed in the Baseline HHRA. The PRGs were calculated to target a hazard index of 1 for non-carcinogenic effects associated with chromium and a fetal blood lead level of less than 10 microgram per deciliter for lead.

Remedial Action Levels for Sediment at WBG	
Driver	**RALs**
Chromium	1,358 mg/kg
Lead	1,100 mg/kg

3.4 Attainment of Sediment RALs

Due to the risk-based nature of the RALs, it is generally considered overly protective to utilize them as "not-to-exceed" concentrations. Generally, the RALs should be utilized as "area average" concentrations for given exposure units (EU) in accordance with United States Environmental Protection Agency (USEPA) guidance (USEPA, 1989 and 2005). An EU is a geographic area within which a receptor would be expected to come in contact with during a given exposure duration. The USEPA's Soil Screening Guidance (USEPA, 1996) recommends a 0.5-acre source area for residential exposures.

However, lead and chromium are present in a small discrete area of the pond and the surrounding concentrations reduce to levels consistent with background in a short distance. Therefore, the RALs will be utilized as "not-to-exceed" cleanup levels with the understanding that in achieving RALs in confirmation samples, the resulting post-remediation exposure level is likely below the required cleanup level (USEPA, 2005). As described in Section 3.5, the removal area will not exceed an area of 0.5 acres and will be conducted within the area of the pond that contains the highest concentrations of chromium and lead.

3.5 Response Action Area

Based on the analytical results from the sediment investigation activities discussed in the 2010 RI Report for the RFAAP-NRU, sediments within the Unnamed Pond that contain lead and chromium above the RALs are confined to an approximate area of

1,000 sf, located on the northeast side of the pond abutting the shoreline (Drawing 1). The depth of sediment containing exceedances of RALs is 1-ft deep. A removal depth of 2 ft has been established as a conservative approach to achieve RALs which will result in an approximate sediment removal volume of 75 cubic yards (cy).

4. Remedial Construction Activities

This section provides a description of the components for the removal actions that will be completed at the WBG. These components include pre-construction and site preparation activities; sediment excavation; transportation and off-site disposal; confirmation sampling; and site restoration. ARCADIS will act as the general contractor and supply labor, methods, materials, equipment and related services for the remedial action. Capitol Environmental Services, Inc., (Capitol) will coordinate transportation and disposal of excavated sediment and other waste materials generated during performance of the work. Capitol will work with RFAAP-NRU and ARCADIS to ensure that all waste materials are properly documented, manifested and disposed. Solid IDW and dredged material will be shipped to Wayne Disposal, which is a Subtitle C facility, located in Bellville, Michigan. Liquid IDW including decontamination water and dewatering liquid will be disposed of at Spirit Services, located in Hagerstown, Maryland. The waste materials are non-hazardous and will be transported in accordance with all applicable Department of Transportation (DOT) regulations.

4.1 Pre-Construction Activities

The following activities will be completed prior to mobilization activities at the WBG.

4.1.1 Contractor Notifications and Permits

The response action is being conducted under CERCLA; therefore, per Section 300.400(e) of the NCP, 40 C.F.R. § 300.400(e), no federal, state, or local permits are required for on-site response actions. However, all activities will be conducted in accordance with the substantive requirements of those applicable or relevant and appropriate requirements (ARARs) determined applicable to on-site activities (e.g., stormwater management and erosion and sediment control). ARCADIS and all subcontractors will obtain RFAAP safety permits prior to the commencement of on-site activities.

On March 17, 2011, ARCADIS wetland ecologists delineated wetland boundaries at and around the WBG site in accordance with the *Federal Manual for Identifying and Delineating Jurisdictional Wetlands* (Manual) (Federal Interagency Committee for Wetland Delineation [FICWD] 1989) and the *DRAFT Interim Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Eastern Mountains and Piedmont Region* (United States Army Corps of Engineers [USACE] 2010). The wetland delineation identified the extent of wetlands, open waters and transition areas around

the planned sediment removal areas in accordance with permit equivalency requirements described in Nationwide Permit (38) for Section 404 of the Clean Water Act (CWA) and Section 10 of the Rivers and Harbors Act. The results of the wetland delineation were used to support the preparation of U.S. Army Corps of Engineers, Nationwide Permit #38 permit equivalency application package for regulated activities occurring at the site in areas regulated under CERCLA. A copy of the Nationwide Permit #38 permit equivalency application package and wetlands delineation report are presented in Appendix D. As this work is being performed under CERCLA, there is no Federal requirement for submitting this application package or obtaining a Nationwide #38 Permit.

The site activities detailed herein trigger additional enforceable ARARs as well as To Be Considered standards applicable to surface water quality requirements, including:

- Virginia Water Quality Standards Criteria (VA WQSs) for Surface Water (9VAC 25-260-140);
- VA WQS Antidegradation Policy (9 VAC 25-260-30);
- VA WQS Numerical Criteria for dissolved oxygen, pH and maximum temperature (9VAC 25-31-10).

4.1.2 Utility Clearance

A three point utility clearance will be performed prior to initiating any intrusive work at the Site. The three point utility clearance will consist of the following activities: (1) ARCADIS will coordinate with RFAAP to review the scope of work and identify any utility lines that may be located in the work areas, (2) a records review will be conducted to review all available drawings/information that can aide in identifying and locating adjacent underground utilities/structures, (3) a private utility locator (Mid-Atlantic Utility Locating, LLC) will be retained to locate underground lines/structures by applying surface geophysical methods around the pond. Finally, ARCADIS will conduct a visual inspection of the work areas and conduct construction activities to avoid marked subsurface utility locations, manholes, and other locations with evidence of such utilities.

4.2 Mobilization and Site Preparation

This section describes the manner in which ARCADIS shall maintain a controlled work site. The activities or requirements set forth by this section shall be applicable to all aspects of the site remediation activities.

4.2.1 Site Layout and Controls

Upon the initial mobilization to the site, ARCADIS will perform a thorough inspection of the Site to document existing conditions and review the required scope of work for the sediment removal activities. Primary site access is from the north via dirt access roads which will provide accessibility to the proposed upland administrative and construction staging areas (see Figure 1 and Drawing 1). Temporary facilities, including a restroom, administrative offices and personnel parking, will be located in this area. Due to the cessation of facility operations and limited use of the area, minimal perimeter site controls and security are expected. In the event that such are required, ARCADIS will immediately erect and establish such controls (e.g., safety cones, caution tape, snow fencing, temporary gates, etc.).

4.2.2 Truck and Equipment Ingress/Egress Routes

Paved, gravel and dirt surface roads run throughout RFAAP-NRU facility and provide access to WBG. Where possible, all vehicle traffic will remain on these roads. It is anticipated that limited debris removal will be required to facilitate site access. However, vegetation, including overhanging tree branches and limbs, will be removed if necessary in order to provide equipment/truck access to the work area. After removal, vegetation will be temporarily staged, chipped, and spread on-site and left for decomposition. ARCADIS will make every effort to minimize the amount of vegetation removed to access the site. A Stabilized Construction Entrance (SCE) may be required during execution of construction activities. The necessity of the SCE will be determined in the field by the engineer. If required, the SCE will be constructed in accordance with the details provided on Drawing 2. Depending on the condition of access roads prior to and during construction, improvements and/or reconstruction to adequately accommodate the anticipated construction equipment and traffic during construction activities may be required. In the event that the roads used for site ingress/egress require improvement to accommodate construction or other equipment utilized during the removal action, temporary gravel roads may be installed. If required, the temporary roads will be constructed in accordance with the details provided on Drawing 2.

4.2.3 Stormwater Management and Erosion and Sediment Control

Soil erosion and sediment controls as well as storm water management controls may be required during execution of construction activities. Field conditions and on-site ARCADIS personnel will dictate and identify the control techniques and specific locations for installation of such applications. The controls may include, but are not limited to, silt fence, straw bales, and plastic sheeting. If required, such controls and their approximate locations are detailed in Drawings 1 and 2. The erosion and sediment control practices and stormwater management controls will remain in place during construction activities until deemed no longer necessary by the field engineer. If required, controls will be inspected periodically and maintained throughout the duration of the remedial action.

4.2.4 Sediment Staging and Dewatering Area

A two-foot bermed area approximately 40 feet by 75 feet will be constructed to stage the sediment and allow for dewatering. The staging area will be covered with three layers of polyethylene sheeting and covered. The approximate location of the sediment staging and dewatering area is provided on Drawing No. 1.

4.2.5 Decontamination Facilities

A pre-fabricated decontamination pad (Spilltech, Model: PAC1225, or equivalent) will be installed and utilized as necessary for decontamination of trucks and equipment to remove any excess materials prior to site departure. When warranted, as determined by the field engineer, wet decontamination processes may be required and will be implemented utilizing water only, no solvents or other solutions will be required. Decon water will be disposed of off-site.

4.3 Sediment Removal, Transportation, and Disposal

The following sections discuss the activities that will be conducted for the required sediment excavation, transportation and disposal at the WBG site.

4.3.1 Resuspension Controls

Removal activities are not expected to cause sediment resuspension in the water column due to the limited volume of removal and site characteristics (such as minimal surface water flow, limited wind fetch, etc.) observed in the pond. Therefore, installation of structural resuspension controls is not anticipated during removal activities.

However, the implementation of engineering techniques and equipment controls (i.e., fall height of the bucket, reduced cycle times, pausing above surface water to allow draining, etc.) will be implemented to further reduce the likelihood of sediment resuspension during removal action.

4.3.2 Debris Removal

Minimal debris removal within the Unnamed Pond is anticipated. Visual observation along the shoreline of the removal area resulted in the identification of large to medium size rocks which will be mechanically removed and placed upland during excavation activities. Large rocks and boulders removed during construction activities will be replaced along the shoreline of the Unnamed Pond following completion of sediment removal and confirmation sampling activities. If they were in contact with sediments targeted for removal, it will be removed from the boulders prior to being replaced.

4.3.3 Sediment Removal Procedures

Sediment removal activities will commence once debris has been removed from the pond. Removal will be conducted from the top of bank via mechanical techniques utilizing general construction equipment (i.e., long reach excavator). The approximate footprint of the excavation activities for the WBG site is depicted in Drawing 1 and is approximately 1,000 sf in area. The planned depth for sediment removal is 2 feet below sediment surface, for an approximate total volume of 75 cy. Once removal limits and depths have been achieved and verified, confirmation sampling will be conducted. The proposed confirmation sampling program is discussed in Section 4.3.5.

4.3.4 Sediment Processing, Transportation, and Disposal

Excavated sediment will be placed within the dewatering area, as depicted on Drawing 1. The dewatering area will be lined with a triple layer of Linear Low Density Polyethylene (LLDPE) geomembrane, or equivalent, to act as barrier to upland soil and collect water and sediments resulting from excavator bucket spillage. Any miscellaneous spillage will be cleaned immediately and handled accordingly. Any free liquids that accumulate within the sediment staging containment will be containerized and transported off-site for proper disposal. Dredged material is required to pass a paint filter test prior to transportation and disposal at the Wayne Disposal facility. If necessary, solidification agents, such as Portland cement, will be mixed with the sediment to allow the sediment to be transported off-site for disposal. Care will be exercised when mixing any solidification agents to prevent tearing of the containment liner and the generation of dust.

Staged sediment will be loaded onto permitted trucks, covered and transported by Capitol Environmental, Inc., to Wayne Disposal, Bellville, MI, a subtitle C facility. A vehicle log denoting when each truck has entered and left the site will be maintained and will include each truck's identification number, driver identification, the times of arrival and departure, and the approximate volume of material hauled. A representative from RFAAP will review, approve, and sign waste profiles and manifests prior to the disposal of excavated sediment from the site.

Transportation of the excavated sediment will be conducted in accordance with all applicable regulations. In addition, all materials transporters will be appropriately licensed, permitted, and in compliance with all applicable regulations. The waste disposal contractor will submit copies of all manifests to the on-site ARCADIS representative. Copies of the final waste manifests and weigh tickets will also be provided to ARCADIS upon receipt of the material at the disposal facility.

4.3.5 Sediment Confirmation Sampling Program

Sediment samples will be collected from the perimeter and interior of the removal area to verify achievement of applicable RALs. Samples collection will be conducted from a boat. Perimeter samples will be collected at equidistant intervals of 20-ft starting from the shoreline and extending around the perimeter. Based on the anticipated sediment removal surface area (approximately 1,000 sf), two confirmation sediment samples will be collected from the interior of the removal area (1 sample per 500 sf). Sediment samples will be collected from the excavation bottom within 1-ft of the excavation bottom. Sediment confirmation samples will be collected in accordance with the MWP and SOPs (URS, 2003). The samples will be field screened for chromium and lead using a NITON Model XLT792 XRF analyzer, or equivalent. Approximately 50 percent of the field samples will be submitted for laboratory analysis of lead and chromium via USEPA Method 6010. The laboratory results will be used to confirm the XRF field screening results and the success of the removal action.

In the event that the field screening or laboratory analytical results indicate that COCs are present within the Unnamed Pond at concentrations exceeding the established RALs, the removal area will be expanded as follows:

1. For perimeter samples that exceed the target RALs, the removal area will be expanded a distance of two feet outward, perpendicular to the sampling location along the horizontal extent. The lateral extent of the removal area expansion shall extend from the exceeding sample location to the mid-way point between the next compliant sample location.

2. For samples collected in the interior of the removal area that exceed the target RALs, the depth of the excavation will be increased by 1 foot at the corresponding sample location. The lateral extent of the excavation expansion shall extend from the exceeding sample location to the mid-way point between the next compliant sample location.

3. Confirmation samples from the extended excavation area will be collected at the following frequency: 20 ft intervals at the perimeter and 1 per 250 sq feet. The sediment removal area expansions will be terminated when the results of the confirmation sampling program indicate COC concentrations at each of the sample locations achieve the applicable RALs.

Sediment samples will be collected in accordance with the sampling procedures outlined in the MWP for the RFAAP (URS, 2003). Quality assurance/quality control (QA/QC) samples will be collected in accordance with the Draft QAPA (ARCADIS, 2008b).

4.3.6 Waste Characterization Sampling Program

Sediment proposed for excavation was previously characterized as non-hazardous based on the results of the October 2010 analytical results provided in Appendix C.

In addition, if free liquid and decon water will be disposed of off-site, one aqueous sample will be collected from the combined decontamination water and free liquids pumped from the dredged material for waste characterization. The aqueous waste sample will be analyzed for metals and additional parameters, as needed, to facilitate proper off-site disposal.

4.3.7 Surface Water Sampling

Surface water monitoring at the outfall for turbidity will be conducted during the excavation to evaluate performance of the response action. In addition, a surface water sample will be collected after the excavation to verify that the sediment excavation activities have not adversely impacted water quality in the pond. The sample will be collected from the perimeter of the sediment removal area and will be analyzed for lead and chromium in accordance with the MWP for RFAAP (URS, 2003) and compared to numerical VA WQS.

4.4 Demobilization and Site Restoration

Following completion of construction activities, Site demobilization activities will be conducted. This will consist of equipment decontamination; site restoration activities at the Site; removal of all temporary work-related facilities, equipment and materials; and final inspection of all work and restored areas. Disturbed areas affected as a result of construction activities will be restored by placing topsoil, seed and mulch, as needed (i.e., removal of the temporary parking areas, staging areas, and temporary site controls). Any refuse, such as waste construction materials and personal protective equipment, utilized during removal activities will be removed and properly disposed. A final site inspection will be conducted following the aforementioned activities.

5. Construction Quality Assurance

QA/QC for the remedial action will be provided under the direction of the Construction Manager (CM) in accordance with the Master Quality Assurance Project Plan (QAPP) (URS, 2003) as amended by ARCADIS' QAPA. The CM will meet with the remedial contractor initially, as well as periodically, throughout the project, supervise the contractor, and conduct inspections throughout the remedial action. The final QA/QC approval will be provided by certification that the remedial action was performed in accordance with the approved MWP and all applicable regulations.

As part of construction quality assurance (CQA) management activities, the CM will be responsible for overseeing the construction quality and for ensuring compliance with the specifications and drawings. These activities include visual inspection of equipment, materials, and operations and verification they comply with project specifications; independent verification of quantity calculations, confirmation sampling, preparation of daily construction reports, and weekly progress reports.

The CM will perform field inspections to visually verify that the remedial action components and controls comply with this RAWP, the MWP, and all applicable regulations. The daily routine activities that will be observed by the CM include the following items:

- Site preparation;
- Site controls;
- Erosion controls;
- Sediment removal;
- Confirmation sampling;
- Dewatering;
- Decontamination/equipment washing; and
- Site restoration.

Field activity reports will be executed daily and made available for review at the Site. The results and certifications from the laboratory and field testing programs will also be available for review at the Site.

5.1 Data Quality Objectives for Measurement Data

The Data Quality Objective (DQO) for the sediment sampling program is to ensure that the limits of the excavation are sufficient to achieve the RAOs.

In addition to the qualitative DQO, the analyses conducted will also conform to the project DQO pertaining to field sampling methodology and laboratory-specific DQOs referenced in the Master QAPP.

5.2 Measurement/Data Acquisition

Field, laboratory, and data handling procedures relating to activities performed at RFAAP-NRU will conform to the specific requirements detailed in the MWP or in the SOPs as identified below.

Subject	MWP Section	SOP(s)
Sample management	5.1	50.1, 50.2, 50.3
Documentation	4.3	10.1, 10.2, 10.3, 10.4
Sediment Sampling	5.4	30.4, 30.5
Surface Water Sampling	5.3	30.3
Decontamination	5.12	80.1

5.3 Data Validation and Usability

Level III data validation for samples collected and analyzed from RFAAP-NRU will be conducted in accordance with Section 9.5 of the MWP (URS, 2003) and the ARCADIS QAPA in Appendix B.

6. Health and Safety

All phases of work for the removal action at the WBG will be conducted in accordance with the requirements and procedures outlined in ARCADIS' Final HSPA (ARCADIS, 2008a) to the Master Work Plan (URS 2003). Updated Emergency Contact Information and Hospital Route are provided in Appendix A. Consistent with the HSPA, Appendix A includes the Lead Addendum. In addition, Job Safety Analysis (JSA) forms have been included for each of the safety critical tasks that will be performed during the field work for this removal action. The JSAs identify specific hazards that could be encountered during an action as well as control methods to protect employees and property from hazards. The JSAs also list the type of personal protective equipment (PPE) required for the completion of the work. The following JSAs are provided in Appendix A:

- Heavy Equipment Operation
- Site Clearing
- Sediment Sampling
- Equipment Decontamination
- Truck Loading

In addition to the HSPA and the information provided in Appendix A, a copy of the ARCADIS Field Health and Safety Handbook will be available on-site. This handbook contains relevant general topics and is used as part of the overall health and safety process. To aid in the consistency of the process the handbook will be used as an informational source in conjunction with this HSPA. The following four (4) handbook sections are minimally required reading for this project:

- Section III-F. General Housekeeping, Personal Hygiene and Field Sanitation
- Section III-G. Site Security, Work Zone and Decontamination for HAZWOPER Sites
- Section III-GG. HAZWOPER and HAZMAT Response
- Section III-II. Drums and other Material Handling

All on-site personnel during the removal action will be fully trained and compliant with the OSHA HAZWOPER regulations. Health and Safety tailgate meetings will be performed at the beginning of each work day and when personnel return from any extended break. These meetings will ensure that all site personnel are fully aware of the specific conditions and hazards present at the site and the emergency response procedures. All Health and Safety meetings will be documented on *Site Activities Tailgate Health and Safety Briefing Form* provide in Appendix D of the HSPA.

7. Reporting and Schedule

ARCADIS anticipates that the field components of the response actions discussed in this report will be conducted over a one-week period, in May 9th, 2011. Once the analytical data for the confirmation samples have been received from the laboratory and the waste disposal manifests have been received from the disposal facility, a completion report will be prepared summarizing the full details of the response actions completed at the WBG. This report will include:

- Field notes and daily logs;
- Tabulated quantities of excavated sediment;
- Field and laboratory analytical data from confirmation sampling program;
- Sediment waste disposal information;
- Photographic documentation of field activities;
- As-built drawings; and
- Documentation of any deviations from this Work Plan.

The Completion Report will be submitted to Virginia Department of Environmental Quality (VDEQ) and will be utilized to document that the RAOs specific to this remedial action have been achieved. Remedial activities will commence upon approval of this RAWP by the USAEC and VDEQ. The estimated timeframe of project completion is subject to change based on actual dates of approvals, identification and approval of additional data requirements, and weather conditions. The remedial action will require approximately 1 week from contractor mobilization through demobilization. Approximately one day will be required for mobilization and site preparation, two days for excavation, one to two days for dewatering, 1 day for disposal and site restoration.

8. References

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ARCADIS, 2008b. DRAFT Health and Safety Plan Addendum, Radford Army Ammunition Plant, Radford, Virginia, April.

ARCADIS, 2010a. Final Remedial Investigation Report, New River Unit (RAAP-044), Radford Army Ammunition Plant, Radford, Virginia. June

ARCADIS, 2010b. Final Feasibility Study Report, New River Unit (RAAP-044), Radford Army Ammunition Plant, Radford, Virginia. September.

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U.S. Environmental Protection Agency (USEPA). 1989. Methods for Evaluating the Attainment of Cleanup Standards. Vol. 1: Soil and Solid Media. EPA 230/02/89-042. February.

U.S. Environmental Protection Agency (USEPA). 2005. Guidance on Surface Soil cleanup at Hazardous Waste Sites: Implementing Cleanup Levels. Office of Emergency and Remedial Response. EPA 9355.0-91. April

URS, 2003. Master Work Plan, Radford Army Ammunition Plan, Radford, Virginia. August.

Tables

Table 1. Summary of Samples Collected at the Western Burning Ground, 1997 through 2008, Radford Army Ammunition Plant, Radford, Virginia.

Sample Name	Matrix	Date Collected	Depth Start (ft)	Depth End (ft)	Dioxin/Furan	Explosives	Herbicides	Inorganics	Inorganics-Filtered	Inorganics-TCLP	Organochlorine Pesticides	PAHs	PCBs	Perchlorate	SVOCs	VOCs
Gannett Fleming Independent Sampling, 1997																
Soil Samples																
SS-04	Soil	6/3/1997	0	0.5	X			X					X		X	X
SS-04a	Soil	6/3/1997	0	0.5	X			X					X		X	X
SS-05	Soil	6/3/1997	0	0.5	X			X					X		X	X
Sediment Samples																
SD-01	SE	6/4/1997	0	0.5				X			X		X		X	X
SD-02	SE	6/4/1997	0	0.5				X			X		X		X	X
Surface Water Samples																
SW-01	SW	6/5/1997	-	-				X								
SW-02	SW	6/4/1997	-	-				X								
ICF KE Remedial Investigation, 1998																
Soil Samples																
WBGSB1A	Soil	8/5/1998	0	2		X		X							X	X
WBGSB1B	Soil	8/5/1998	2	4		X		X							X	X
WBGSB2A	Soil	8/5/1998	0	2		X		X							X	X
WBGSB2B	Soil	8/5/1998	6	8		X		X							X	X
WBGSB2C	Soil	8/5/1998	9	11		X		X							X	X
WBGSB3A	Soil	8/5/1998	0	1		X		X							X	X
WBGSB4A	Soil	8/5/1998	0	1.5		X		X							X	X
WBGSB5A	Soil	8/5/1998	0	2		X		X							X	X
ICF KE Remedial Investigation, 1999																
Soil Samples																
WBGSB6A	Soil	5/26/1999	0	2		X		X				X			X	X
WBGSB7A	Soil	5/26/1999	0	2		X		X				X			X	X
WBGSB8A	Soil	5/26/1999	0	2		X		X				X			X	X
WBGSB9A	Soil	5/26/1999	0	2		X		X		X		X			X	X
WBGSB10A	Soil	5/26/1999	0	2		X		X				X			X	X
WBGSB11A	Soil	5/26/1999	0	2		X		X				X			X	X
WBGSB12	Soil	8/18/1999	0	4				X							X	
WBGSB13	Soil	10/6/1999	0	2				X							X	
WBGSB13A	Soil	10/6/1999	2	4				X							X	
WBGSB13D	Soil	10/6/1999	0	2				X							X	
WBGSB14	Soil	10/6/1999	0	2				X								
WBGSB14A	Soil	10/6/1999	2	4				X								
WBGSB15	Soil	10/6/1999	0	2				X							X	
WBGSB15A	Soil	10/6/1999	2	4				X							X	
WBGSB16	Soil	10/6/1999	0	2				X								
WBGSB16A	Soil	10/6/1999	2	4				X								
WBGSB17	Soil	10/6/1999	0	2				X								
WBGSB17A	Soil	10/6/1999	2	4				X								
WBGSB18	Soil	10/6/1999	0	2				X								
WBGSB18A	Soil	10/6/1999	2	4				X								
WBGSB19	Soil	10/6/1999	0	2				X							X	
WBGSB19A	Soil	10/6/1999	2	4				X							X	
WBGSB20	Soil	10/6/1999	0	2				X								
WBGSB20A	Soil	10/6/1999	2	4				X								
WBGSB21	Soil	10/6/1999	0	2				X							X	
WBGSB21A	Soil	10/6/1999	2	4				X							X	
WBGBC1A	Soil	8/18/1999	0	2				X							X	
WBGBC1B	Soil	8/18/1999	5	7				X							X	
Stockpiled Soil Samples																
WBGDW1	Stockpiled Soil	5/26/1999	0	2						X						
WBGDW2	Stockpiled Soil	5/26/1999	0	2						X						
WBGDW3	Stockpiled Soil	5/26/1999	0	2						X						
WBGDW4	Stockpiled Soil	5/26/1999	0	2						X						
WBGDW5	Stockpiled Soil	5/26/1999	0	2						X						
WBGDW6	Stockpiled Soil	5/26/1999	0	2						X						
WBGDW7	Stockpiled Soil	6/21/1999	-	-						X						
WBGDW15	Stockpiled Soil	6/28/1999	-	-						X						
WBGDW16	Stockpiled Soil	7/13/1999	-	-						X						
WBGDW17	Stockpiled Soil	7/14/1999	-	-						X						
WBGDW18	Stockpiled Soil	7/15/1999	-	-						X						
WBGDW19	Stockpiled Soil	7/15/1999	-	-						X						
WBGDW20	Stockpiled Soil	7/15/1999	-	-						X						
WBGDW21	Stockpiled Soil	7/15/1999	-	-						X						
WBGDW22	Stockpiled Soil	7/22/1999	-	-						X						
WBGDW23	Stockpiled Soil	7/22/1999	-	-						X						
WBGDW23A	Stockpiled Soil	7/29/1999	-	-						X						
WBGDW24	Stockpiled Soil	7/23/1999	-	-						X						
WBGDW25	Stockpiled Soil	7/23/1999	-	-						X						
WBGDW26	Stockpiled Soil	10/6/1999	-	-						X						

Notes found at end of table.

Table 1. Summary of Samples Collected at the Western Burning Ground, 1997 through 2008, Radford Army Ammunition Plant, Radford, Virginia.

Sample Name	Matrix	Date Collected	Depth Start (ft)	Depth End (ft)	Dioxin/Furan	Explosives	Herbicides	Inorganics	Inorganics-Filtered	Inorganics-TCLP	Organochlorine Pesticides	PAHs	PCBs	Perchlorate	SVOCs	VOCs
ICF KE Remedial Investigation, 1999																
Test Pit Confirmation Soil Samples																
WBGTP1A	Soil	6/22/1999	2.5	3				X							X	
WBGTP1B	Soil	6/23/1999	3	3.5				X							X	
WBGTP1B2	Soil	7/23/1999	3.5	4				X								
WBGTP1S	Soil	6/22/1999	1	1.5				X							X	
WBGTP1SB	Soil	6/23/1999	1	1.5				X							X	
WBGTP2A	Soil	6/22/1999	2.5	3				X							X	
WBGTP2B	Soil	6/22/1999	3	3.5	X			X							X	
WBGTP2S	Soil	6/22/1999	1	1.5				X							X	
WBGTP3A	Soil	6/23/1999	2.5	3				X							X	
WBGTP3S	Soil	6/23/1999	1	1.5				X							X	
WBGTP4A	Soil	6/24/1999	2.5	3				X							X	
WBGTP4B	Soil	6/24/1999	2	2.5				X							X	
WBGTP4S	Soil	6/24/1999	0.5	1				X							X	
WBGTP5A	Soil	6/24/1999	2.5	3				X							X	
WBGTP5B	Soil	6/24/1999	2.5	3				X							X	
WBGTP6A	Soil	6/23/1999	2.5	3				X							X	
WBGTP7A	Soil	7/13/1999	2.5	3	X			X							X	
WBGTP7B	Soil	7/14/1999	2.5	3				X							X	
WBGTP7S	Soil	7/14/1999	1	1.5				X							X	
WBGTP8A	Soil	7/13/1999	3	3.5				X							X	
WBGTP8B	Soil	7/13/1999	3	3.5				X							X	
WBGTP9A	Soil	6/24/1999	2.5	3				X							X	
WBGTP9S	Soil	6/24/1999	1	1.5				X							X	
WBGTP10A	Soil	7/15/1999	2.5	3				X							X	
WBGTP10B	Soil	7/15/1999	2.5	3	X			X							X	
WBGTP10S	Soil	7/15/1999	0.5	1				X							X	
WBGTP11A	Soil	7/15/1999	2.5	3				X							X	
WBGTP11B	Soil	7/15/1999	2.5	3				X							X	
WBGTP12A	Soil	7/15/1999	2.5	3	X			X							X	
WBGTP12S	Soil	7/15/1999	0.5	1	X			X							X	
WBGTP13A	Soil	7/22/1999	1.5	2				X							X	
WBGTP13B	Soil	7/22/1999	1	1.5				X							X	
WBGTP13S	Soil	7/22/1999	1.5	2				X							X	
WBGTP14A	Soil	7/22/1999	2	2.5				X							X	
WBGTP14B	Soil	7/22/1999	1.5	2				X							X	
WBGTP15A	Soil	7/15/1999	1.5	2				X							X	
WBGTP16A	Soil	7/22/1999	0.5	1				X							X	
WBGTP16A2	Soil	9/14/1999	0.5	1				X								
WBGTP17A	Soil	7/22/1999	0.5	1				X							X	
WBGTP18A	Soil	7/22/1999	1	1.5	X			X							X	
WBGTP18S	Soil	7/22/1999	1	1.5				X							X	
WBGTP19A	Soil	7/29/1999	2.5	3	X			X							X	
WBGTP19S	Soil	7/29/1999	2.5	3				X							X	
Sediment Samples																
WBGSD1	SE	7/16/1998	0	0.5		X		X							X	X
WBGSD2	SE	7/16/1998	0	0.5		X		X							X	X
WBGSD3	SE	7/16/1998	0	0.5		X		X							X	X
WBGSD4	SE	5/27/1999	0	0.5				X							X	
WBGSD5	SE	5/27/1999	0	0.5				X							X	
WBGSD5-2	SE	6/16/1999	0	0.5				X								
WBGSD6	SE	5/27/1999	0	0.5				X							X	
Surface Water Samples																
WBGSW1	SW	7/16/1998	-	-		X		X							X	X
WBGSW2	SW	7/16/1998	-	-		X		X							X	X
WBGSW3	SW	7/16/1998	-	-		X		X				X			X	X
WBGSW4	SW	5/27/1999	-	-				X						X	X	
WBGSW5	SW	5/27/1999	-	-				X						X	X	
WBGSW6	SW	5/27/1999	-	-				X						X	X	
Shaw Remedial Investigation, 2002																
Soil Samples																
WBGSB22A	Soil	6/18/2002	0	0.5	X	X	X	X			X	X	X		X	X
WBGSB22B	Soil	6/19/2002	2	4	X	X		X				X	X		X	X
WBGSB22C	Soil	6/19/2002	6	8	X	X		X				X	X		X	X
WBGSB23A	Soil	6/18/2002	0	0.5	X	X	X	X			X	X	X		X	X
WBGSB23B	Soil	6/19/2002	2	4	X	X		X				X	X		X	X
WBGSB23C	Soil	6/19/2002	6	8	X	X		X				X	X		X	X
WBGSB24A	Soil	6/18/2002	0	0.5	X	X	X	X			X	X	X		X	X
WBGSB24B	Soil	6/19/2002	2	4	X	X		X				X	X		X	X
WBGSB24C	Soil	6/19/2002	6	8	X	X		X				X	X		X	X
WBGSB25A	Soil	6/18/2002	0	0.5	X	X	X	X			X	X	X		X	X
WBGSB25B	Soil	6/19/2002	2	4	X	X		X				X	X		X	X
WBGSB25C	Soil	6/19/2002	6	8	X	X		X				X	X		X	X
WBGTR01	Soil	6/18/2002	0	0.5									X			

Notes found at end of table.

Table 1. Summary of Samples Collected at the Western Burning Ground, 1997 through 2008, Radford Army Ammunition Plant, Radford, Virginia.

Sample Name	Matrix	Date Collected	Depth Start (ft)	Depth End (ft)	Dioxin/Furan	Explosives	Herbicides	Inorganics	Inorganics-Filtered	Inorganics-TCLP	Organochlorine Pesticides	PAHs	PCBs	Perchlorate	SVOCs	VOCs
Shaw Remedial Investigation, 2002																
Sediment Samples																
WBGSD07	SE	6/26/2002	0	0.5	X			X				X	X		X	X
WBGSD08	SE	6/25/2002	0	0.5	X	X	X	X			X	X	X		X	X
WBGSD09	SE	6/25/2002	0	0.5	X	X		X				X	X		X	X
WBGSD10	SE	6/26/2002	0	0.5	X	X	X	X			X	X	X		X	X
WBGSD11	SE	6/27/2002	0	0.5	X	X		X				X	X		X	X
WBGSD12	SE	6/26/2002	0	0.5	X	X		X					X		X	X
WBGSD13	SE	6/26/2002	0	0.5			X	X			X		X		X	X
WBGSD14	SE	6/25/2002	0	0.5			X	X			X		X		X	X
WBGSD15	SE	6/27/2002	0	0.5			X	X			X		X		X	X
Surface Water Samples																
WBGSW07	SW	6/26/2002	-	-	X	X		X				X	X	X	X	X
WBGSW08	SW	6/25/2002	-	-	X	X	X	X			X	X	X	X	X	X
WBGSW09	SW	6/25/2002	-	-	X	X		X				X	X	X	X	X
WBGSW10	SW	6/26/2002	-	-	X	X	X	X			X	X	X	X	X	X
WBGSW13	SW	6/26/2002	-	-			X	X			X		X	X	X	X
WBGSW14	SW	6/25/2002	-	-			X	X			X		X	X	X	X
WBGSW15	SW	6/27/2002	-	-			X	X			X		X	X	X	X
Shaw Additional Characterization Sampling, 2004																
Soil Samples																
WBGSB26A	Soil	7/16/2004	0	0.5				X				X	X			
WBGSB27A	Soil	7/16/2004	0	0.5				X				X	X			
WBGSB28A	Soil	7/16/2004	0	0.5				X				X	X			
WBGSB29A	Soil	7/19/2004	0	0.5				X					X			
WBGSB30A	Soil	7/19/2004	0	0.5				X					X			
WBGSB31A	Soil	7/19/2004	0	0.5				X					X			
WBGSB32A	Soil	7/19/2004	0	0.5				X					X			
WBGSB33A	Soil	7/19/2004	0	0.5				X					X			
WBGSB34A	Soil	7/19/2004	0	0.5				X					X			
WBGSB35A	Soil	7/20/2004	0	0.5				X					X			
WBGSB36A	Soil	7/20/2004	0	0.5				X					X			
WBGSB37A	Soil	7/20/2004	0	0.5				X					X			
WBGSB38A	Soil	7/19/2004	0	0.5				X					X			
WBGSB39A	Soil	7/19/2004	0	0.5				X					X			
WBGSB40A	Soil	7/19/2004	0	0.5				X					X			
WBGSB41A	Soil	7/19/2004	0	0.5				X					X			
WBGSB42A	Soil	7/19/2004	0	0.5				X					X			
WBGSB43A	Soil	7/19/2004	0	0.5				X					X			
WBGSB43B	Soil	7/19/2004	4	5				X					X			
WBGSB44A	Soil	7/19/2004	0	0.5				X					X			
WBGSB44B	Soil	7/19/2004	1	2				X					X			
WBGSB45A	Soil	7/19/2004	0	0.5				X					X			
WBGSB45B	Soil	7/19/2004	4	5				X					X			
WBGSB46C	Soil	7/19/2004	4	5				X					X			
WBGSB47C	Soil	7/19/2004	5	6				X					X			
WBGSB48C	Soil	7/19/2004	4	5				X					X			
WBGSB49B	Soil	7/19/2004	1	2				X					X			
WBGSB50B	Soil	7/19/2004	3	4				X					X			
WBGSB51B	Soil	7/19/2004	3	4				X					X			
WBGSB52B	Soil	7/19/2004	3	4				X					X			
WBGSB53A	Soil	9/14/2004	0	0.5				X								
Sediment Samples																
WBGSD16	SE	7/16/2004	0	0.5				X				X	X			
WBGSD17	SE	7/22/2004	0	0.5				X					X			
WBGSD18	SE	7/22/2004	0	0.5				X					X			
WBGSD19	SE	7/22/2004	0	0.5				X					X			
WBGSD20	SE	7/22/2004	0	0.5				X					X			
WBGSD21	SE	7/22/2004	0	0.5				X					X			
WBGSD22	SE	7/22/2004	0	0.5				X					X			
WBGSD23	SE	9/14/2004	0	0.5				X								
WBGSD24	SE	9/14/2004	0	0.5				X								
WBGSD25	SE	9/14/2004	0	0.5				X								

Notes found at end of table.

Table 1. Summary of Samples Collected at the Western Burning Ground, 1997 through 2008, Radford Army Ammunition Plant, Radford, Virginia.

Sample Name	Matrix	Date Collected	Depth Start (ft)	Depth End (ft)	Dioxin/Furan	Explosives	Herbicides	Inorganics	Inorganics-Filtered	Inorganics-TCLP	Organochlorine Pesticides	PAHs	PCBs	Perchlorate	SVOCs	VOCs
Shaw Additional Characterization Sampling, 2004																
Fish Tissue Samples																
WBGTS01	TI	7/21/2004	-	-				X					X			
WBGTS02	TI	7/21/2004	-	-				X					X			
WBGTS03	TI	7/21/2004	-	-				X					X			
WBGTS04	TI	7/21/2004	-	-				X					X			
WBGTS05	TI	7/21/2004	-	-				X					X			
WBGTS06	TI	7/21/2004	-	-				X					X			
WBGTS07	TI	7/21/2004	-	-				X					X			
WBGTS08	TI	7/21/2004	-	-				X					X			
WBGTS15	TI	7/21/2004	-	-				X					X			
WBGTS16	TI	7/21/2004	-	-				X					X			
WBGTS17	TI	7/21/2004	-	-				X					X			
WBGTS18	TI	7/21/2004	-	-				X					X			
WBGTS19	TI	7/21/2004	-	-				X					X			
WBGTS20	TI	7/21/2004	-	-				X					X			
WBGTS21	TI	7/21/2004	-	-				X					X			
WBGTS22	TI	7/21/2004	-	-				X					X			
ARCADIS Remedial Investigation, 2008																
Soil Samples																
WBG-SE001(0-1)	SE	7/30/2008	0	1				X								
WBG-SE002(0-1)	SE	7/30/2008	0	1				X								
WBG-SE003(0-1)	SE	7/30/2008	0	1				X								
WBG-SE004(0-1)	SE	7/30/2008	0	1				X								
WBG-SE005(0-0.5)	SE	7/31/2008	0	0.5											X	
WBG-SE006 (0-0.5)	SE	7/31/2008	0	0.5											X	
Surface Water Samples																
WBG-SW002(073008)	SW	7/30/2008	-	-				X								
WBG-SW003(073008)	SW	7/30/2008	-	-				X								
WBG-SW004(073008)	SW	7/30/2008	-	-				X								
WBG-SW005 (20080731)	SW	7/31/2008	-	-											X	
WBG-SW006 (20080731)	SW	7/31/2008	-	-											X	

SE	Sediment.
SW	Surface Water.
ft	Feet.
TCLP	Toxicity Characteristic Leachaing Procedure.
PAHs	Polycyclic Aromatic Hydrocarbons.
PCBs	Polychlorinated biphenyls.
SVOCs	Semivolatile Organic Compounds.
VOCs	Volatile Organic Compounds.

Figures

LEGEND

- TOP OF BERM
- FORMER BURN CAGE
- BREAK BETWEEN ASPHALT AND DIRT ROAD
- UNLINED DRAINAGE DITCH
- TEST PIT AREA (1999 RI)
- SURFACE WATER
- PAVED ROADS
- DIRT ROADS
- BUILDINGS
- STUDY AREA
- INSTALLATION BOUNDARY

N

0 100 200 Feet

GRAPHIC SCALE

RADFORD ARMY AMMUNITION PLANT
RADFORD, VA

WESTERN BURNING GROUND SITE LAYOUT

ARCADIS

FIGURE 1

NYC: SER 4/AIT: DB: TBR LD: TBR PIC: TL
Radford (GP08RAAP.00PM)
I:\Radford\GIS\ArcMap_MXD\FeasibilityStudy\0710WBG_Basemap.mxd - 7/22/2010 @ 11:47:31 AM

CITY:NOVI DIV/GROUP:ENV DB: PIC: PM: TM: TR: PROJECT NUMBER:
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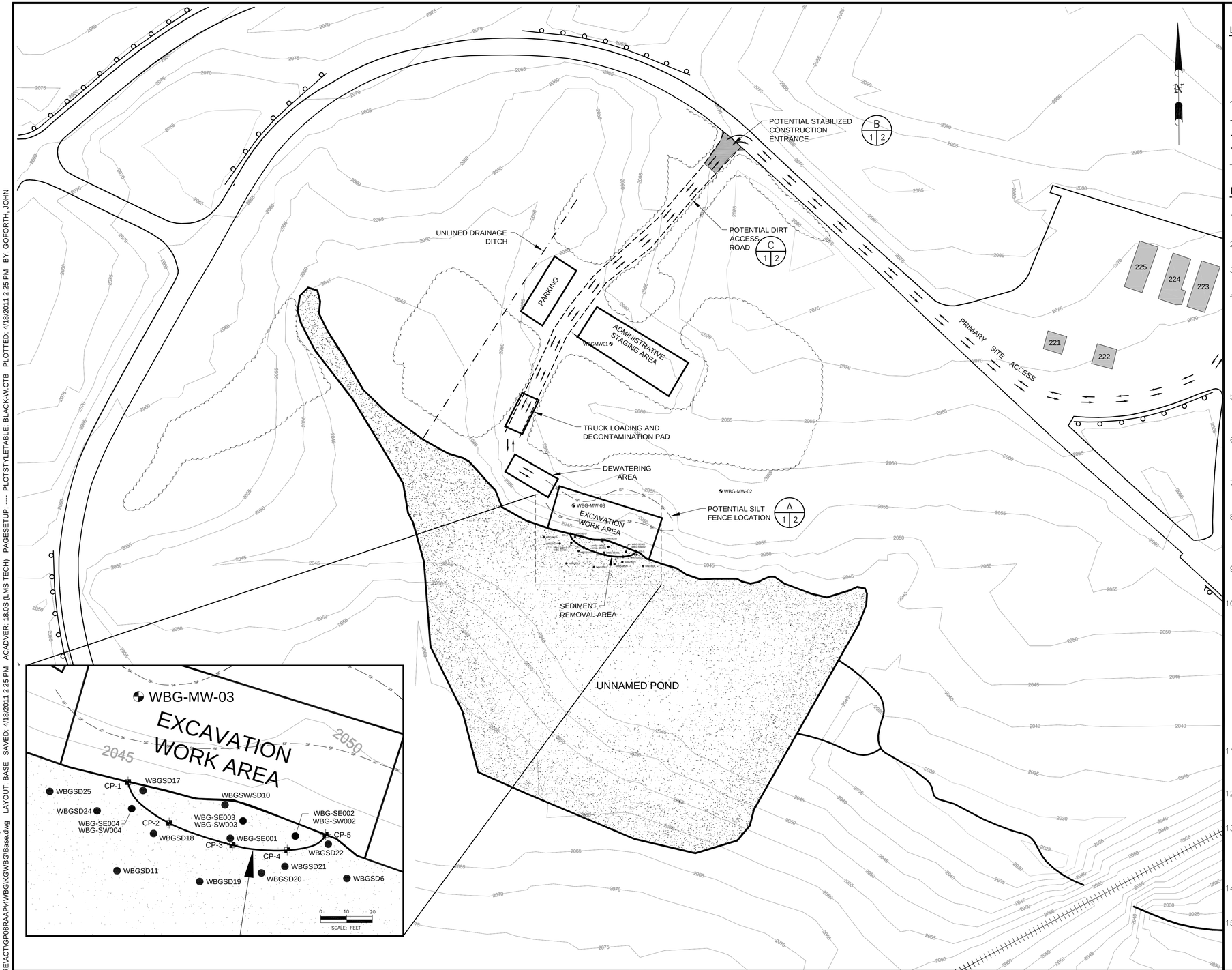
Drawings



LEGEND:

- MONITORING WELL
- WBGSW/SD10 — SEDIMENT SAMPLE LOCATION
- CP-1 — CONTROL POINT
- TREE LINE
- UNLINED DRAINAGE DITCH
- DIRT ACCESS ROAD
- RAILROAD
- 222 — EXISTING BUILDING
- TRAFFIC PATTERN
- GUARD RAIL
- SF — SF — SF — FILT FENCE

NOTES:

1. BASEMAP AND LINE WORK OBTAINED FROM NEW RIVER UNIT ADDITIONAL CHARACTERIZATION SAMPLING & GROUNDWATER INVESTIGATION DATA REPORT (SHAW ENVIRONMENTAL, 2007).
2. ALL LOCATIONS ARE IN FEET AND REFER TO NORTH AMERICAN DATUM OF 1983. AND NORTH AMERICAN VERTICAL DATUM 1988.
3. SITE DEVELOPMENT DIMENSIONS, FEATURES, BOUNDARIES, AND LOCATIONS DEPICTED ARE APPROXIMATE AND SHALL BE FIELD LOCATED AND MODIFIED ACCORDINGLY.
4. EXISTING BUILDINGS, UTILITIES, AND OTHER FEATURES SHALL BE PROTECTED THROUGHOUT CONSTRUCTION ACTIVITIES. A THREE POINT UTILITY CLEARANCE WILL BE PERFORMED PRIOR TO INITIATING ANY INTRUSIVE WORK AT THE SITE. THE THREE POINT UTILITY CLEARANCE WILL CONSIST OF THE FOLLOWING ACTIVITIES: (1) ARCADIS WILL COORDINATE WITH RADFORD ARMY AMMUNITION PLANT TO REVIEW THE SCOPE OF WORK AND IDENTIFY ANY UTILITY LINES THAT MAY BE LOCATED IN THE WORK AREAS, (2) A RECORDS REVIEW WILL BE CONDUCTED TO REVIEW ALL AVAILABLE DRAWINGS/INFORMATION THAT CAN AIDE IN IDENTIFYING AND LOCATING ADJACENT UNDERGROUND UTILITIES/STRUCTURES, (3) A PRIVATE UTILITY LOCATOR WILL BE RETAINED TO LOCATE UNDERGROUND LINES/STRUCTURES BY APPLYING GEOPHYSICAL METHODS SURROUNDING THE AREAS WHERE INTRUSIVE WORK WILL BE CONDUCTED.
5. INGRESS/EGRESS ROUTES ARE ANTICIPATED TO REQUIRE LIMITED OVERHEAD CLEARING OF LIMBS AND BRANCHES. THE CLEARING OF VEGETATION FOR SITE ACCESS SHALL BE KEPT TO A MINIMUM. CLEARED VEGETATION SHALL BE CHIPPED AND DISPOSED OF ON-SITE WITHIN WOODED OR VEGETATED AREAS.
6. DEBRIS LOCATED ALONG THE SHORELINE, INCLUDING LARGE TO MEDIUM SIZE ROCKS, WILL BE MECHANICALLY REMOVED AND PLACED UPLAND DURING REMOVAL ACTIVITIES. LARGE ROCK AND BOULDERS REMOVED DURING CONSTRUCTION ACTIVITIES WILL BE REPLACED ALONG THE SHORELINE OF THE UNNAMED POND FOLLOWING THE COMPLETION OF SEDIMENT REMOVAL ACTIVITIES.
7. STABILIZED CONSTRUCTION ENTRANCES AND TEMPORARY ACCESS ROADS SHALL BE CONSTRUCTED AS DEPICTED ON DRAWING 2. THE LOCATION OF STABILIZED CONSTRUCTION ENTRANCES AND TEMPORARY ACCESS ROADS SHALL BE FIELD DETERMINED BY THE ENGINEER.
8. EROSION AND SEDIMENT CONTROLS, IF REQUIRED, ARE TO BE PLACED DOWN GRADIENT OF DISTURBED AREAS, AS NECESSARY. ALL EROSION AND SEDIMENT CONTROLS ARE TO REMAIN IN PLACE UNTIL THE SITE IS STABILIZED WITH VEGETATION AND APPROVED FOR REMOVAL BY THE ENGINEER. EROSION AND SEDIMENT CONTROLS SHALL BE CONSTRUCTED AS DEPICTED ON DRAWING 2.
9. A PRE-FABRICATED DECONTAMINATION PAD WILL BE INSTALLED AND UTILIZED AS NECESSARY FOR DRY DECONTAMINATION OF TRUCKS AND EQUIPMENT TO REMOVE ANY EXCESS MATERIALS PRIOR TO SITE DEPARTURE.
10. SEDIMENT REMOVAL WILL BE CONDUCTED FROM THE TOP OF BANK VIA MECHANICAL TECHNIQUES UTILIZING GENERAL CONSTRUCTION EQUIPMENT, SUCH AS A LONG REACH EXCAVATOR. REMOVAL LIMITS, AS IDENTIFIED BY THE FOLLOWING CONTROL POINTS DEPTH WILL BE VERIFIED USING A GPS:

CONTROL POINT	NORTHING	EASTING
CP-1	3,565,563.3	10,849,262.4
CP-2	3,565,547.4	10,849,278.3
CP-3	3,565,538.9	10,849,302.7
CP-4	3,565,536.9	10,849,324.0
CP-5	3,565,542.9	10,849,338.8

11. APPROXIMATELY 75 CUBIC YARDS (CY) OF SEDIMENT WILL BE REMOVED FROM THE NORTHEAST SIDE OF THE UNNAMED POND. IMPACTED SEDIMENTS ARE CONFINED TO AN ESTIMATED 1,000 SQUARE FOOT AREA. THE PLANNED DEPTH OF THE SEDIMENT REMOVAL ACTIVITIES IS 2 FEET BELOW SEDIMENT SURFACE.
12. CONSTRUCTION CONTROLS, SUCH AS FALL HEIGHT OF BUCKET AND BUCKET CYCLE TIMES, SHALL BE IMPLEMENTED AS NECESSARY TO LIMIT RESUSPENSION OF SEDIMENTS WITHIN THE UNNAMED POND DURING REMOVAL ACTIVITIES. STRUCTURAL RESUSPENSION CONTROLS ARE NOT ANTICIPATED.
13. A SEDIMENT DEWATERING AND STAGING AREA APPROXIMATELY 40 FT. BY 75 FT. WILL BE CONSTRUCTED. THE 2 FT. BERMINED AREA WILL BE LINED WITH A TRIPLE LAYER OF POLYETHYLENE GEOMEMBRANE AND A LAYER OF SAND. DREDGED SEDIMENTS WILL BE PLACED IN THE DEWATERING AREA WHERE SEDIMENTS WILL GRAVITY DEWATER. FREE LIQUIDS FROM DEWATERING ACTIVITIES WILL BE CONTAINERIZED AND DISPOSED OF OFF SITE. AGENTS MAY BE ADDED IF ADDITIONAL DEWATERING IS REQUIRED PRIOR TO OFF-SITE TRANSPORTATION AND DISPOSAL.
14. DEWATERED SEDIMENT WILL BE TRANSPORTED OFFSITE BY CAPITOL ENVIRONMENTAL, INC. AND DISPOSED OF AS NON-HAZARDOUS AT A SUBTITLE C DISPOSAL FACILITY LOCATED IN BELLEVILLE, MICHIGAN.
15. ANY DISTURBED AREAS AFFECTED AS A RESULT OF CONSTRUCTION ACTIVITIES WILL BE REPLACED TO PRE-CONSTRUCTION CONDITIONS. RESTORATION AT THE SITE WILL CONSIST OF REMOVAL OF TEMPORARY PARKING AREAS, STAGING AREAS, AND TEMPORARY CONTROLS.

0 30 60 120
SCALE: FEET

THIS BAR REPRESENTS ONE INCH ON THE ORIGINAL DRAWING: USE TO VERIFY FIGURE REPRODUCTION SCALE

No.	Date	Revisions	By	Ckd
0				

Professional Engineer's Name		
Professional Engineer's No.		
State	Date Signed	Project Mgr.
Designed by	Drawn by	Checked by

ARCADIS U.S., INC.

RADFORD ARMY AMMUNITION PLANT
WESTERN BURNING GROUND
RADFORD, VIRGINIA

SITE DEVELOPMENT PLAN

ARCADIS Project No.
GP08RAAP.4WBG.KGWBG

Date
November 2010

801 CORPORATE
Center Dr. Suite 300
Raleigh, North Carolina
(919) 854-1262

DRAWING
1

CITY: DIV/GROUP: DB: LD: PIC: PM: TM: LYR:ON=*;OFF=*REF*
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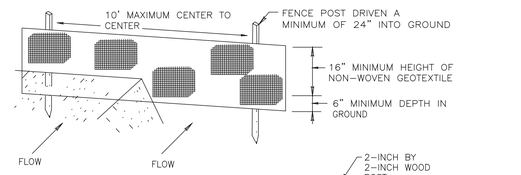
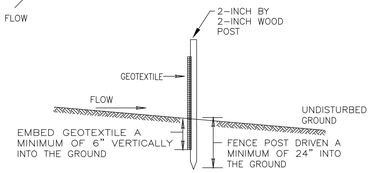


PERSPECTIVE



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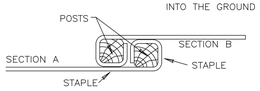


JOINING TWO ADJACENT SILT FENCE SECTIONS

SILT FENCE PROPERTIES

PHYSICAL PROPERTIES	MINIMUM REQUIREMENT
FILTERING EFFICIENCY	85%
TENSILE STRENGTH AT 20% (MAX) ELONGATION:	
STANDARD STRENGTH	30 LBS./LINEAR IN.
EXTRA STRENGTH	50 LBS./LINEAR IN.

CONSTRUCTION SPECIFICATIONS:

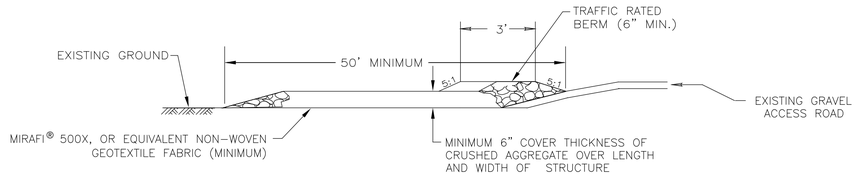
1. EXCAVATE A TRENCH AT LEAST 6 INCHES DEEP ALONG THE SILT FENCE ALIGNMENT.
2. DRIVE POSTS AT LEAST 24 INCHES INTO THE GROUND ON THE DOWNSLOPE SIDE OF THE TRENCH. SPACE POSTS AT A MAXIMUM OF 10 FEET.
3. FASTEN SUPPORT FENCE TO UPSLOPE SIDE OF POSTS, EXTENDING 6 INCHES INTO THE TRENCH.
4. ATTACH A CONTINUOUS LENGTH OF FABRIC TO THE UPSLOPE SIDE OF THE FENCE POSTS, MINIMIZING THE NUMBER OF JOINTS. AVOID JOINTS AT LOW POINTS IN THE FENCE LINE. WHERE JOINTS ARE NECESSARY, FASTEN FABRIC SECURELY TO SUPPORT POSTS AND OVERLAP TO THE NEXT POST.
5. PLACE THE BOTTOM 1-FOOT OF FABRIC IN THE 6-INCH DEEP TRENCH (MINIMUM), LAPPING TOWARD THE UPSLOPE SIDE. BACKFILL WITH COMPACTED EARTH OR GRAVEL.
6. IF USING A PRE-PACKED COMMERCIAL SILT FENCE RATHER THAN ON-SITE CONSTRUCTION; FOLLOW MANUFACTURER'S INSTALLATION INSTRUCTIONS.

MAINTENANCE REQUIREMENTS

1. SILT FENCE SHALL BE INSPECTED AFTER EACH RAINFALL EVENT AND MAINTAINED WHEN "BULGES" OCCUR OR WHEN SEDIMENT ACCUMULATION REACHES 50% OF THE FABRIC HEIGHT. IF FENCE FABRIC TEARS, STARTS TO DECOMPOSE, OR IN ANY WAY BECOMES INEFFECTIVE, THE AFFECTED SECTION SHALL BE REPLACED IMMEDIATELY.

TYPICAL SILT FENCE DETAIL — A (1 | 2)

N.T.S.



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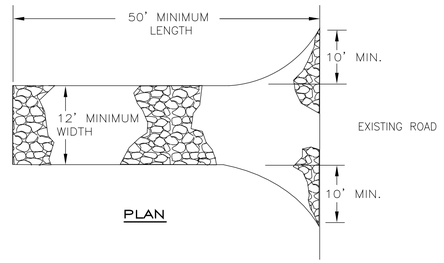


PLAN

CONSTRUCTION SPECIFICATIONS:

1. LENGTH: – MINIMUM OF 50'.
2. WIDTH: – 12' MINIMUM, FLARED AT THE EXISTING ROAD TO PROVIDE A TURNING RADIUS.
3. MIRAFI® 500X, OR EQUIVALENT NON-WOVEN GEOTEXTILE SHALL BE PLACED OVER THE EXISTING GROUND PRIOR TO PLACING STONE. UNLESS OTHERWISE NOTED, GEOTEXTILE SUPPLIERS SHALL FURNISH MATERIALS WHOSE MINUMUM AVERAGE ROLL VALUES, AS DEFINED BY THE FEDERAL HIGHWAY ADMINISTRATION, MEET OR EXCEED THE CRITERIA SPECIFIED IN THE TABLE BELOW:

NON – WOVEN GEOTEXTILE

PROPERTIES	QUALIFIER	SPECIFIED VALUE	TEST METHOD
POLYER COMPOSITION	MINIMUM	95% WEIGHT POLYPROPYLENE POLYESTER	-----
FLOW RATE	MINIMUM	75 GPM/SQ FT	ASTM D – 4491
PERMITTIVITY	MINIMUM	0.90/SEC – 1	ASTM D – 4491
TRAPEZOIDAL TEAR STRENGTH	MINIMUM	100 LBS	ASTM D – 4533
GRAB ELONGATION	MINIMUM	50%	ASTM D – 4632
FABRIC WEIGHT	MINIMUM	10 OZ/SYD	ASTM D – 5261 or D – 3776
APPARENT OPENING SIZE	-----	SIEVE SIZE: 100–70	ASTM D – 4751
PUNCTURE RESISTANCE	MINIMUM	125 LBS	ASTM D – 4833

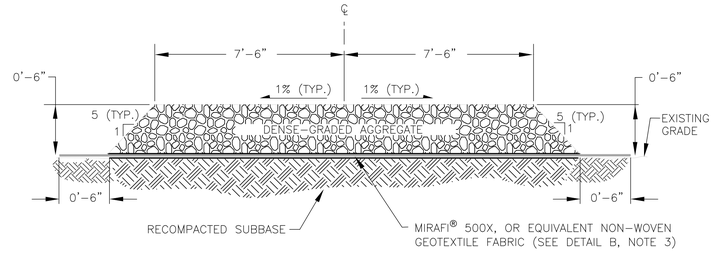
4. STONE: CRUSHED AGGREGATE (2–INCH MINIMUM, 3–INCH MAXIMUM DIAMETER) SHALL BE PLACED AT LEAST 6" DEEP OVER THE LENGTH AND WIDTH OF THE ENTRANCE.
5. LOCATION: A STABILIZED CONSTRUCTION ENTRANCE SHALL BE LOCATED AT EVERY POINT WHERE CONSTRUCTION TRAFFIC ENTERS OR LEAVES A CONSTRUCTION SITE. VEHICLES LEAVING THE SITE MUST TRAVEL OVER THE ENTIRE LENGTH OF THE STABILIZED CONSTRUCTION ENTRANCE.

MAINTENANCE REQUIREMENTS:

1. INSPECT ENTRANCE PAD WEEKLY AND AFTER STORM EVENTS OR HEAVY USE.
2. RESHAPE PAD AS NEEDED FOR DRAINAGE AND RUNOFF CONTROL.
3. TOP DRESS PAD WITH CLEAN STONE AS NEEDED.
4. IMMEDIATELY REMOVE MUD AND SEDIMENT TRACKED BY BRUSHING OR SWEEPING. FLUSHING SHALL ONLY BE USED IF THE WATER IS CONVEYED INTO A SEDIMENT TRAP OR BASIN.

TYPICAL STABILIZED CONSTRUCTION ENTRANCE DETAIL — B (1 | 2)

N.T.S.



NOTE:

1. DENSE-GRADED AGGREGATE SHALL CONSIST OF HARD, STRONG, DURABLE PARTICLES THAT ARE FREE OF ANY MATERIALS, ROOTS, TREES, STUMPS, CONCRETE, CONSTRUCTION DEBRIS, OTHER ORGANIC MATTER, AND DELETERIOUS MATERIALS. DENSE-GRADED AGGREGATE SHALL HAVE A MINIMUM LIQUID LIMIT OF 25, A MAXIMUM PLASTICITY INDEX OF 3, AND SHALL MEET THE GRADATION REQUIREMENTS SET FORTH BY THESE SPECIFICATIONS AS GIVEN BELOW AND AS DETERMINED BY ASTM C–136:

SIEVE SIZE	PERCENT PASSING
1–INCH	100
3/4–INCH	70–100
1/2–INCH	--
3/8–INCH	50–80
No. 4	30–65
No. 30	10–40
No. 200	4–13

ACCESS ROAD DETAIL — C (1 | 2)

N.T.S.

THIS BAR REPRESENTS ONE INCH ON THE ORIGINAL DRAWING: USE TO VERIFY FIGURE REPRODUCTION SCALE

No.	Date	Revisions	By	Ckd
0				

Professional Engineer's Name

Professional Engineer's No.

State	Date Signed	Project Mgr.
Designed by	Drawn by	Checked by

ARCADIS U.S., INC.

RADFORD ARMY AMMUNITION PLANT
WESTERN BURNING GROUND
RADFORD, VIRGINIA

SECTIONS & DETAILS

ARCADIS Project No.
GP08RAAP.4WBG.KGWBG

Date
November 2010

801 CORPORATE
Center Dr. Suite 300
Raleigh, North Carolina
(919) 854-1262

DRAWING
2

Appendix A

Health and Safety Plan Updates

Table 1: Emergency Contact List

Emergency Contact	Phone Number
Local Police - Dublin Police Department	540-674-5167
Local Ambulance	911 (if appropriate)
Radford Army Ammunition Plant Fire Department	540.639.7323
Local Fire Department	911 (from cell phone); 9911 (from plant phone)
New River Unit Security Post	540.674.4988
Local Hospital (Carilion New River Valley Medical Center)	540.731.2000
Poison Control	800.332.3073
National Response Center (all spills in reportable quantities)	800.424.8802
U.S Coast Guard (spills to water)	800.424.8802
ARCADIS Project Manager - Diane Wisbeck	410.923.7834 (office); 443.909.9059 (cell)
ARCADIS Site Manager - Chris Kalinowski	919.854.1282 (office); 919.656.7731 (cell)
ARCADIS H&S Manager - Chuck Webster	315.671.9297
Client Contact - James McKenna	540.731.5782
Client Contact - Jerry Redder	540.639.7536 (office); 540.239.2990 (cell)
Client Contact - Matt Alberts	540.639.8722 (office); 540.230.3294 (cell)
Emergency Coordinator - Diane Wisbeck	410.923.7834 (office); 443.909.9059 (cell)

Emergency Notification Procedure for Project:
Step 1: Field Personnel must contact Chuck Webster or Diane Wisbeck.
Step 2: Diane Wisbeck will contact Site Manager and Client Contacts
Step 3: If field personnel cannot locate Diane Wisbeck or Chuck Webster, then field personnel may contact client contacts

In the event of a medical emergency, field personnel will call 911 and then the RAAP Fire Department

mapquest

Trip to:
2400 Lee Hwy
Pulaski, VA 24301
6.55 miles
10 minutes

Notes

Route to Lewis-Gale Hospital in Pulaski, VA

		Miles Per Section
A	**[5508-5585] Bagging Plant Rd** Dublin, VA 24084	
●	1. Start out going WEST on BAGGING PLANT RD toward GREENWOOD DR.	**Go 1.0 Mi**
↱ NORTH 100	2. Turn RIGHT onto CLEBURNE BLVD / VA-100 N. *CLEBURNE BLVD is just past ARMSTRONG ST*	**Go 0.6 Mi**
↱ SOUTH 11	3. Merge onto US-11 S via the ramp on the LEFT toward PULASKI. *If you are on CLEBURNE BLVD and reach 4TH ST you've gone about 0.2 miles too far*	**Go 4.9 Mi**
↰	4. Turn LEFT onto PLEASANT HILL DR. *PLEASANT HILL DR is 0.5 miles past MOREHEAD LN*	**Go 0.01 Mi**
●	5. 2400 LEE HWY. *If you reach LEE HWY you've gone a little too far*	**Go 0.01 Mi**
B	**2400 Lee Hwy** Pulaski, VA 24301	**6.5 mi**

Total Travel Estimate: **6.55 miles - about 10 minutes**

ARCADIS

HSPA Addendum Page

This addendum will be included at Attachment A to the work plan. The information summarized in this addendum will be shared with site staff, including subcontractors, during the daily tailgate briefing, and complete the tailgate briefing form as required.

Addendum Number:	4/19/11-1	Project Number:	GP08RAAP.4WBG.KGWBG
Date of Addendum:	4/19/11		

Description of Change that Results in Modifications to HSPA:

Sediment removal activities at WBG Site with the presence of lead and monitoring requirements are described in this addendum.

Sediment removal activities will be conducted from the top of bank via mechanical techniques utilizing general construction equipment (i.e., long reach excavator). The approximate footprint of the excavation activities for the WBG site is approximately 1,000 sf in area. The planned depth for sediment removal is 2 feet below sediment surface, for an approximate total volume of 75 cy. Once removal limits and depths have been achieved and verified, confirmation sampling will be conducted.

Excavated sediment will be placed within a dewatering area. The dewatering area will be lined with a triple layer of Linear Low Density Polyethylene (LLDPE) geomembrane, or equivalent, to act as barrier to upland soil and collect water and sediments resulting from excavator bucket spillage. Any miscellaneous spillage will be cleaned immediately and handled accordingly. Any free liquids that accumulate within the sediment staging containment will be containerized and transported off-site for proper disposal. Dredged material is required to pass a paint filter test prior to transportation and disposal at the Wayne Disposal facility. If necessary, solidification agents, such as Portland cement, will be mixed with the sediment to allow the sediment to be transported off-site for disposal. Care will be exercised when mixing any solidification agents to prevent tearing of the containment liner and the generation of dust.

Staged sediment will be loaded onto permitted trucks, covered and transported by Capitol Environmental, Inc., to Wayne Disposal, Bellville, MI, a subtitle C facility. A vehicle log denoting when each truck has entered and left the site will be maintained and will include each truck's identification number, driver identification, the times of arrival and departure, and the approximate volume of material hauled. A representative from RFAAP will review, approve, and sign waste profiles and manifests prior to the disposal of excavated sediment from the site.

Transportation of the excavated sediment will be conducted in accordance with all applicable regulations. In addition, all materials transporters will be appropriately licensed, permitted, and in compliance with all applicable regulations. The waste disposal contractor will submit copies of all manifests to the on-site ARCADIS representative. Copies of the final waste manifests and weigh tickets will also be provided to ARCADIS upon receipt of the material at the disposal facility.

Air monitoring shall be performed by ARCADIS field personnel and the monitoring action levels are provided below:

Constituent-specific max concentration	Exposure limits
Lead - 1.39 mg/m3	0.05 mg/m3
Chromium - 8.27 mg/m3	0.5 mg/m3

Based on the maximum exposure concentration of lead (3,610 mg/kg) and chromium (6,048 mg/kg)
Dust Action level (for one dust) = [(1E+6)(Exposure Limit mg/m^3)]/[(Concentration mg/kg)(Safety Factor)].
With a safety factor of 10, the action limits that would apply conservatively with lead being the chemical of concern is 1.3 mg/m^3.
Therefore the action level at the site for upgrade to Level C respirators (APR with HEPA cartridges) will be 1.3 mg/m^3.

Exposure Hazard	Monitoring Equipment	Monitoring Frequency	Action Level	Required Action
Lead	Particulate Monitor	Continuously	Background to 1.3 mg/m3	Modified Level D PPE
			1.3 to 5 mg/m3	Stop work; Upgrade PPE and engineering controls
			5 mg/m3 >	Stop work

PPE Requirements (for Lead)
Level D protection will be used during sediment excavation activities and consist of the following:

- Nitrile gloves worn over nitrile surgical gloves;
- Steel toe work boots;
- Hard hat;
- Hearing protection (if noise levels exceed 85 dB); and
- Tyvek suits will be available to minimize contact to sediment.

Signage for Lead

The Contractor shall post the following warning sign in each work area where employees exposure to lead is above the PEL.

WARNING
LEAD WORK AREA
POISON
NO SMOKING OR EATING

Dust (Lead) Control

The Contractor will use water as a primary engineering control to reduce fugitive airborne dust (lead) prior to and during the excavation activities. Water must also be utilized to prevent emissions from temporary soil staging areas. Water for dust (lead) and asbestos control shall be obtained from clean (potable) sources.

Training and Communication of Lead Hazards

The Contractor shall communicate information concerning lead hazards according to the requirements of OSHA's Hazard Communication Standard for the construction industry, 29 CFR 1926.59, including but not limited to the requirements concerning warning signs and labels, material safety data sheets (MSDS), and employee information and training.

Signed: _____
Project Manager

Signed: _____
Site Safety Officer

Signed: _____
H&S Plan Writer

Signed: _____
H&S Plan Reviewer

1. POLICY

It is ARCADIS US policy to be proactive in the identification, assessment and control of health and safety hazards and associated risks. ARCADIS will assess potential respiratory exposure hazards resulting from or encountered by our staff during job activities in accordance with the ARCADIS Industrial Hygiene Standard ARC HSIH009. To the extent feasible, appropriate engineering and/or administrative controls will be used to reduce or eliminate exposure to airborne compounds. If those controls are not able to reduce exposure adequately, employees who are exposed or potentially exposed to a respiratory hazard at or above the applicable occupational exposure guideline are required to wear appropriate respiratory protection. ARCADIS' policy requires that our staff be adequately trained, medically cleared, and appropriately fit-tested before using respiratory protection.

2. PURPOSE AND SCOPE

2.1 This standard sets forth the requirements for the selection, use and care of respiratory protective equipment (respirators) by ARCADIS staff.

2.2 This standard applies to all employees who use or could potentially use respiratory protection. It also applies to all work where airborne hazards present the potential where respiratory protection may be required.

3. DEFINITIONS

All definitions are documented in Exhibit 1.

4. RESPONSIBILITIES

4.1 **Corporate H&S** - On an annual basis, review and update, as necessary, this standard and associated attachments and assess the effectiveness of the program. In addition, Corporate H&S serves as the overall Respiratory Protection Program Administrator in accordance with OSHA 29 CFR 1910.134 (Exhibit 5).

4.2 **Operations Managers and Supervisors** - support the requirements of this standard and provide the resources necessary to implement this standard including equipment, time for training, medical exams, and fit-testing, and other appropriate and necessary resources.

4.3 **Project and Task Managers** – ensure the completion of exposure assessments on applicable projects to determine the need for respiratory protection. In addition, ensure that appropriate budgets are established on projects to provide the necessary respiratory protection based on the exposure assessments. Also, understand the requirements of the client with regards to respiratory protection.

4.4 **Health and Safety Staff and Project Site Safety Officers or Supervisors** – conduct or assist with the completion of exposure assessments and respirator training and fit-testing as necessary. These staff will also assist in the proper selection of respiratory protection and ensure the proper use and care of respiratory protection by ARCADIS staff. In addition, these staff will assist in the assessment of this respiratory protection program and procedure.

4.5 **Designated Medical Provider – WorkCare** – coordinates annual medical surveillance exams to determine the employee's ability to use a respirator and provides documentation to the employee and ARCADIS in regard the employee's ability to wear a respirator. WorkCare may also coordinate fit testing and, in these situations, provide documentation as to the outcome of the fit test. WorkCare is responsible for maintaining all medical records, including the required medical questionnaire.

4.6 **Location H&S Coordinators or Fit Testing Designees** – responsible for conducting qualitative fit-testing for employees in their locations unless the location elects to use WorkCare for such activities. The H&S Coordinator or Fit Testing Designee will conduct the fit tests in accordance with this standard. They will check that the employee is medically cleared to participate in the fit-testing activity and ensure that the fit-test record is sent to Corporate H&S either via hard copy or electronically as determined by the Corporate H&S Administrator. In addition, the H&S Coordinator or Fit Testing Designee is responsible for purchasing a complete Qualitative Fit Testing kit to have on hand at the office location for performing the fit testing. The specific kit and source will be designated by Corporate H&S

4.6 **Employees** - Wear respirators as required by project conditions and as outlined in the site-specific Health and Safety Plan (HASP) or approved project guidance. Use and maintain respirators per the manufacturer's recommendations and this standard. Perform pre-use negative and positive pressure fit checks of respirators. Participate in the required medical evaluation, training, and fit test prior to assignment and inform the site supervisor if medical, training, or fit test certifications have expired. Provide the site supervisor with a copy of medical and training certifications, and fit test results, upon request. Will not participate in the fit-testing procedure or wear a respirator of any kind for any reason nor put themselves in any situation where a respirator may be necessary if the medical clearance has expired or a fit-test has not been conducted within the last 12 months.

5. PROCEDURE

5.1 Respirator Selection

Respirators will be selected as follows:

- All respirators must have NIOSH approval.
- Only respirators selected, supplied, and/or approved by ARCADIS may be used.
- The maximum use concentration (**MUC**) shall be evaluated for proper respirator selection. The MUC can be calculated by multiplying the APF rating for the respirator selected by the PEL or TLV for the contaminant of interest. If the airborne concentrations of the contaminant exceed the MUC for the respirator, then another respirator, meeting the MUC requirements, shall be selected.
- The following "Rule of Thumb" may also be used in conjunction with the information below:

- If the chemical has a boiling point greater than 70° C and the concentration is less than 200 parts per million (ppm), a service life of 8 hours at a normal work rate can be expected.
- Service life is inversely proportional to work rate.
- Reducing the concentration by 10 will increase service life by a factor of 5.
- Humidity above 85 percent will reduce service life by 50 percent.

5.1.1 Air purifying respirators

A. ARCADIS recommends that air purifying respirators of the full-face, dual cartridge design be used when an APR is required and appropriate. However, a half-face respirator may be used following appropriate hazard and risk assessment to ensure the protection factor is adequate for the exposure.

B. Respirator cartridge selection must be based on the anticipated hazards as identified in the site-specific health and safety plan (HASP). The following points must be considered when selecting air purifying cartridges: *[Air-purifying respirators do not supply oxygen and may not be used in oxygen-deficient atmospheres or in ones that are immediately dangerous to life or health (IDLH)].*

- The anticipated air contaminant(s) concentration and the potential for air contaminant(s) to be present in concentrations which present an immediate danger to life and health (IDLH) and/or an oxygen deficient atmosphere.
- The nature of the air contaminant (s) (e.g. gas, vapor, particulate).
- The odor characteristics and odor threshold of the contaminant.
- Irritant properties of the air contaminant(s).
- The Occupational Safety and Health Administration (OSHA), Permissible Exposure Limit (PEL), the American Conference of Governmental Industrial Hygienists (ACGIH), Threshold Limit Value (TLV), and/or the National Institute for Occupational Safety and Health (NIOSH), Recommended Exposure Limit (REL).
- Work activities and the anticipated duration of respirator usage.

C. The filters are split up into three classes: N, R, and P:

- N series filters: **N**ot resistant to oil - can be used in environments where oil particles are not present in the atmosphere.
- R series filters: **R**esistant to oil – can be used in atmospheres where oil particles are present.

- P series filters: oil **P**roof – can be used in atmospheres where oil particles are present for more than 8 hours.

  In addition to the N, R, and P series above, filter efficiency shall also be considered for appropriate selection. There are three filter efficiency categories: 95 percent, 99 percent, and 99.7 percent. The higher the filter efficiency, the lower the filter leakage

D. Respirator cartridge End of Service Life shall be factored when selecting the appropriate cartridge. Use of warning properties such as odor and taste are not permissible practices. Some cartridges are equipped with End of Service Life Indicators (ESLIs). If the cartridges selected have ESLIs, cartridges will be changed based upon that indicator. If cartridges are not equipped with ESLIs, then the ESL shall be determined and a cartridge change out schedule established in the task hazard analysis stage of the project.

At a minimum, organic vapor filters should be changed at the end of each day's use or sooner, if the respirator manufacturer change-out schedule software program dictates otherwise.

Using respirator manufacturer-supplied information (this may be in the form of computer software), a change out schedule will be established based on conditions and/or concentration data obtained from the job site. The Director of Health and Safety or designate will specify if the cartridge change out schedule for a particular activity differs from that presented above.

Cartridges will be changed out as required by the established schedule or as job site conditions dictate. The change out will be performed only when the user has left the work area and has followed decontamination procedures.

Several OSHA chemical-specific standards specifically address cartridge change out schedules. Examples include the following:

Chemical	OSHA Standard	Change Out Schedule
Acrylonitrile	1910.1045 (h)(2)(ii)	end of service life indicator (ESLI) or end of shift (whichever occurs first)
Benzene	1910.1028 (g)(2)(ii)	ESLI or beginning of shift (whichever occurs first)
Butadiene	1910.1051 (h)(2)(ii)	Every 1, 2, or 4 hours dependent upon concentration according to Table 1 of standard and at beginning of every shift

Chemical	OSHA Standard	Change Out Schedule
Formaldehyde	1910.1048 (g)(2)(ii)	For cartridges every three hours or end of shift (whichever is sooner); for canisters, every 2 or 4 hours according to the schedule in (g)(3)(iv)
Vinyl chloride	1910.1017 (g)(3)(ii)	ESLI or end of shift in which they are first used (whichever occurs first)
Methylene chloride	1910.1052 (g)(2)(ii)	Canisters may only be used for emergency escape and must be replaced after use.

5.1.2 Atmosphere-supplying respirators/ Supplied Air Respirators (SARs)

A. This section applies to compressed air/oxygen and liquid air/oxygen used for supplied-air and SCBA respirators. Atmosphere-supplying respirators are designed to provide breathable air from a clean air source other than the surrounding contaminated work atmosphere.

B. They include airline-type supplied-air systems supplying air from cascaded breathing air cylinders or compressors, systems, self-contained breathing apparatus (SCBA) and complete air-supplied suits.

C. Breathing air couplings must *not be compatible* with outlets for nonrespirable worksite air or other gas systems. Compressed and liquid oxygen will meet the U.S. Pharmacopoeia requirements. Compressed breathing air will meet at least the requirements for Grade D breathing air described in ANSI G-7.1-1989 to include:

- Oxygen content (v/v) of 19.5-23.5%;
- Hydrocarbon (condensed) content of 5 milligrams per cubic meter of air or less;
- Carbon monoxide (CO) content of 10 ppm or less;
- Carbon dioxide content of 1,000 ppm or less; and
- Lack of noticeable odor.

D. Cylinders of purchased breathing air must have a *certificate* of analysis from the supplier that the breathing air meets the requirements for Grade D breathing air.

Cylinder air must be tested (Oxygen content (v/v) of 19.5-23.5%) by a calibrated oxygen sensor prior to being placed into service.

E. Cylinders used to supply breathing air must also be hydrostatically tested by a qualified organization. Steel tanks must be tested at least every five year and composite tanks at least every three years. The tested tanks will be marked with the date of the last test. Breathing air containers must be marked in accordance with the NIOSH Respirator Certification Standard, 42 CFR Part 84.

F. Employees using SARs must attend additional respirator training covering the use, care, and limitations of this equipment.

G. Airlines used in compressor or cascaded cylinder systems shall be used only for breathing air and no other gas or liquid. Maximum length of the lines is 300 feet. Airlines will be inspected before each use and at a minimum, daily and checked for damage, contamination, etc.

H. Where airline systems are utilized, all users will be equipped with a suitable escape respirator system.

I. Compressors used to supply breathing air to respirators must be constructed and/or situated to provide the following:

- Prevent contaminated air from entering the system.
- Have in-line air-purifying filters to further ensure breathing air quality. Filters must be maintained and replaced periodically following the manufacturer's instructions.
- Display a tag with the most recent filter change date with the signature of the individual authorized to perform the filter maintenance.
- Have a carbon monoxide alarm to monitor carbon monoxide (CO) levels. Levels of CO in breathing air must be maintained below 10 ppm.

5.2 Fit Testing

Fit testing will be completed on all employees that may wear or do wear respirators as follows:

- Fit testing will be conducted as required in OSHA 29 CFR 1910.134 Appendix A which is mandatory and as described in Exhibit 2.
- Employees must have received an initial and annual medical examination in accordance with the ARCADIS Medical Surveillance Standard prior to fit testing. Evidence of medical clearance to wear respiratory protection or physician authorization must be provided for review to the individual conducting the fit test.
- The fit-tester will complete a fit-test form and provide a copy to the employee upon completion of the fit-test using the form shown in Exhibit 3 or similar form.

- Fit testing will be conducted prior to actual respirator use and at least annually thereafter.
- Additional fit testing will be conducted in the event that an employee's physical condition changes resulting in the potential for an inadequate "fit." i.e. Significant weight gain/loss, reconstructive facial surgery, etc.
- Fit testing must be performed by trained and qualified individuals in accordance with the OSHA respiratory protection standard and manufacturer's specifications. Fit testing may be conducted by the ARCADIS medical exam provider or by an approved provider whether an internal or external source. (as long as the medical examination and qualification is received first). ARCADIS Corporate H&S will approve those fit-test providers.
- Only those respirators that have been properly fitted may be worn. Alternative respirator makes, models, and sizes will require additional fit testing.
- If after passing a fit test, an employee notifies a supervisor or the respirator program administrator that the fit is not acceptable, an additional fit test will be conducted.
- Fit testing will be, at a minimum, qualitative (QLFT). Quanitative Fit Testing (QNFT) will be conducted as required by the client or based on the exposure assessments completed before the initiation of a project and the protection factors required to adequately control exposure. When QNFT is conducted, it will be done so using a Porta-Count or similar device. QLFT is also acceptable as long as the respirator is used at protection factors as designated by OSHA.
- If QLFT is used, any of the approved challenge agents approved by OSHA and NIOSH shall be utilized including isoamyl acetate (banana oil), irritant smoke (stannous chloride), sacharrine, or Bitrex.
- The person doing the fit-test will ensure the respirator user is competent to conduct and understand the following:

  A. Donning and doffing of the respirator

  B. Negative and positive fit checks

  C. Parts and pieces of the respirator

  D. Maintenance and care

  E. Inspections

5.3 Respirator Usage

5.3.1 General Requirements

A. Staff doing active field work will be provided their own full-face air purifying respirator.

B. Only medically cleared, trained, and fit tested, employees may use respirators.

C. Employees must use only those respirators in which they have been fit tested.

D. Employees must wear and use all respirators in accordance with training, this standard, and the manufacturer's instructions.

E. Respirators must be assigned to a single individual for their exclusive use.

F. Respirators must not be worn if there is any condition that prohibits a good face to face piece seal (i.e., facial hair, glasses, loss of weight, lack of teeth). If an employee requires corrective lenses, ARCADIS will provide glass inserts for the respirator.

G. Respirator users will conduct a respirator user seal check each time they put on a respirator.

H. Respirator users must exit the work area immediately upon the following:

- Odor breakthrough.
- Increased breathing resistance.
- Physical symptoms, such as headache, dizziness, nausea, blurred vision or any other conditions that indicate respirator failure.

I. Respirator users must leave the work area to change filter cartridges or air bottles.

J. Surveillance will be conducted during respirator use to monitor the work area, employee exposure, or any other condition that may affect respirator effectiveness.

K. The buddy system must be used during all activities requiring the use of a respirator.

L. Respirator cartridges must be changed when they are damaged, defective, dirty, odor breakthrough, or increased breathing resistance occurs, or when indicated by the end of life service indicator (ELSI), or in accordance with a project-specific change-out schedule that must be documented in the site-specific health and safety plan (See section 5.1.1 D).

5.3.2 IDLH atmospheres

A. Work in an IDLH atmosphere shall be approved by the Environmental Division H&S Director or designate

B. In IDLH atmosphere situations, at least one person will be located outside the IDLH atmosphere. In addition visual, voice, or signal line communication will be maintained between the person in and the person outside the IDLH atmosphere. The person located outside the IDLH atmosphere will be trained to provide effective emergency rescue, and will be equipped with pressure demand, other positive SCBA or supplied-air respirator with auxiliary SCBA and:

- Appropriate retrieval equipment if it will not increase the overall risk; or
- Equivalent means for rescue where retrieval equipment is not required as noted above.

C. The appropriate supervisor will be notified before the person located outside the IDLH atmosphere enters the IDLH atmosphere to provide emergency rescue. Once notified, the supervisor will provide assistance appropriate to the situation.

5.4 Program Evaluation

A. Evaluations of work areas (site inspections) will be conducted by supervisory and Health and Safety personnel to determine the effectiveness of the program.

B. During site inspections and the annual HAZWOPER 8-hour refresher-training program, employees will be consulted to assess program effectiveness and identify problem areas.

C. Corporate Health and Safety, will review information compiled during site inspections and employee discussions and make adjustments to the program to correct identified deficiencies.

5.5 Voluntary Respirator Use

A. Respirators will be provided at the request of an employee, if the use of the respirator will not create a hazard.

B. Prior to voluntary respirator use, employees must undergo a medical examination to ensure they are physically able to use the respirator.

C. Prior to voluntary respirator use, employees must be trained in the use, care, and limitations of the respirator.

D. Prior to voluntary respirator use, employees must be fit tested as outlined in section 5.2.

E. A copy of 29 CFR 1910.134 Appendix D "Information for Employees Using Respirators When Not Required Under the Standard" will be provided to any employee who wears a respirator when its use is not required.

5.6 Maintenance, Care, and Storage of Respirators

5.6.1 Inspection

A. All respirators will be inspected according to the schedule outlined below. The checklist shown in Exhibit 6 should be followed to ensure a complete and thorough inspection:

- Respirators used routinely will be inspected before each use and during cleaning;
- SCBAs will be inspected before each use, during cleaning and monthly; inspection will include making sure that the regulator and warning devices function properly;
- Respirators that are maintained for emergency use will be inspected monthly and in accordance with the manufacturer's recommendations; and
- Emergency escape-only respirators will be inspected before being taken to the work site.

B. Documentation of respirator inspections will include checks on the following:

- Respirator function.
- Tightness of connections and condition of parts (e.g., face piece, head straps, valves, connecting tube and filters, canisters or cartridges).
- Pliability and any deterioration of any elastic or elastic-type parts.
- Condition of the regulator.
- Proper functioning of warning devices.
- If air and oxygen cylinder are fully charged. Cylinders will be recharged when the pressure falls to 90% of the manufacturer's recommended pressure level.

C. Respirators that fail inspection must be removed from service and tagged "DO NOT USE."

5.6.2 Cleaning

- As often as necessary to maintain a sanitary condition if used exclusively by one employee.

- Each time before it is worn if used by more than one employee.
- After each use if maintained for emergency use.
- After each use if used for fit testing.

The procedure for cleaning respirators is presented in Exhibit 4.

5.6.3 Maintenance

Respirators requiring maintenance due to worn or malfunctioning parts will be repaired as follows:

- Repairs shall be conducted only by individuals appropriately trained to perform necessary repairs;
- Replacement parts shall be approved by the manufacturer of the respirator; be NIOSH approved for use with the respirator; and designed and manufactured for the specific respirator being repaired.
- Repairs are to be made in accordance with manufacturer recommendations and specifications.
- Reducing and admission valves, regulators, and alarms shall only be adjusted or repaired by an authorized technician trained by the manufacturer or by the manufacturer.

5.6.4 Storage

- All respirators shall be stored in the following manner which protects them from damage, contamination, dust, sunlight, temperature extremes, excessive moisture, damaging chemicals and shall be stored in a manner which prevents deformation of the face piece and exhalation valve.
- Emergency respirators shall be stored in readily accessible condition to the work area, stored in containers or covers clearly marked as containing emergency respirators, and stored in accordance with manufacturer recommendations. Since most emergency respirators are issued to ARCADIS by the client at job sites, any client protocol for proper storage and use shall be followed.

5.7 Work Area Surveillance

- Air monitoring will be performed continuously during any work that involves use of respiratory protection. The type of monitoring to be performed will be identified during the task hazard analysis phase of the work and will be specified in the site-specific health and safety plan for the project in accordance with policy ARC HSFS010, "Health and Safety Plans".
- Workers wearing respirators will be monitored during work to ensure employees are not enduring undue stress or difficulty of any type while wearing the respirator

and to ensure the respirator is adequate protection for the hazard. Surveillance will also be conducted to identify any changes in the work method of environmental conditions which may alter the effectiveness of respirator use.

5.8 Medical Evaluation

- Because using a respirator may place a physiological burden on an employee that may vary depending upon the type of respirator and workplace conditions, the written Respiratory Protection Program includes what medical evaluation process we have implemented at ARCADIS. All employees who use a respirator as defined under this standard will participate in the company's medical monitoring program ARC HSGE010. Medical evaluations may cease if the employee is no longer required to use a respirator per the Medical Surveillance standard.

- A physician or other licensed health care professional will perform the evaluation using a medical questionnaire as defined in CFR 1910.134, Appendix C or an equivalent medical examination. A follow-up medical examination may be given depending upon the answers to the questionnaire and/or medical examination.

5.8.1 Timeframe of Medical Evaluations

Medical evaluations will take place according to the following schedule:

- Prior to fit testing and use at the work site;

- When an employee reports medical signs/symptoms that may be related to his/her ability to use a respirator;

- When a physician, supervisor or the respirator Program Administrator suggests/requests an evaluation;

- When information such as observations made during fit testing or program evaluation indicate a need; or

- When a change occurs in workplace conditions that may result in a substantial increase in the physiological burden placed on an employee (e.g., physical work effort, protective clothing, temperature, etc.).

5.8.2 Written Medical Opinion

The physician or other licensed health care professional will determine and provide a written opinion as to the employee's ability to use a respirator. This opinion will contain:

- Whether or not the employee is medically able to use the respirator;

- Any limitations on respirator use;

- The need for follow-up medical evaluations; and

- A statement that the employee was provided with a copy of the written recommendation.

6. TRAINING

Training will be provided prior to respirator use; annually; when changes in the workplace or respirator make the training obsolete; when inadequacies are found in the employee's knowledge or use of PPE; or any other situation in which retraining appears necessary.

6.1 General Requirements

A. All employees who use respirators must be trained in their use, care, and limitations. Employees will also be trained to understand why respirators are necessary and the importance of a proper fit, the signs and symptoms of over exposure, the requirements of this standard and the general requirements of the OSHA Respiratory Protection Standard.

B. Respirator training will be conducted prior to actual respirator use and at least annually thereafter. Annual training will be conducted as part of the HAZWOPER 8-hour refresher-training program.

C. All training provided must be reviewed and approved by Corporate Health & Safety and will be managed through the corporate training database.

D. Documentation of training certification received by attendance at any training course including externally provided training courses will be kept by the employee with copies provided to the corporate training group.

6.2 Training Content Requirements

Training will ensure that employees can demonstrate, at a minimum, knowledge of the following:

- Why the respirator is necessary and its limitations and capabilities;
- How improper fit, usage, or maintenance can compromise the protective effect of the respirator, and how to recognize the signs and symptoms that may limit or prevent the effective use of respirators;
- How to use the respirator effectively in emergency situations, including when it malfunctions;
- How to inspect, put on and remove, use, and check the seals of the respirator;
- Proper procedures for maintenance and storage of the respirator; and
- The general requirements of this standard.

6.3 Other Training Considerations

- Training does not need to be repeated for a new employee if he/she can provide documentation of training within the 12 months prior.
- Although annual HAZWOPER training may be utilized to help meet compliance with the training portion of this standard, training will be specific to the type of respirator used and the conditions at the job/work site.

6.4 Training for ARCADIS Fit Testers

- ARCADIS Fit Testers will complete either live meeting training or course posted on Archimedes. In addition, following completion of the training, fit testers will complete an on-line quiz to test their knowledge and competency before they conduct fit-testing of employees. A score of 90% will be required to pass the quiz.

7. REFERENCES

- 29 CFR 1910.134 "Respiratory Protection"
- National Institute for Occupational Safety & Health (NIOSH) Guide to the Selection and Use of Particulate Respirators Certified under 42 CFR 84, NIOSH 96-101, 1996.
- NIOSH Guide to Industrial Respiratory Protection, NIOSH 87-116, 1987.
- ARCADIS Health and Safety Standard ARC HSGE010 – Medical Surveillance

8. RECORDS

- Training records will be kept by the individual employee with copies of such certificates kept by the ARCADIS corporate training group. Information related to the course such as training dates and vendors, will be kept by the corporate training group.
- Air monitoring results must be maintained with project files.
- Results of medical surveillance examinations will be maintained by the designated medical provider in compliance with 29 CFR 1910.1020.
- Fit test records will be maintained by the employee who is fit tested per CFR 1910.134 (m)(2)(11) and, where utilized, the designated medical provider. In addition, records for those employees fit-tested by an ARCADIS fit tester will be sent to the ARCADIS corporate office either in hard copy or electronically by the fit tester.
- Copies of fit test records are to be kept centrally at the corporate office or they will be scanned and sent to ARCADIS' designated medical provider to be kept with the employee's medical records.

9. APPROVALS AND HISTORY OF CHANGE

Approved By: Michael A Thomas

History of Change

Revision Date	Revision Number	Reason for change
19 January 2009	01	Original document
1 September 2009	02	Updated requirements for fit-testing and made other changes to clarify requirements. Added fit-testing responsibilities for H&S Coordinators or their designee, added the fit test agents that are allowed for use for qualitative fit testing, and added training requirements for ARCADIS fit-testers. Updated the fit test form.
1 February 2010	03	Enhanced the section on Change out Schedule for respirator cartridges to better meet the intent of the US Occupational Health and Safety Administration respiratory protection standard.
24 February 2010	04	Modified section 5.1.1 A to allow the use of half face air purifying respirators

Exhibit 1 – Definitions

Air-purifying respirator means a respirator with an air-purifying filter, cartridge, or canister that removes specific air contaminants by passing ambient air through the air-purifying element.

Assigned protection factor (APF) means the workplace level of respiratory protection that a respirator or class of respirators is expected to provide to employees when the employer implements a continuing, effective respiratory protection program as specified by this section.

Atmosphere-supplying respirator means a respirator that supplies the respirator user with suitable breathing air from a source independent of the ambient atmosphere, and includes supplied-air respirators (SARs) and self-contained breathing apparatus (SCBA) units.

Canister or cartridge means a container with a filter, sorbent, catalyst, or combination of these items, which removes specific contaminants from the air passed through the container.

Demand respirator means an atmosphere-supplying respirator that admits breathing air to the facepiece only when a negative pressure is created inside the facepiece by inhalation.

Emergency situation means any occurrence such as, but not limited to, equipment failure, rupture of containers, or failure of control equipment that may or does result in an uncontrolled significant release of an airborne contaminant.

Employee exposure means exposure to a concentration of an airborne contaminant that would occur if the employee were not using respiratory protection. Note: all exposure assessments are made and reported regardless of the assigned protection factor of the respiratory protective device used

End-of-service-life indicator (ESLI) means a system that warns the respirator user of the approach of the end of adequate respiratory protection, for example, that the sorbent is approaching saturation or is no longer effective.

Escape-only respirator means a respirator intended to be used only for emergency exit.

Filter or air purifying element means a component used in respirators to remove solid or liquid aerosols from the inspired air.

Filtering facepiece (dust mask) means a negative pressure particulate respirator with a filter as an integral part of the facepiece or with the entire facepiece composed of the filtering medium.

Fit factor means a quantitative estimate of the fit of a particular respirator to a specific individual, and typically estimates the ratio of the concentration of a substance in ambient air to its concentration inside the respirator when worn.

Fit test means the use of a protocol to qualitatively or quantitatively evaluate the fit of a respirator on an individual. See also Qualitative fit test (QLFT) and Quantitative fit test (QNFT).

Helmet means a rigid respiratory inlet covering that also provides head protection against impact and penetration.

High efficiency particulate air (HEPA) filter means a filter that is at least 99.97% efficient in

removing monodisperse particles of 0.3 micrometers in diameter. The equivalent NIOSH 42 CFR 84 particulate filters are the N100, R100, and P100 filters.

Hood means a respiratory inlet covering that completely covers the head and neck and may also cover portions of the shoulders and torso.

Immediately dangerous to life or health (IDLH) means an atmosphere that poses an immediate threat to life, would cause irreversible adverse health effects, or would impair an individual's ability to escape from a dangerous atmosphere.

Loose-fitting facepiece means a respiratory inlet covering that is designed to form a partial seal with the face.

Maximum use concentration (MUC) means the maximum atmospheric concentration of a hazardous substance from which an employee can be expected to be protected when wearing a respirator, and is determined by the assigned protection factor of the respirator or class of respirators and the exposure limit of the hazardous substance. The MUC can be determined mathematically by multiplying the assigned protection factor specified for a respirator by the required OSHA permissible exposure limit, short-term exposure limit, or ceiling limit. When no OSHA exposure limit is available for a hazardous substance, an employer must determine an MUC on the basis of relevant available information and informed professional judgment.

Negative pressure respirator (tight fitting) means a respirator in which the air pressure inside the facepiece is negative during inhalation with respect to the ambient air pressure outside the respirator.

Oxygen deficient atmosphere means an atmosphere with oxygen content below 19.5% by volume.

Physician or other licensed health care professional (PLHCP) means an individual whose legally permitted scope of practice (i.e., license, registration, or certification) allows him or her to independently provide, or be delegated the responsibility to provide, some or all of the health care services required by paragraph (e) of this section.

Positive pressure respirator means a respirator in which the pressure inside the respiratory inlet covering exceeds the ambient air pressure outside the respirator.

Powered air-purifying respirator (PAPR) means an air-purifying respirator that uses a blower to force the ambient air through air-purifying elements to the inlet covering.

Pressure demand respirator means a positive pressure atmosphere-supplying respirator that admits breathing air to the facepiece when the positive pressure is reduced inside the facepiece by inhalation.

Qualitative fit test (QLFT) means a pass/fail fit test to assess the adequacy of respirator fit that relies on the individual's response to the test agent.

Quantitative fit test (QNFT) means an assessment of the adequacy of respirator fit by numerically measuring the amount of leakage into the respirator.

Respiratory inlet covering means that portion of a respirator that forms the protective barrier between the user's respiratory tract and an air-purifying device or breathing air source, or both. It may be a facepiece, helmet, hood, suit, or a mouthpiece respirator with nose clamp.

Self-contained breathing apparatus (SCBA) means an atmosphere-supplying respirator for which the breathing air source is designed to be carried by the user.

Service life means the period of time that a respirator, filter or sorbent, or other respiratory equipment provides adequate protection to the wearer.

Supplied-air respirator (SAR) or airline respirator means an atmosphere-supplying respirator for which the source of breathing air is not designed to be carried by the user.

Tight-fitting facepiece means a respiratory inlet covering that forms a complete seal with the face.

User seal check means an action conducted by the respirator user to determine if the respirator is properly seated to the face. This is conducted through the performance of a negative and positive pressure check each time the respirator is donned.

Exhibit 2 – Fit Testing Procedure

A. This is a summary of the fit-testing procedure. The person conducting the fit-test should thoroughly review OSHA 29 CFR 1910.134 Appendix A for the method of fit-testing that is to be performed.

B. The employee will be instructed in the proper placement and positioning of the respirator on the head and face. Proper tensioning of the straps will be reviewed as well as methods to determine proper and acceptable fit. A mirror should be provided to assist with this review.

C. The selected respirator shall be worn for 5 minutes to determine the comfort of the respirator. An assessment of comfort will include the following which will be discussed with the employee:

- Position of the mask on the nose
- Room for eye protection, as appropriate
- Room to talk
- Position of mask on the face and cheeks

D. Adequacy of the respirator selected will be evaluated using the following criteria:

- Proper placement of chin
- Adequate strap tension
- Fit across bridge of the nose
- Size of respirator appropriate to span distance from nose to chin
- Tendency of respirator to slip
- Employee evaluation of proper fit and position

E. The employee shall perform a seal check consisting of a positive and negative pressure check as follows:

- *Positive Pressure Check.* Close off exhalation valve and gently exhale into the facepiece. The test is satisfactory if slight positive pressure can be produced without any evidence of leakage from the mask and face seal.
- *Negative Pressure Check.* Close off the inlet opening of the canister or cartridge(s) by covering with palm of the hand(s) or by replacing filter seal(s). Inhale gently so that the mask collapses slightly and hold breath for 10 seconds. The test is considered satisfactory when the facepiece remains in its collapsed position and no inward leakage of air is detected.

F. Perform test exercises as follows:

- *Normal breathing.* In a normal standing position, without talking, the employee shall breathe normally.
- *Deep breathing.* In a normal standing position, the employee shall breathe slowly and deeply, taking caution not to hyperventilate.
- *Turning head side to side.* Standing in place, the employee shall turn his/her head slowly from side to side between the extreme positions of each side. The head shall be held at each extreme side position momentarily so the employee can inhale.
- *Moving head up and down.* Standing in place, the employee shall slowly move his/her head up and down. The employee shall be instructed to inhale in the up position.
- *Talking.* The employee shall talk out loud slowly and loud enough to be heard by the individual conducting the test. The employee shall read the Rainbow Passage:

  "When sunlight strikes raindrops in the air, they act like a prism and form a rainbow. The rainbow is a division of white light into many beautiful colors. These take the shape of a long round arch, with its path high above, and its two ends apparently beyond the horizon. There is according to legend, a boiling pot of gold at each end. People look, but no one ever finds it. When a man looks for something beyond reach, his friends say he is looking for the pot of gold at the end of the rainbow."
- *Bending over.* The test subject shall bend over at the waist as if he/she were to touch his/her toes. Qualitative fit tests using a shroud or other device to contain the testing media may substitute jogging in place for bending over at the waist.
- *Normal breathing.* The employee shall repeat exercise number 1.

G. Each test shall be performed for one minute. The employee shall be questioned regarding the comfort of the respirator. If the respirator becomes unacceptable due to discomfort, adequacy of seals, or for any other reason identified during the fit test process, then the respirator will be replaced with another suitable and acceptable respirator and the fit test procedure repeated.

H. TThe fit-tester will record the information on the fit test form, have the employee sign the form, sign the form themself and submit it either hard copy or electronically to Corporate H&S. A copy should also be given to the employee.

Exhibit 3 - Respirator Program Fit Test Form and Employee Checklist

Employee Name: _____
Last First

Employee Number: _____

Date: _____

Office: _____

Division: _____

Business practice: _____

Checklist Item	OK
Respirator Training	☐
Medical Review/Exam **(mandatory)** *Date completed:*	☐
Medical Clearance Records on File	☐

Fit Test Method: ___ Qualitative; Test Agent Used: _____

Model: _____ Type: _____ Size: _____

___ Quantitative; Model: _____ Size: _____

Response:	**Passed**	**Failed**	**Fit Factor (QN)**
Normal Breathing	☐	☐	_____
Deep Breathing	☐	☐	_____
Turning Head Side to Side	☐	☐	_____
Moving Heads Up and Down	☐	☐	_____
Talking	☐	☐	_____
Grimace	☐	☐	_____
Bending Over	☐	☐	_____
Normal Breathing	☐	☐	_____
Pass or Fail (Qualitative Fit Test)	☐	☐	_____
Overall Fit Test Factor: (from Portacount)	☐	☐	_____

Employee: Printed name_____
Signature_____

Test Administrator: Printed name_____
Signature_____
Company_____

Respirator Type [1]	Assigned Protection Factor
Single use or quarter mask	5
Air purifying half mask with cartridge and/or any type of particulate filter	10
Air purifying full facepiece with cartridge and/or high efficiency filter	50
Supplied air equipped with full facepiece and operated in pressure demand or other positive pressure mode	2000
Self contained breathing apparatus with tight fitting facepiece and operated in pressure demand mode	10,000

[1]For respirators not listed in this table, contact corporate health and safety for assistance in determining APFs.

Exhibit 4 – Respirator Cleaning Procedure

- Remove cartridges/canisters/filters. Disassemble facepiece by removing speaking diaphragm, demand and pressure-demand valve assemblies, hoses, or any components recommended by the manufacturer.
- Wash components with warm (<110° F) water with a mild detergent or with a cleaner approved by the manufacturer. A soft, non-wire bristle brush may be used to facilitate dirt removal.
- Rinse with warm (<110° F) clean water, preferably running water.
- If the cleaner used does not contain a disinfecting agent, respirator components should be immersed in one of the following for two minutes:
    a. Hypochlorite solution (50 ppm chlorine) made by adding approximately 1 milliliter of laundry bleach to 1 liter of water at 110° F; or
    b. Aqueous solution of iodine (50 ppm iodine) made by adding approximately 0.8 milliliters of tincture of iodine [6-8 grams ammonium and/or potassium iodide/100 cubic centimeters (cc) of 45 percent alcohol] to one liter of water at 110° F; or
    c. Other commercially available cleansers of equivalent disinfectant quality, when used as directed by the manufacturer, and are approved for use by the respirator manufacturer.
- Thoroughly rinse the respirator components in clean, warm, (<110° F) running water.
- Components should be hand dried with a soft lint free cloth or allowed to air dry.
- Reassemble the facepiece and restore cartridges/canisters/filters as necessary.
- Test the respirator for proper working condition.

Exhibit 5 - OSHA Standards with Respiratory Protection Requirements

Compound	29 CFR
Asbestos	1910.1001
4-Nitrobiphenol	1910.1003
Alpha-Naphthylamine	1910.1004
Methyl-Chloromethyl Ether	1910.1006
3,3-Dichlorobenzidine (+ salts)	1910.1007
Bis-Chloromethyl Ether	1910.1008
Beta-Naphthylamine	1910.1009
Benzidine	1910.1010
4-Aminodiphenyl	1910.1011
Ethyleneimine	1910.1012
Beta-Propiolactone	1910.1013
2-Acetylaminofluorene	1910.1014
4-Dimethylaminoazobenzene	1910.1015
N-Nitrosodimethylamine	1910.1016
Vinyl Chloride	1910.1017
Inorganic Arsenic	1910.1018
Lead	1910.1025
Benzene	1910.1028
Coke Oven Emissions	1910.1029
Cotton Dust	1910.1043
1,2,Dibromo-3-Chloropropane	1910.1044
Acrylonitrile	1910.1045
Ethylene Oxide	1910.1047
Formaldehyde	1910.1048

Exhibit 6 – Respirator Inspection Checklist

The following is a guideline to be used when inspecting a respirator before wearing:

Head Strap

_____ attached properly to the respirator
_____ pliable, not stretched out or too stiff
_____ the rubber is not cracked or warped in anyway

Face Shield

_____ no visible cracks
_____ securely attached to the respirator
_____ not badly scratched, visibility is good
_____ there are no gouges or divots
_____ if there are screws, make sure they are securely in place

Nose Piece

_____ is securely in place
_____ contains all inhalation valves

Actual Face Seal

_____ pliable, not stiff
_____ does not contain any cracks or warped areas
_____ does not appear worn or discolored

Inhalation and Exhalation Valves

_____ are they in place
_____ they are not sealed shut
_____ pliable, not brittle

Cartridge Connectors

_____ plastic is not cracked
_____ if bayonet style, all three prongs are in place
_____ of screw-in style, it is not stripped
_____ O-ring is in place and not brittle

Speaker Diaphragm

_____ the diaphragm is not missing
_____ plastic cover is in place
_____ screw is in place and not loose

Job Loss Analysis

General

Client Name	U.S. ARMY ENVIRONMENTAL CENTER
JSA ID	4422
Job Name	Environmental-Sediment sampling
Task Description	Confirmation sediment sampling
Project Number	GP08RAAP4WBG
Project Name	WBG Response Action
PIC Name	TALELE, TUSHAR
Project Manager	WISBECK, DIANE
Status	(3) Completed
Creation Date	1/28/2011 1:30:14 PM
Auto Closed	False

User Roles

Role	Employee	Due Date	Completed	Approve	Supervisor	Active Employee
Created By	Wisbeck, Diane	2/18/2011	1/28/2011		Smith, Lee	True

Job Steps

Job Step	Job Step Description		Potential Hazard	Critical Action	HSP Reference
1	Placement of boat for sediment sampling	1	Slip/trip/falls can occur when accessing or egressing boat	Wear anti-slip footwear with ankle support. Plan route onto and off of boat, do not hurry through task.	Field H&S Handbook V(G)
		2	Clutter and equipment on boat can cause tripping hazard including location and placement of equipment cables, ropes, or chains.	Maintain good housekeeping and aisle space. Secure objects to prevent shifting or movement that could impair walkway. Keep materials clear of designated walkways, cover if practical.	Field H&S Handbook V(G)
		3	Boat can be damaged from encountering objects and other protuberances in water during boat operation	Use qualified boat operator, and use spotters if navigating in areas with shallow depths, felled trees in water or rock hazards, use depth finders as appropriate	Field H&S Handbook V(G)
		4	Muscle strains from moving vibracore components or other equipment onto or off of boat	Use proper techniques by keeping back straight, use buddy system for large or bulky items, avoid awkward twisting or stooping.	Field H&S Handbook V(G)
2	Setup/demobilize of vibracore sampling device	1	Pinch/crush hazards while erecting tripod, installing Vibracore barrel, placing spuds (if equipped).	Wear protective gloves that maintain dexterity. Identify and keep hands clear, do not hurry through task or take shortcuts,	
		2	Wet surfaces on boat can cause slipping	Wear anti-slip footwear with ankle support. Do not hurry through task. Ensure adequate illumination if working in non-daylight hours	
		3	Muscle strain from lifting barrel, tripod or moving other equipment.	Use buddy system to lift bulky objects or objects weighing more than what you are capable of lifting alone. Team lift items greater than 50 lbs.	

2	Setup/demobilize of vibracore sampling device	4	Hand injuries can be caused from rough edges on equipment, metal sheeting or during the cutting of rope	Wear protective gloves that maintain dexterity. Identify and keep hands clear, do not hurry through task or take shortcuts, take the time to correct/protect protruding or sharp edges
3	Collection of Sediment samples	1	Wet surfaces can cause slipping	Wear anti-slip footwear with ankle support. Do not hurry through task. Ensure adequate illumination if working in non-daylight hours
		2	Hand injury including cuts and lacerations can occur when extracting samples	Wear protective gloves, do not reach into nose of devices with cutting edges or teeth, do not hurry or takes shortcuts during extraction. If cutting liners, use proper tool for the job.
		3	Muscle strain can occur when lifting barrel, or large volume of sample	See above. Break sample volume down into manageable portions if large volume of sediment is collected.
		4	Chemical exposure can occur from contact with potentially impacted media	Wear protective clothing prescribed by HASP. Avoid conditions that create splashing.
4	Sediment sample management and logging	1	Awkward bending for prolong periods can cause muscle strain.	Take the time to setup preparation/logging area where neutral body positions can be maintained (work at waist height when possible) keep sample coolers and equipment out of areas that promote work to be performed in awkward positions.
		2	Hands and knees can become sore or stiff when kneeling and working with equipment for extended periods of time.	See neutral positions above, if kneeling required use knee pads or padding, do not rest body weight on hands for extended periods.
		3	Tripping hazards from equipment and IDW.	Maintain good housekeeping , keep used mixing bowls and similar devices organized and out of walkways. Keep garbage controlled and secure. Ensure sample coolers are out of designated walkways

Personal Protective Equipment

Type	Personal Protective Equipment	Description	Required
Eye Protection	safety glasses		Required
Foot Protection	boots		Required
Hand Protection	chemical resistant gloves (specify type)	nitrile	Required
Hand Protection	work gloves (specify type)	leather	Required
Hearing Protection	ear plugs		Required
Miscellaneous PPE	personal flotation device		Required

Supplies

Type	Supply	Description	Required
Communication Devices	walkie talkie		Required
Decontamination	Decon supplies (specify type)		Required
Miscellaneous	fire extinguisher		Required
Miscellaneous	first aid kit		Required
Personal	eye wash (specify type)		Required

Job Loss Analysis

General

Client Name	U.S. ARMY ENVIRONMENTAL CENTER
JSA ID	1129
Job Name	Construction-Heavy equipment operation
Task Description	Heavy Equipment Operation for Soil Excavation
Project Number	GP08RAAP4NBG
Project Name	RAAP-044 NBG INTERIM REMOVAL ACTION
PIC Name	TALELE, TUSHAR
Project Manager	WISBECK, DIANE
Status Name	(3) Completed
Cretaion Date	11/12/2009 08:44:30 AM

User Roles

Role	Employee	Due Date	Completed	Approve	Supervisor	Active
Created By	Kalinowski, Christopher	12/3/2009	11/12/2009		Bertz, Charles	True

Job Steps

Job Step	Job Step Description		Potential Hazard	Critical Action	HSP Reference
1	Loading and Unloading Equipment from transport vehicles.	1	Stake or impact hazards from moving equipment	Stand clear of equipment loading or unloading form transport vehicles	FHSHB Section IV (E); ARCHSF019, FHSHB Section III(MM)
		2	Equipment damage from improper removal or placement on vehicle	Ensure any ramps used are rated for weight and properly placed and secure prior to moving equipment across, ensure trailers being loaded or unloaded are properly secured against movement.	FHSHB Section IV (E); ARCHSF019, FHSHB Section III(MM)
		3	Overhead utility contact for equipment with booms or extensions	Plan position of transport vehicle to maintain safe distance (>20 ft) from all overhead lines and structures, Use spotters since operator focus may be on vehicle alignment with ramps or other ground level distractions.	FHSHB Section IV (E); ARCHSF019, FHSHB Section III(MM)
		4	Ascending/Descending equipment cab.	Do not hurry through task, wear footwear with good tread and ankle support, maintain 3 points of contact while accessing or egress equipment, no jumping off trailers or truck beds.	FHSHB Section IV (E); ARCHSF019, FHSHB Section III(MM)
2	Pre-operation inspection	1	Pinch hazards to hands	Wear gloves appropriate for hazard while maintaining dexterity. Keep hand in field of vision and watch for and keep hands clear of obvious hazards like door or cover closures. Do not hurry during the removal or placement of covers or equipment components.	
		2	Head injury from striking equipment covers or components	Wear hard hat, stay focused on surroundings, avoid standing or raising up suddenly especially if door cover is overhead.	

Job Step	Job Step Description		Potential Hazard	Critical Action	HSP Reference
		3	Exposure to engine fluids or lubricants	Wear protective gloves, ensure MSDS is available for engine fluids and lubricants, promptly wash exposed skin, contact WorkCare immediately for any situation where diesel is injected under the skin.	
		4	Awkward body positions and twisting	Plan inspection activity and do not hurry through task, stretch before crawling or squatting. Avoid overreaching.	
		5	Entanglement in equipment components.	Do not circumvent protective guards or shields, ensure equipment is not operational (LOTO if necessary) when accessing engine compartment if intrusion required.	
3	Equipment operation	1	Strike or impact hazards with other workers, equipment or structures.	Keep eyes moving and watch for unanticipated worker movement. Keep workers 15 ft from any extendable area of the equipment, Maintain 360 degrees of awareness and ensure adequate communication method with other workers. All workers to know emergency STOP hand signals. all back up alarms to be functional.	
		2	Utility contact (subsurface or above ground)	Follow utility clearance procedure prior to any intrusive work with equipment. Immediately stop work if any unusual or unanticipated condition encountered.	
		3	Rollovers on slopes or from improper usage	Follow equipment manufacturer instructions for use on slopes or load capacities, wear seatbelt at all times, Ensure all outriggers, if equipped are properly deployed on stable surface.	
		4	Noise from engine or work activity	Wear hearing protection as required, keep equipment well maintained.	
		5	Slips and falls from accessing or egress from equipment	Maintain 3 points of contact when access or egress equipment, keep any ladder or steps on equipment clean and dry to extent practical, ensure equipment doors, if present, are in good working order.	
		6	Exposure to tools and metal edges and damaged metal resulting in cuts lacerations to hands during maintenance	Wear protective gloves that allow for good dexterity. Mitigate sharp surfaces to extent practical.	
		7	Pinch/crush hazards to hands from doors or covers	wear gloves appropriate for hazard while maintaining dexterity, Watch for and keep hands clear of obvious hazards like door or cover closures. Do not hurry during the removal or placement of covers or equipment components.	

Job Step	Job Step Description		Potential Hazard	Critical Action	HSP Reference
		8	Contact stress to knees and hands	Use padding or knee pads if kneeling on hard surfaces for an extended period of time. Avoid placing weight on hands for extended periods of time.	
4	Maintenance	1	Awkward body positions and twisting	Plan inspection activity and do not hurry through task, stretch before crawling or squatting. Avoid overreaching.	
		2	Excessive force turning bolts or lifting heavy components, decontamination activities.	Use automated methods to loosen tight bolts, do not use excessive force or torque when using hand tools. Do not use "cheater bars"	
		3	Contact with engine fluids or lubricants	Wear protective gloves, ensure MSDS is available for engine fluids and lubricants, promptly wash exposed skin, contact WorkCare immediately for any situation where diesel is injected under the skin.	
		4	Flying debris during gross decontamination or cleaning activities	Wear adequate eye and face protection when removing soils or solid media form tracks, buckets, or other component of equipment using pressure washer.	
		5	Entanglement in equipment components.	Do not circumvent protective guards or shields, ensure equipment is not operational (LOTO if necessary) when accessing engine compartment if intrusion required.	
		6	Exposure of hands and arms to hot engine components	Take the time to allow the engine to cool, wear protective gloves and forearm protection.	
		7	Struck by moving equipment or boom extensions	Keep at least 15 ft from any extendable area of the equipment, if entering within 15 ft, establish and maintain contact with equipment operator, ear high visibility clothing or work vest.	
5	Working in proximity to heavy equipment	1	Equipment damage from moving equipment	Keep other equipment not required for work outside of heavy equipment work area in all directions. Flag or mark with high visibility markings, cones, etc., any required equipment near the ground	
		2	Noise hazards from equipment operation	Wear hearing protection and increase distance if work activity permits.	

Personal Protective Equipment

Type	Personal Protective Equipment	Description	Required
Eye Protection	safety glasses		Required
Foot Protection	steel-toe boots		Required
Hand Protection	work gloves (specify type)		Required
Head Protection	hard hat		Required
Hearing Protection	ear plugs	as needed	Recommended

Supplies

Type	Supply	Description	Required
Miscellaneous	fire extinguisher		Required
Miscellaneous	first aid kit		Required
Personal	eye wash (specify type)		Required

ARCADIS

JOB SAFETY ANALYSIS

SECTION 1

JSA Type:	Field Work
JSA No:	JSA001405
Date:	4/11/2008
Work Type:	Environmental - Decontamination of Large Equipment
Work Activity:	
Project No.:	GP08RAAPC000 - AEC/ RADFORD ARMY AMMUNITION PLANT PBC (AEC/ RADFORD ARMY AMMUNITION PLANT PBC)

SECTION 2

Development Team	Position/Title	PC	Reviewed By	Position/Title	Date

SECTION 3

Job Steps	Potential Hazard (s)	Critical Action(s)	SOP Reference
Decontamination procedures will be implemented for all non-disposal equipment (e.g., Macro core sampler, hand trowels, splitspoons, etc.).	Inhalation and absorption of decon fluids, slips/trips/falls, hand/eye/foot injuries (cuts), lifting hazards (sprains/strains).	Utilize appropriate PPE. Handle equipment carefully. Use proper decontamination techniques as per the sampling task (soil, surface water, groundwater investigations). Use squirt bottles instead of spray bottles to eliminate mists from solvents. Use caution if walking on wet plastic sheeting and establish decontamination boundaries to keep unauthorized personnel away from area.	
Decontamination of large equipment and vehicles.	Inhalation and absorption of wash fluids, slips/trips/falls, hand/eye/foot injuries (cuts), lifting hazards (sprains/strains).	Utilize appropriate PPE with splash shield. Handle equipment carefully. Use proper decontamination techniques as per the sampling task. Caution using high pressure washing equipment and steam cleaners with the hot surfaces and water jet blast of sprayer. Check decon. area for uneven surfaces and keep eye contact with drivers when moving vehicles in and out of the decon. pad. Use caution if walking on wet plastic sheeting and establish decontamination boundaries to keep unauthorized personnel away from area.	

SECTION 4
Personal Protective Equipment (PPE):
Hard Hat
Level D
Protective Gloves - Type dependent on job-specific requirements
Safety Glasses
Safety Shoes
Required and/or Recommended Equipment and Supplies:

Initial - In Progress - 04/14/2008 12:03 PM EST

ARCADIS

JOB SAFETY ANALYSIS

SECTION 1

JSA Type:	Field Work
JSA No:	JSA001406
Date:	4/11/2008
Work Type:	Environmental - Decontamination of Small Sampling Equipment
Work Activity:	Decontamination of Field Equipment
Project No.:	GP08RAAPC000 - AEC/ RADFORD ARMY AMMUNITION PLANT PBC (AEC/ RADFORD ARMY AMMUNITION PLANT PBC)

SECTION 2

Development Team	Position/Title	PC	Reviewed By	Position/Title	Date

SECTION 3

Job Steps	Potential Hazard (s)	Critical Action(s)	SOP Reference
Prepare decontamination area	Selection of appropriate decontamination area; site hazards; back strains; slips, trips, and falls	Situate decontamination area in a location designated by the site supervisor or health and safety supervisor; check the decontamination area for uneven surfaces. Utilize appropriate PPE including work boots and leather work gloves.	
Decontamination of small, non-disposable, sampling equipment (e.g., parastaltic pump, YSI, submersible pump, turbidy meter, hand auger, trowels, etc.)	Ingestion, inhalation, and absorption of decontamination fluids; slips, trips, and falls; hand, eye, and foot injuries (cuts); lifting hazards; sprains and strains	Perform decontamination activities in an area designed to prevent spillage or leakage of decontamination fluids. Utilize appropriate PPE. Handle equipment carefully using correct bending and lifting techniques. Use proper decontamination techniques as per the sampling task. Use caution if walking on wet plastic sheeting. Establish decontamination boundaries to keep unauthorized personnel away from area.	
Decontamination of large sampling equipment	Ingestion, inhalation, and absorption of decontamination fluids; slips, trips, and falls; hand, eye, and foot injuries (cuts); lifting hazards; sprains and strains	Perform decontamination activities in an area designed to prevent spillage or leakage of decontamination fluids. Utilize appropriate PPE with a splash shield. Handle equipment carefully using correct bending and lifting techniques. Use proper decontamination techniques as per the sampling task. Use caution while working with high pressure washing equipment including avoiding the hot surfaces of steam cleaners and water jet blast of sprayers. Use caution if walking on wet plastic sheeting. Establish decontamination boundaries to keep unauthorized personnel away from area.	

Collection of decontamination fluids	Spillage of decontamination fluids	Utilize nitrile gloves. Handle equipment and containers carefully. Material Safety Data Sheets, absorbent materials, an eye wash station, and a first aid kit will be available.	

SECTION 4

Personal Protective Equipment (PPE):

Hard Hat

Level D

Protective Gloves - nitrile, leather

Safety Glasses

Safety Shoes

Required and/or Recommended Equipment and Supplies:
Company identification card and FRA Training card must be kept on site at all times
CSXT Contractor handbook must be kept on site at all times
DI water, Isopropyl alcohol, Water/Liquinox mixture
ANSI Level II Vest
Sunscreen
Insect repellant
2-way radio/cell phones
First Aid Kit
Rain gear/ inclement weather clothing

Initial - In Progress - 04/14/2008 12:06 PM EST

Job Loss Analysis

General

Client Name	U.S. ARMY ENVIRONMENTAL CENTER
JSA ID	1131
Job Name	General Industry-Site clearing (tree/brush/vegetation) removal
Task Description	Site Clearing Prior to Excavation
Project Number	GP08RAAP4NBG
Project Name	RAAP-044 NBG INTERIM REMOVAL ACTION
PIC Name	TALELE, TUSHAR
Project Manager	WISBECK, DIANE
Status Name	(3) Completed
Cretaion Date	11/12/2009 08:54:05 AM

User Roles

Role	Employee	Due Date	Completed	Approve	Supervisor	Active
Created By	Kalinowski, Christopher	12/3/2009	11/12/2009		Bertz, Charles	True

Job Steps

Job Step	Job Step Description		Potential Hazard	Critical Action	HSP Reference
1	Prepping equipment for clearing activities	1	Improperly maintained tools and equipment increase risk for injury to workers using tools/equipment	Maintain tools and equipment according to manufacturer recommendations, including proper oiling and inspection of tool/equipment. Ensure cutting blades are sharp.	
		2	Cuts to hands, fingers, forearms from sharpening tool/equipment blades	Wear protective gloves suitable for the tool/device being sharpened, use proper sharpening techniques and do not hurry through the sharpening process.	
		3	Falls accessing from egressing from large equipment like tractors or bulldozers	Always use 3 points of contact when access/egressing large heavy equipment. Never attempt to access/egress form moving equipment, wear footwear with good anti-slip tread and ankle support, keep mud off of stepping surfaces. Promptly affix seatbelt when sitting in seat.	
		4	Exposure to fuel during refueling activities	Wear protective gloves during refueling activities, avoid breathing fuel vapors by standing in up wind position when practical, promptly wash exposed skin or clothing.	
2	Clearing large brush/trees with heavy equipment	1	Struck by vegetation under tension during clearing	Stand at least 100 ft from clearing activity. Keep unnecessary workers away from clearing activity in all directions.	

		2	Trip fall hazards on uneven ground surfaces	Plan route and avoid walking over down trees and into vegetation where ground surface can not be seen. Wear footwear with good tread and ankle support, don't carry tools in a manner that can obstruct vision of ground	
		3	Slip or trip on muddy or sloped surfaces	Plan route, wear footwear as above, keep hands out of pockets to balance and brace falls,	
		4	Contact with poisonous or physically damaging plants	Identify and avoid contact, if brush containing poisonous plants being burned, do not stand down wind and inhale smoke, wear long pants and long sleeve shirt, in heavy briar infested areas requiring walking, wear briar chaps.	
		5	Contact with poisonous or biting insects	Watch for and avoid hazardous insects, keep cab doors closed, if equipped, to reduce exposure potential.	
		6	Struck by falling trees or large brush	Keep clear of planned fall direction, assume tree can fall in any direction and keep clear in all fall directions	
3	Clearing large brush/trees with hand tools/chainsaws	1	Cuts to arms, legs, hands from cutting tools or chainsaw	Wear protective gloves. When using chainsaw, using chainsaw chaps and helmet equipped with face shield. When using manual tools cut away form body, maintain large distance between workers using hand tools or chainsaw. When using chainsaws, don't reach over running saw, saw over head height, use saw in low visibility situations, use chainsaws on ladders or use one handed.	
		2	Physical stresses from repetitive motion or excessive push/pulling during clearing	Use job or task rotation or frequent rest breaks. Don't use excessive force pulling or pushing on vegetation.	
		3	Scrapes, cuts to skin from vegetation	Wear protective gloves, long pants and long sleeve shirt. Wear briar chaps in thorny vegetation.	
		4	Noise form chainsaws	Wear hearing protection, keep unnecessary workers away form sawing activity	
4	Clearing small brush/tall grass with mowers/bush hogs	1	Struck by flying debris form mowing activity	Keep unnecessary worker 100 ft form mowing activities	
		2	Foot hazards from slipping into cutting blades using walk behind mowers	Do not remove and promptly repair guards that reduce potential for foot entry into blade housing of mowers. Plan mowing to reduce situations that increase risk of foot slippage towards mower housing, wear steel toe boots with good tread	
		3	Noise from mowing activitie	Wear hearing protection	

5	Using wood chippers	1	Struck by debris being chipped or chips emanating form the chipper	Stand clear of material being drawn into the chipper, stand to the side of the chipper table during vegetation entry. Maintain swinging baffles that prevent throwback of material.	
		2	Cuts/amputation of hands/arm inserting brush into chipper	Only use chippers with a 36 inch or more feed throw at from the cutting knives. Never place hand, feet on top the feed table of the chipper wear protective gloves.	
		3	Noise from chipping activity.	Wear hearting protection	
		4	Injury caused form unplanned movement of chipper.	Chock tires of chipper when operating.	
6	Using herbicides	1	Worker exposure to herbicide during mixing or application.	Follow manufacturer mixing and application instructions, review product MSDS for additional hazards or PPE requirements, wear impermeable gloves and clothing during mixing and application, promptly wash any skin exposed to herbicide, wear safety goggles and face shield during mixing and application	
		2	Fatigue and physical stresses form carrying hand applicator for prolonged period of time.	Use job or task rotation to reduce fatigue. For applicators carried by hand, switch hands periodically, opt for backpack versions of applicators when possible.	

Personal Protective Equipment

Type	Personal Protective Equipment	Description	Required
Dermal Protection	coveralls	when using herbicides	Required
Eye Protection	faceshield	when using herbicides	Required
Eye Protection	safety glasses		Required
Eye Protection	safety goggles	when using herbicides	Required
Foot Protection	steel-toe boots		Required
Hand Protection	work gloves (specify type)	leather	Required
Head Protection	hard hat		Required
Hearing Protection	ear plugs		Required
Miscellaneous PPE	other	chainsaw chaps	Required

Supplies

Type	Supply	Description	Required
Communication Devices	mobile phone		Required
Miscellaneous	fire extinguisher		Required
Miscellaneous	first aid kit		Required

Job Loss Analysis

General

Client Name	U.S. ARMY ENVIRONMENTAL CENTER
JSA ID	1191
Job Name	Construction-Excavation and trenching
Task Description	Truck Loading for Radford NBG Removal Action
Project Number	GP08RAAP4NBG
Project Name	RAAP-044 NBG INTERIM REMOVAL ACTION
PIC Name	TALELE, TUSHAR
Project Manager	WISBECK, DIANE
Status Name	(2) Review
Cretaion Date	12/2/2009 08:28:58 AM

User Roles

Role	Employee	Due Date	Completed	Approve	Supervisor	Active
Created By	Kalinowski, Christopher	12/2/2009	12/2/2009		Bertz, Charles	True
Developer (Primary Contact)	Kalinowski, Christopher	12/2/2009	12/2/2009		Bertz, Charles	True
HASP Reviewer	Powell, Jace'que	12/16/2009			Mosher, Tyler	True

Job Steps

Job Step	Job Step Description	Potential Hazard	Critical Action	HSP Reference
1	Evaluate work area prior to initiating excavation or truck loading activities and identify overhead and underground utilities.	1 Ovehead and underground utilities can be encountered during excavation or truck loading activities causing injury to personnel and/or damage to equipment and property.	Follow the ARCADIS Utility Location H&S procedure and complete the Underground /Overhead Utilities Checklist. use Local site contacts to assist with utility location.	ARCHSFS019
2	Set up truck loading and decontamination areas.	1 Damage to excavation equipment, dump trucks or other property.	Make sure loading area is free of obstructions and that the loading area is secured to prevent unauthorized access. Make sure excavation equipment can easily place load in trucks.	
		2 Contamination of unimpacted areas.	If possible set up truck decontamination pad within or close to excavation. Lay down plastic to prevent debris falling off truck from contacting unimpacted areas. Remove all loose debris from trucks and equipment prior to leaving decontamiation area.	
3	Perform excavation activities and direct load trucks using mechanical equipment.	1 Contamination of unimpacted areas.	Direct load the excavation material onto dump trucks for off-site disposal. Do not stockpile soil in areas outside the excavation footprint.	
		2 Workers could be exposed to dust during excavation activities.	Use a dust monitor to evaluate dust levels. If necessary wet the soils to prevent dust from blowing. Workers should wear dust masks to minimize dust inhalation. Safety glasses should be worn per HASP.	

4	Decontaminate trucks and equipment.	1	Contaminants could be spread to unimpacted areas on-site or off-site.	Remove all loose debris on trucks and equipment in specified decontamination area. Cover load prior to departing site.	
		2	Moving trucks and equipment.	Make sure trucks and equipment are in park with parking break on during decontamination to prevent risk of decon workers being hit by moving vehicles.	
5	Transport waste to off site disposal facility.	1	Traffic hazards	utilize safe driving practices and follow all traffic regulations.	
		2	Spills/Releases during transport.	In the event of a spill or release during transport to the disposal facility, follow transporters spill contingency plan. follow all notification requirements.	

Personal Protective Equipment

Type	Personal Protective Equipment	Description	Required
Dermal Protection	coveralls		Recommended
Dermal Protection	long sleeve shirt/pants		Recommended
Eye Protection	safety glasses		Required
Eye Protection	safety goggles		Recommended
Foot Protection	boots		Required
Foot Protection	steel-toe boots		Required
Hand Protection	chemical resistant gloves (specify type)	Nitrile	Required
Hand Protection	work gloves (specify type)	Leather	Recommended
Head Protection	hard hat		Required
Respiratory Protection	dust mask		Recommended

Supplies

Type	Supply	Description	Required
Communication Devices	mobile phone		Required
Decontamination	Decon supplies (specify type)		Required
Miscellaneous	fire extinguisher		Required
Miscellaneous	first aid kit		Required
Personal	insect repellant		Recommended
Personal	sunscreen		Recommended

Appendix B

Quality Assurance Plan Addendum

(Provided on CD)

Imagine the result

US Army Corps of Engineers
Baltimore District

INTERNAL DRAFT

QUALITY ASSURANCE PLAN ADDENDUM

PERFORMANCE BASED PROJECT (PBC)

Prepared for:

Radford Army Ammunition Plant

APRIL 2008

ARCADIS
Infrastructure, environment, facilities

INTERNAL DRAFT

Quality Assurance Plan Addendum Performance Based Contract (PBC)

Radford Army Ammunition Plant,
Radford, Virginia

April 2008

Jane Kennedy
Project Chemist

Kurt Beil
Quality Assurance Manager

Tim Llewellyn
Project Manager

Quality Assurance Plan Addendum
Performance Based Contract (PBC)

Radford Army Ammunition Plant,
Radford, Virginia

ENVIRONMENT

Prepared for:
Radford Army Ammunition Plant

Prepared by:
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Our Ref.:
GP08RAAP.C000.CC008

Date:
April 14, 2008

Title and Approval Page

Site Name/Project Name: Radford Army Ammunition Plant
Site Location: Radford, Virginia

Quality Assurance Plan Addendum for PBC2

Document Title

USEPA Region III and Virginia Department of Environmental Quality

Lead Organization

Jane Kennedy, ARCADIS

Preparer's Name and Organizational Affiliation

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Preparer's Address, Telephone Number, and E-mail Address

April 15, 2008

Preparation Date (Day/Month/Year)

Approval Signatures

Contract Officers Representative: _____
Signature

Tom Meyer/ US Army Corps of Engineers
April 15, 2008
Printed Name/Organization/Date

VDEQ Federal Facilities Project Manager: _____
Signature

Jim Cutler / VDEQ /April 15, 2008
Printed Name/Organization/Date

USEPA RCRA Project Manager: _____
Signature

William Geiger / USEPA Region 3 / April 15, 2008
Printed Name/Organization/Date

ATK Environmental Lead: _____
Signature

Jerome Redder / ATK / April, 2008
Printed Name/Title/Date

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List of Acronyms and Abbreviations

ATK	Alliant Techsystems
ASTM	American Society of Testing Materials
BDDT	Building Debris Disposal Trench
BLA	Bag Loading Area
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CLP	Contract Laboratory Program
COC	Chain-of-Custody
COD	Chemical Oxygen Demand
DOD	Department of Defense
DQO	Data Quality Objective
EDD	Electronic Data Deliverable
EQuIS	Environmental Quality Information Systems
FHSO	Field Health and Safety Officer
FRA	Field Readiness Assessment
ft	Feet
g	Gram
GC	Gas Chromatography
GO/CO	Government-Owned Contractor-Operated
GW	Groundwater
HSA	Horseshoe Area
HASP	Health and Safety Plan
HSPA	Health and Safety Plan Addendum
HSWA	Hazardous and Solid Waste Amendments
IAA	Igniter Assembly Area
ICP	Inductively Coupled Plasma

List of Acronyms and Abbreviations Continued

IRP	Installation Restoration Program
MCL	Maximum Contaminant Level
MDL	Method Detection Limit
MHSP	Master Health and Safety Plan
MMA	Main Manufacturing Area
MQAP	Master Quality Assurance Plan
MS/MSD	Matrix Spike/Matrix Spike Duplicate
MW	Monitoring Well
MWP	Master Work Plan
NBG	Northern Burning Ground
NCP	Natural Oil and Hazardous Substances Contingency Plan
NELAP	National Environmental Laboratory Accreditation Program
NFA	No Further Action
NFG	National Functional Guidelines
NIST	National Institute of Standards and Technology
NRU	New River Unit
PBC	Performance Based Contract
PM	Project Manager
PMP	Project Manager Plan
QA	Quality Assurance
QC	Quality Control
QA/QC	Quality Assurance/Quality Control
QAM	Quality Assurance Manual
QAP	Quality Assurance Plan
QAPA	Quality Assurance Plan Addendum
R	Rinse Blank

List of Acronyms and Abbreviations Continued

RAAP	Radford Army Ammunition Plant
RBC	Risk-Based Concentration
RCRA	Resource Conservation and Recovery Act
RFI	RCRA Facility Investigation
RL	Reporting Limit
RY	Rail Yard
SARA	Superfund Amendments and Reauthorization Act
SOP	Standard Operating Procedure
SVOC	Semi-volatile Organic Compound
SWMU	Solid Waste Management Unit
TB	Trip Blank
TAL	Target Analyte List
TCE	Trichloroethene
TCL	Target Compound List
TM	Task Manager
TNT	Trinitrotoluene
TOC	Total Organic Carbon
TSDF	Treatment, Storage, and Disposal Facility
USEPA	United States Environmental Protection Agency
VDEQ	Virginia Department of Environmental Quality
VPDES	Virginia Permitted Discharge Elimination System
VOC	Volatile Organic Compound
WBG	Western Burning Ground

Quality Assurance Plan Addendum
Performance Based Contract (PBC)

Radford Army Ammuntition Plant, Radford, Virginia

1. Introduction and Background

This Quality Assurance Plan Addendum (QAPA) describes the project background and quality assurance (QA) mechanisms that will be implemented to ensure that usable data will be generated during the project execution for the Performance Based Contract (PBC) awarded to ARCADIS associated with the environmental restoration program at Radford Army Ammunition Plant (RAAP) Radford, Virginia. Work will be conducted under contract W91ZLK-05-D-0015: Task 0002. This is the second PBC contract awarded for RAAP, and is thus referred to as PBC2.

This Quality Assurance Plan Addendum (QAPA) is prepared in conjunction with the Master Work Plan (MWP) and the Master Quality Assurance Plan (MQAP) to address the PBC2 specific responsibilities and authorities that will be implemented during supplemental investigative and remediation activities. The project objectives will be met through the execution of the Standard Operating Procedure (SOP) included in the MWP, or as appended to this document and site, or area specific work plans.

The Installation Restoration Program (IRP) activities at RAAP operate in accordance with the provisions of the Resource Conservation and Recovery Act (RCRA) as amended by the Hazardous and Solid Waste Amendments (HSWA) of 1984 at the Main Manufacturing Area (MMA), and the requirements of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) as amended by the Superfund Amendments and Reauthorization Act (SARA), and the Natural Oil and Hazardous Substances Contingency Plan (NCP) at the New River Unit (NRU). The U.S. Environmental Protection Agency (USEPA) issued a final Hazardous Waste Management Permit – Part II (Part II Permit) to RAAP in September 2000. This permit addresses the corrective action requirements for all Solid and Hazardous Waste Management Units (SWMUs) at RAAP.

1.1 Project Scope and History

This QAPA supports the environmental restoration of RAAP sites identified in the PBC2 contract. The goal of this PBC is to meet the requirements for all sites, as defined in the contract and summarized in the Project Management Plan (PMP) (ARCADIS, 2008). The full scope of services for this contract is defined in PBC2. All work performed under this contract will be consistent with all applicable regulatory requirements, and relevant Department of Defense (DoD) and Army policy.

1.2 Site Location and History

The MMA is an industrial area with ongoing propellant manufacturing operations. The MMA is regulated under a RCRA permit finalized in 2000, to be renegotiated in 2010. The MMA areas addressed in this Project Management Plan (PMP) include two distinct sites, SWMU 31 (RAAP-026) and RAAP-031, and two related sites, RAAP-042 and -047. Sites RAAP-042 and -047 are related by a persistent, low-level trichloroethene (TCE) groundwater (GW) plume from an unsubstantiated source. RAAP-042 is a closed surface impoundment measuring approximately 100 ft x 150 ft. The impoundment (HWMU #5) was first used in 1970. It was unlined until 1981, when a liner was added. It was taken out of operation in 1986 and closed in 1989. During operation, the impoundment received storm water runoff, spill and washdown water from the neutralization from the acid tank farm (nitric and sulfuric acids). Before 1983, some wastewater also contained nitrocellulose. RAAP-047 is a high-security active manufacturing section of the South Bank MMA. The area is on a river terrace which slopes northward down toward the New River. The river is greater than 3,000 feet away and approximately 100 to 150 ft lower in elevation.

SWMU-31 (RAAP-026) is located in the MMA, in the northwest section of the HSA. The New River flows from northeast to southwest along the northern boundary of SWMU-31. The site consists of three connected, unlined settling lagoons which accepted effluent from Power House No. 2 until the 1980s. The lagoons are presently operational, accepting effluent from the water treatment plant. The effluent consists of overflow from drinking water settling tanks and backwash from filter cleaning. The lagoons are arranged sequentially, with the primary lagoon directly accepting effluent and subsequently discharging to the secondary and tertiary lagoons. Effluent from the secondary and tertiary lagoons is regulated under a Virginia Permitted Discharge Elimination System (VPDES) permit. RAAP-031 consists of 0.045 acres located near the nitrocellulose A-line production area. A shallow concrete ditch approximately 2-ft wide runs through the site at the base of a grassy bank.

The NRU comprises more than 2,800 acres and is located approximately 6 miles from the MMA. An initial phase of remedial investigation has been completed at the site, which led to the identification of six individual areas within the greater unit requiring additional characterization and possible remediation: the Building Debris Disposal Trench (BDDT), the Bag Loading Area (BLA); the Igniter Assembly Area (IAA), the Rail Yard (RY), the Northern Burning Ground (NBG), and the Western Burning Ground (WBG). These six sites span an area of approximately 800 acres. The NRU is

managed under CERCLA, which allows for consideration of the NRU as one site with six internal areas of concern.

1.3 Status of Environmental Restoration Program

Remediation at the MMA is being conducted pursuant to RCRA Corrective Action requirements with regulatory coordination, as appropriate, with the Virginia Department of Environmental Quality (VDEQ) and the USEPA Region III. The Commonwealth of Virginia received RCRA corrective action authority in 2000 but in conjunction with the USEPA-State corrective action transition process, remediation is currently being coordinated consistent with the Permit for Corrective Action and Waste Minimization pursuant to RCRA as amended by the Hazardous Waste and Solid Waste Amendments of 1984 issued in September 2000 by USEPA (Permit Number VA1210020730). This permit will be renegotiated with VDEQ in 2010, at which time the contractor will be required to comply with the new permit. RAAP has separate permits issued by the Commonwealth of Virginia that manage the treatment, storage, and disposal facility (TSDF) operations pertaining to RCRA Subtitle C, D, and Subpart X. The Commonwealth of Virginia has also issued a post-closure care permit for closed HWMUs listed in the RCRA operating permit.

Work is being conducted at the NRU under CERCLA with the VDEQ in the lead regulatory role and the U.S. Army as the lead Federal Agency.

2. Master Quality Assurance Plan

The MQAP was prepared as a site-wide planning document (URS, 2003). The QAPA is designed to be used in conjunction with the MQAP for work conducted by ARCADIS. It specifies field and laboratory procedures that will be used in support of the investigation, delineation, and remediation activities. This document has been prepared in accordance with USEPA *Requirements for Quality Assurance Project Plans for Environmental Data Operations*, EPA QA/R-5 (March 2001); *Guidance for Quality Assurance Project Plans*, EPA QA/G-5, EPA/240/R-02/009 (December 2002); and the REGION III QAPP Preparation Checklist (USEPA Region III, 2001)

The available SOPs previously published in are listed in Table 2-1. Specific quality control (QC) requirements include development of Data Quality Objectives (DQOs), performance of internal QC checks, and execution of appropriate analytical procedures during investigative and remedial activities are presented herein.

Applicable ARCADIS SOPs will be included in site specific work plan addenda. If an SOP for an activity is necessary and has not previously been referenced, the SOP will be prepared as necessary.

3. Document Distribution

The distribution list for all submittals is presented in the PMP. In addition to the standard document submittal list, the QAPA will also be provided to the entities identified below.

QAPA Supplemental Distribution List	Address
Kurt Beil, PE ARCADIS Quality Assurance Manager	ARCADIS 6 Terry Drive Suite 300 Newtown, PA 18940 Tel : 267.685.1800
Jane Kennedy ARCADIS Project Chemist	ARCADIS US 3850 N. Causeway Blvd. Suite 1600 Metairie, LA 70002 Tel: 504.832.4174
Marcia McGinnity Empirical Laboratories Project Manager	Empirical Laboratories, LLC 227 French Landing Dr. Suite 550 Nashville, TN 37228
Brandon Dunmore Air Toxics Project Manager	Air Toxics, Inc. 180-B Blue Ravine Road Folsom, CA 95630
ARCADIS Field Operations Manager	Prior to initiation of field operations

4. Project Organization and Responsibilities

4.1 Project Organization

The ARCADIS organizational chart for PBC2 is presented on Figure 4-1. The Project Manager (PM), Task Managers (TM)s, and Field Operations Managers are primarily responsible for the implementation of the QA program.

The primary USEPA and VDEQ personnel involved with this project include the following:

- William Geiger: USEPA RCRA PM - who will provide oversight and other additional duties; and

- Jim Cutler: VDEQ PM - who will provide oversight and perform other additional duties.

The specific QA responsibilities of the key ARCADIS project personnel and subcontractors are described below.

4.2 ARCADIS Staff

This section describes the roles and responsibilities of the ARCADIS project team members.

4.2.1 Project Manager

For the RAAP project, Mr. Tim Llewellyn will be the PM. Mr. Llewellyn will assign the Task Managers and oversee the implementation of all schedules and budgets. He will establish and interpret PBC2 contract policies and procedures and access appropriate ARCADIS resources in order to maintain technical quality. Mr. Llewellyn will coordinate with the ARCADIS Federal Programs Manager (Ms. Lee Ann Smith) and ARCADIS Technical Advisors on issues that impact the overall quality of ARCADIS' performance on the contract.

The PM is responsible for distributing documents to the U.S. Army, USEPA, VDEQ, and Task Managers who in turn distribute it to the appropriate technical staff. Additional information regarding responsibilities of the PM is provided in the PMP.

4.2.2 Deputy Project Manager

Ms. Diane Wisbeck will support the PM in contract management as well as task implementation, document preparation, personnel coordination, and budget management. Ms. Wisbeck will perform a key role in ensuring compliance with quality performance objectives. She will identify required resources and initiate acquisition of appropriate assets to complete project requirements. She will coordinate operations to ensure compliance with the project schedules. Ms. Wisbeck with also track project budges assist with quality program implementation and coordinate document preparation and submittal.

4.2.3 Task Project Managers

The Task Managers (TMs) will be responsible for the overall quality of work performed under PBC2 as it relates to the following specific roles:

- Overseeing day-to-day of task performance including all technical and administrative operations;
- Performing assessment and oversight duties as described in the PMP, MQAP and QAPA;
- Selecting and monitoring technical staff;
- Managing the development of area specific Work Plans;
- Reviewing and approving all final reports and other work products; and
- Distributing the QAPA to the ARCADIS technical staff.

TMs are as follows:

- Mr. Christopher Sharp; and
- Mr. Chris Kalinowski.

4.2.4 QA Manager

The Corporate QA Manager for the RAAP project, Mr. Kurt Beil, is responsible for oversight of all QA/QC activities. He will remain independent of day-to-day direct project involvement, but will have the responsibility for ensuring that all project and task-specific QA/QC requirements are met. He will have direct access to corporate staff, as necessary, to resolve any QA/QC problems, disputes, or deficiencies. The QA Manager's duties include:

- Reviewing and approving the QAPA and site-specific Work Plans;
- Reviewing and approving substantive changes to the QAPA and site-specific Work Plans;
- Reviewing any new work orders with the PM to determine if the QAPA requires; and
- Conducting field audits, as appropriate, in conjunction with the corporate QA office and keeping written records of those audits.

4.2.5 Health and Safety Manager

Mr. Charles Webster will serve as the project Health and Safety Manager. The Health and Safety Manager will review and internally approve the Health and Safety Plan Addendum (HSPA) that will be designed to the specific needs and operations associated with PBC2. In consultation with the PM, the Health and Safety Manager will ensure that an adequate level of personal protection exists for anticipated potential hazards for field personnel. On-site health and safety will be the responsibility of the Field Health and Safety Officer (FHSO). The FHSO will work in coordination with the PM and the project Health and Safety Manager to ensure that all activities are conducted safely and in accordance with the HSPA as well as facility requirements.

4.2.6 Project Chemist

The RAAP Project Chemist, Ms. Jane Kennedy, is responsible for data validation and verification, the generation of QC reports, and oversight of analytical laboratories. The Project Chemist's specific duties include:

- Developing the project QAPA and QA aspects of site specific Work Plans;

- Providing external review of analytical activities by performance of assessment and oversight duties as appropriate;

- Coordinating with the PM, Site TM's, and laboratory management to ensure that QA objectives appropriate to the project are set and that laboratory and field personnel are aware of these objectives;

- Reporting nonconformance with either QC criteria or QA objectives to the appropriate managers including recommending, implementing, and/or reviewing corrective actions;

- Conducting definitive analytical data evaluation and review to provide information on data limitations based on specific QC criteria; and

- Establishing that data meet the project technical, QC criteria, assessing the usability and extent of bias of data not meeting the specific technical, and quality criteria.

4.2.7 Field Operations Leaders

The Field Operations Leaders will be determined based on the specific field activities to be performed. The Field Operations Leader is responsible for coordinating the categories of work such as GW sampling, monitor well installation, well development, soil borings, and sampling. The Field Operations Leader will also be responsible for the assignment of on-site personnel and for providing technical assistance when required. The Field Operations Leader is responsible for ensuring that technical matters pertaining to the field-sampling program are addressed. He will ensure that work is being conducted as specified in the technical plans.

In addition, the Field Operations Leader is responsible for field quality assurance / quality control (QA/QC) procedures and for safety-related issues. The Field Operations Leader will coordinate all sampling activities and will ensure the availability and maintenance of all sampling materials/equipment. The Field Operations Leader or his designee will be responsible for the completion of all sampling and chain-of-custody (COC) documentation and will ensure custody of all samples is appropriately maintained.

Prior to initiation of field activities, the Field Operations Leader will utilize a copy of the MQAP and this QAPA with applicable SOPs and other project documents to conduct a

field staff orientation and briefing to acquaint project personnel with the sites and assign field responsibilities.

4.2.8 Technical Staff

The technical staff for this program will be drawn from a pool of technical resources within ARCADIS. The technical staff will implement project and site tasks, analyze data, and prepare reports/support materials. All technical personnel assigned will be experienced professionals who possess the degree of specialization and technical competence required to perform the required work effectively and efficiently. All technical staff will be familiar with the Master Health and Safety Plan (MHSP) and the ARCADIS HSPA as well as all relevant work plans, SOPs, and policies applicable to the fieldwork performed. Each field sampling team will have a copy of the HSPA, and area specific Work Plans in their possession while conducting fieldwork.

4.3 Subcontractors

4.3.1 Laboratories

Independent laboratories providing analytical services will be utilized, as appropriate, for the various project requirements including confirmation sampling, routine monitoring, and pilot/benchscale studies. Analytical chemistry laboratories shall be accredited, under the National Environmental Laboratory Accreditation Program (NELAP) for the analytical parameters required for the project for which accreditation is available through the primary accrediting state. The laboratory QA programs will be reviewed and approved by the ARCADIS Project Chemist. The laboratory will assign an experienced PM to coordinate analytical support with the project chemistry team. The laboratory staff will include a qualified QA Manager/Coordinator, who reports directly to laboratory management independently of the technical operations of the laboratory, to oversee technical adherence to the laboratory QA programs and the RAAP MQAP and QAPA. The specific duties of the laboratory PM and QA Manager/Coordinator for the RAAP analyses include:

- Reviewing the RAAP MQAP, QAPA, and area specific Work Plans to verify that analytical operations will meet project requirements as defined in the RAAP documents;

- Documenting and implementing RAAP-specific QA/QC requirements in the laboratory and reviewing analytical data (10 percent for the QA Officer) to verify the requirements were met;

- Reviewing receipt of all sample shipments and notifying the Site Manager and Project Chemist of any discrepancies within 1 day of receipt;

- Conducting internal laboratory audits to assess implementation of the laboratory Quality Assurance Manual (QAM) and procedures and providing written records of those audits;

- Rapidly notifying the Site Manager and Project Chemist regarding laboratory nonconformance with the QAPA or analytical QA/QC problems affecting RAAP samples; and

- Coordinating with the project and laboratory management to implement corrective actions as required by the MQAP, QAPA, and internal laboratory QAM.

Empirical Laboratories, LLC (Empirical) located in Nashville, TN, will be the primary laboratory performing analytical services for environmental samples collected at RAAP. Empirical will subcontract the dioxin/furan analyses to SGS Environmental Services (Wilmington, NC). Microseeps, Inc. of Pittsburgh, Pennsylvania, will perform dissolved gases analyses as required during remedial operations. Air Toxics, Inc. (Folsom, CA) will analyze soil gas samples and other air analyses that may be required for the project.

Appendix A of this QAPA includes the Empirical QAM, reporting and detection limits, and QC limits. Appendix B of this QAPA includes the Air Toxics QAM, reporting and detection limits, and QC limits. The QAMs for SGS and Microseeps are included by reference and will be maintained in the project files.

Geotechnical laboratories will be selected based on project requirements and will be identified in the site specific work plans. Selection criteria for geotechnical laboratories will be based on previous performance on ARCADIS projects or satisfactory recommendations.

4.3.2 Other Subcontractors

Other subcontractors will provide services under the direct supervision or direction of the ARCADIS PM or TMs or appropriate designated staff. The drilling, surveying, and other subcontractors are responsible for performance in accordance with the individual subcontracts and applicable portions of the QAPA as defined in each subcontract package. Subcontractors are responsible for rapidly notifying the Site Manager regarding nonconformance with the MQAP, QAPA, or QA/QC problems affecting RAAP operations. Subcontractors must coordinate with the Site Manager to implement corrective actions designated in this QAPA.

4.4 Key Points of Contact

Below are the names and points of contact for ARCADIS personnel and subcontractors.

Project Responsibility / Name / Email	Address / Telephone Number
Project Manager Tim Llewellyn Email: tim.llewellyn@arcadis-us.com	ARCADIS US 1114 Benfield Boulevard Suite A Millersville, MD 21108 Tel: 410.987.0032
Deputy Project Manager Diane Wisbeck Email: diane.wisbeck@arcadis-us.com	ARCADIS US 1114 Benfield Boulevard Suite A Millersville, MD 21108 Tel: 410.987.0032
Geology/Hydrology Joseph Quinnan, PE, PG Email: joseph.quinnan@arcadis-us.com	ARCADIS-US 10559 Citation Dr. Suite 100 Brighton, MI 48114 Tel : 810.225.1943
Health and Safety Manager Charles Webster Email: charles.webster@arcadis-us.com	ARCADIS US 6723 Towpath Rd Syracuse, NY 13214 Tel: 720.344.7200
Quality Assurance Manager Kurt Beil, PE Email: kurt.beil@arcadis-us.com	ARCADIS-US 6 Terry Dr. Suite 300 Newtown, PA 18940 Tel: 267.685.1800

Project Responsibility / Name / Email	Address / Telephone Number
Project Chemistry and Data Validation Jane Kennedy Email: jane.kennedy@arcadis-us.com	ARCADIS US 3850 N. Causeway Blvd. Suite 1600 Metairie, LA 70002 Tel: 504.832.4174
Subcontractors	
Empirical Laboratoires, LLC Marcia McGinnity Email: MMcGinnity@EmpirLabs.com	Empirical Laboratories, LLC 227 French Landing Dr. Suite 550 Nashville, TN 37228 Tel: 615.345.1115
Air Toxics, Inc. Brandon Dunmore Email: b.dunmore@airtoxics.com	Air Toxics, Inc. 180-B Blue Ravine Road Folsom, CA 95630 Tel: 916-985-1000

5. Quality Assurance Objectives

QA is defined as the overall system of activities for assuring the reliability of data produced. The site specific work plans in conjunction with the RAAP MWP and MQAP present investigative, chemical, and regulatory measures associated with the QA Objectives of the PBC2 scope. Conformance with referenced SOPs and QA protocols presented in the MQAP and this QAPA will ensure attainment of QA objectives. The overall 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. Section 3 of the MQAP presents the general QA objectives and source documents for the Levels of Concern (LOCs). This section of the QAPA addresses additional QA objectives for the PBC2.

The DQO process is a strategic planning approach to ensure environmental data is of the appropriate type, quantity, and quality for decision-making. Project-specific DQOs are included in Table 2-3 for investigative activities. The overall QA objective is to develop and implement procedures for sample and data collection, shipment, evaluation, and reporting that will allow reviewers to assess 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 DQOs Process (USEPA, 2004), and Guidance for DQOs for Hazardous Waste Sites (USEPA, 2000) formed the basis for the DQO process and development of RAAP data quality criteria and performance specifications.

DQOs will be established for each site specific work plan because the DQOs will vary across projects. A table summarizing the DQO process will be included in each work plan. Following is a summary of the seven steps that will be conducted to develop the DQOs.

1. **State the Problem:** Define the problem to focus the study. Specific activities conducted during this process step include

    a. the identification of the planning team and the primary decision-maker,

b. the statement of the problem, and

c. the identification of available resources, constraints, and deadlines.

2. **Identify the Decision:** Define the decision statement that the study will attempt to resolve. Activities conducted during this step of the process involve the following:

   a. identification of the principal study question(s), and

   b. definition of resultant alternative actions.

3. **Identify Inputs to the Decision:** Identify information inputs required for resolving the decision statement and assessing which inputs require environmental measures. This step of the process includes identification of the data that will be required to make the decision, identification of the information sources, identification of data required for establishment of study action levels, and confirmation of appropriate field sampling and analytical methods. The type of information that is needed to resolve the decision statement and the sources of this information may include the following:

   a. Risk-Based Concentration (RBCs) in the most recent version of the USEPA Region III screening standards, Federal Maximum Contaminant Levels (MCLs), and Commonwealth of Virginia Water Quality Criteria;

   b. Method Detection Limits (MDLs) and Reporting Limits (RLs) for the site chemicals of interest;

   c. Results of an examination of site use, operational history, environmental setting, GW and surface water use and characteristics, and soil exposure characteristics;

   d. Results of physical testing of soil for geotechnical properties; and

   e. Validated results of chemical analyses performed on site samples.

4. **Define the Boundaries:** Define decision statement spatial and temporal boundaries. This step specifies

a. the spatial boundary,

b. the target population characteristics, applicable geographic areas and associated homogeneous characteristics, and

c. the constraints on sample collection.

5. **Develop a Decision Rule:** Define the following:

   a. the parameters of interest,

   b. the action levels, and

   c. develop a decision rule.

6. **Specify Acceptable Limits on Decision Errors:** Specify the decision-maker's tolerable limits on decision errors. This step includes identification of**:**

   a. parameter range of interest,

   b. decision errors, and

7. **Optimize Data Design:** Identify data collection activities commensurate with data quality specifications. This final step in the process consists of:

   a. reviewing DQO outputs and existing environmental data,

   b. developing data collection design alternatives, and

   c. documentation of operational details and theoretical assumptions.

6. Sample Management

Sample management objectives will be met through adherence to the sample identification procedures (identification convention), documentation requirements, and COC procedures in the MWP.

6.1 Sample Locations, Numbers and Types

The site specific work plans will provide itemizations of the samples to be collected, sample depths (if applicable), and analytical parameters for environmental samples proposed during this investigation. Rationale for locations and types of samples with associated QC samples identified. Data use will also be defined in the specific work plans.

6.2 Sample Container, Preservation Method, and Holding Time Requirements

The volumes, containers, and preservatives required for the sampling activities are listed in Table 6-1. The laboratory will provide new, pre-cleaned sample containers. The laboratory shall use an approved specialty container supplier that prepares the containers in accordance with USEPA bottle preparation procedures. The laboratory must maintain a record of all sample bottle lot numbers shipped to RAAP in the event of a contamination problem. Trip blanks (TB) will be transported to the site inside the same cooler/box as the Volatile Organic Compound (VOC) vials.

Sample container lids will not be mixed. All sample lids must stay with the original containers as provided by the supplier. Bottle lids (with any associated bottle) exhibiting cracks, splits, or chips shall be appropriately discarded.

Pre-preserved containers obtained from the laboratory shall be used for all samples requiring preservation. Reagents used for preservation will be reagent-grade chemicals supplied by the laboratory. Each bottle received from the laboratory must be clearly labeled with the type of chemical preservative in the bottle and the test parameters that will be determined from sample collected in the container. Sample containers will not be stored at the site for longer than 30 days.

Bottle orders will be submitted to the laboratory 5 working days prior to commencement of field operations to allow supplies of clean, fresh containers and preservatives to be shipped to the facility.

Sample preservation will be verified on receipt at the laboratory with the exception of aqueous VOC samples. VOC sample preservation shall be verified prior to analysis. The preservation or pH check will be recorded on the sample receipt form or other appropriate logbook. If the samples are improperly preserved, a corrective action form will be submitted to the laboratory PM for follow-up action. The laboratory will notify the ARCADIS Field Operations Manager or Project Chemist to implement corrective actions in the field to ensure sufficient preservative is added at the time of sample collection.

Sample holding times will be based on published EPA guidance and will be calculated for the date and time of collection. A list of preservatives and holding times for each type of analysis are presented in Table 6-1. Additional preservation requirements and holding times for non-target analyses are listed in 40 Code of Federal Regulations (CFR) Part 136. Preservatives and holding times not listed in Table 6-1 applicable to a specific area will be provided in the site specific work plan.

6.3 Sample Identification

Each sample will be identified by a **unique** sample identification number in the logbook and on the COC record using an alphanumeric code. Field samples will be linked to geographic location via location codes. Where possible, location codes will link historical sample data with new data. Field samples will be identified using the following convention where historical identifications (IDs) are not available, contradict or duplicate the IDs previously used:

- Historical sampling locations/IDs will be utilized where possible to facilitate data linking.

- The SWMU, OU, Area, or Monitoring Well (MW) number in the format “SWMU##”, “OU##”. “A##”or “MW##” as based on the associated SWMU, operable unit, area or location of the sample collection point at the facility;

- GW, surface water, and sediment sample IDs will end with the date (in “mmddyy” format);

- Soil samples will end with the depth interval (in ft).

- Blind duplicate samples will be labeled sequentially, starting at 1, in the form OU##DUP01[location type code](mmddyy).

Following are some examples:

- GW Sample collected from MW 47 on June 1, 2008, would be: MW-47 (060108); and
- Surface Soil Sample 4 collected from 0 to 6 inches at SWMU 57 would be: SWMU57-SS004(0-0.5).
- General location type codes are listed below:
  - MW - monitor well or the current convention will be continued using MI, RI, PZ, etc.;
  - TW - temporary well;
  - SB - soil boring (by drilling);
  - GP - soil by direct push (or Geoprobe®);
  - SS - surface soil by trowel or other hand collection method;
  - EX - excavation;
  - SW - surface water by any collection method; and
  - SE - sediment by any collection method.

In addition to the above nomenclature, the COC will be completed to include the Sample Type and Sample Matrix using the codes defined below. Acceptable sample type codes are listed below:

- N - normal or primary sample;
- FD - field duplicate;
- EB - equipment blank; and
- TB - trip blank

The sample matrix will be identified using the following codes:

- IDM – investigation derived material;
- SO - soil sample;
- SE - sediment sample;

- WG - groundwater;
- WS - surface water;
- WT – wastewater; and
- SL - sludge.

These are the commonly used sampling codes. Additional coding will be developed as necessary to maintain electronic database integrity.

Field duplicate samples will be given a “blind” unique number that is different from the original sample while incorporating the standard sample pattern. This number with the corresponding field sample ID will be recorded in the field logbook, so that the duplicates can be identified at a later date.

Samples collected with an additional volume for matrix spike/matrix spike duplicates (MS/MSDs) will be designated on the COC in the remarks column.

Sample coolers will be identified with a unique number that will incorporate the cooler number and the date shipped to the laboratory. Cooler Number 1 for samples shipped on May 5, 2008, would be would be identified as 1-050508. The COC included in this cooler will carry the same number as the cooler.

Equipment blanks will be identified using the sample type code (i.e., EB) followed by the date as “MMDDYY” as a parenthetical statement. If more than one equipment blank is generated for a single day an alpha numeric character will be added to differentiate the blanks. For TBs, the sample code of “TB” will be followed by the cooler identification number. For example the TB associated with Cooler Number 3-050508 submitted on May 5, 2008 would be identified as TB3-050508.

COC records will be completed and shipped with the samples to the laboratories. Each COC will include the cooler number which will also identify the COC for sample tracking purposes. A copy of the COC will be retained with the field records. If samples are shipped by commercial carrier, the shipping records will be maintained in the project files with the field records.

SOP 50.1 in the MWP provides details on sample label completion.

6.4 Sample Handling and Custody Requirements

Field and laboratory personnel will, at all times, be aware of the need to maintain all samples, whether in the field or in the laboratory, under strict COC protocols and in a manner to retain physical properties and chemical composition. The following sections detail sample handling and sample custody requirements from collection to ultimate disposal.

6.4.1 Sample Handling

The transportation and handling of samples will be accomplished in a manner that not only protects the integrity of the sample, but also documents sample custody. Regulations for the packaging, marking, labeling, and shipping of hazardous materials are promulgated by the U.S. Department of Transportation (DOT) in 49 CFR 171 through 177. The procedures for sample packing and shipping in accordance with regulatory requirements are documented in the HSPA (Transportation of Hazardous Materials).

6.4.2 Sample Packaging

MWP SOP 50.2 provides information on sample packaging. This section includes addition requirements and details for PBC2.

Samples will be packaged carefully to avoid breakage or cross contamination and will be shipped to the laboratory at proper temperatures. The following general packaging guidelines will be followed in addition to the DOT requirements:

- Sample containers will generally be segregated according to sample matrix and expected contaminant concentration. Soil samples will not be shipped with water samples, and low-concentration samples will not be shipped with medium- and high-concentration samples;

- Sample bottles from specific sampling locations will be placed in the same cooler where possible;

- In cases where samples for volatile analysis will be shipped in several coolers on a single day, VOC vials may be consolidated into a single cooler to minimize the number of required TBs;

- Temperature blanks may be provided by the laboratory or prepared in the field prior to sealing coolers;

- Under no circumstances will packing material such as sawdust or sand be used;

- Custody seals will be affixed to the sample cooler in such a way as to indicate any tampering during shipment and then dated and initialed; and

6.4.3 Sample Custody

The primary objective of the COC procedures is to provide an accurate, traceable record of the possession and handling of a sample from collection through completion of all required analyses and final disposal. Formal sample custody procedures begin when sample collection is initiated. Sample identification documents will be carefully prepared so that sample identification, COC, and integrity are maintained and sample disposition controlled.

A sample is in custody if it is:

- In a sampling team member's physical possession;

- In a sampling team member's view;

- Locked in a vehicle;

- In a custody-sealed container during shipment via commercial courier; or

- Held in a secured area that is restricted to authorized personnel.

The laboratory must follow internal written and approved procedures for shipping, receiving, logging, and internally transferring samples.

6.4.3.1 Field Custody Procedures

Pre-cleaned sample containers will be shipped to RAAP or other location designated by the Field Operations Leader. The Field Operations Leader may record receipt of the sample containers in the project logbook. The following field custody procedures will be used for collection of samples:

- As few persons as possible should handle samples;

- The sample collector is personally responsible for the care and custody of samples collected until they are transferred to another person or dispatched properly under COC protocols;

- The Field Operations Leader will determine whether proper custody procedures were followed during field operations and decide if replacement samples are required.

6.4.3.2 Chain-of-Custody Record

MWP SOP 10.4 provides COC form protocols. In addition, the COC record must be fully completed by the technical staff designated by the Field Operations Manager as responsible for sample shipment to the appropriate laboratory for analysis. In addition, if samples are known to require rapid turnaround in the laboratory because of project time constraints or analytical concerns (e.g., extraction time or sample retention period limitations), the person completing the COC record should note these constraints in the "Remarks" section of the COC record. The COC record should also indicate any special preservation techniques necessary or whether the samples need to be filtered and clearly indicate field QC samples for MS/MSD, TBs, and equipment blanks. The original signed COC record accompanies the samples from the field to the laboratory where receipt is documented by appropriate signatures and dates. Copies of the COC records are maintained with the project file.

7. Documentation

Section 5.6 of the MQAP and MWPSOPs provide the primary methodology for 10.1 through 10.4 field documentation. Additional information regarding documentation and management to be employed under PBC2 are listed below.

7.1 Corrections to Field Documentation

As with all bound data logbooks, no pages will be removed for any reason. If corrections are necessary on any field documentation, they will be made by drawing a single line through the original entry (so that the original entry can still be read) and writing the corrected entry alongside it. The correction must be initialed and dated. Corrections will include an explanation footnote, as applicable.

7.2 Photographs

Photographs will be taken as directed by the team leader. Documentation by a photograph will ensure the validity as a visual representation of an existing situation. A log will be developed to track the media that the photos are filed on (e.g., compact disc, floppy disk). Photographs, as developed or transferred to electronic media, shall be compiled into a photograph log and information recorded in field notebooks added to the log with appropriate photographs. The following information will be noted in the log for digital or non-digital photographs as applicable to the media utilized for preservation:

- Date, time, location, and direction photograph was taken;
- Reasons why the photograph was taken; and
- Sequential number of the photograph and the film roll number or electronic media identification.

7.3 Laboratory Data Reporting/Record Retention

Analytical data reports for samples collected in conjunction with contaminant delineation, risk assessment, or remediation attainment verification at RAAP will include the following items and will be defined as a Level 4 Data Package. The elements of the Level 4 (CLP-like) Data Package include all of the Level 2 (defined below) components and instrument tuning, initial and continuing calibrations, raw data

associated with instrument performance and sample analysis. Level 4 reports will also contain a summary report or batch identification report clearly linking all QC results to actual field sample results. The case narrative will present an explanation of all QC results reported outside control limits and samples analyzed at dilutions where all results are non-detect. The laboratory report will include copies of any nonconformance or corrective action forms associated with data generation.

The majority of analytical data packages will be defined as a Level 2 Data Package and will not include raw or calibration data. Level 2 Data Packages for RAAP will include a fully-executed COC sample receipt checklist cross-reference table of field samples that identifies laboratory and sample number preparation and analytical batch numbers, analytical results, collection and analysis dates, RLs, dilution factors, surrogate recoveries, method blank data, laboratory control samples (LCSs), matrix spikes, laboratory replicates, laboratory control limits, and explanation of data flags, as well as a case narrative and fully executed COC.

Soils will be reported on a dry weight basis. The Reporting and (MDLs) will be corrected for percent moisture (soils only) and all dilution factors. Any compounds found less than the RL, but greater than the MDL should be reported and qualified with a “J” flag as estimated.

The laboratory will provide an electronic data deliverable (EDD) that matches all data reported on the hard copy analytical report. Electronic data report requirements are described in Section 9.3.

All records related to the analytical effort will be maintained at the laboratory or in the office (for field screening data) in access controlled areas for at least 1 year. All records will be maintained in a secure location for a period of 6 years after the final report is issued.

7.4 Electronic Data Retention

Electronic data and media retention policies will correlate with hard copy data retention at the laboratories as well as other points of electronic data generation. Additionally, electronic data must be subject to back-up routines that will enable recovery of data that may become corrupted or lost due to instrument, computer, and/or power failures. Electronic media will be stored in climate-controlled areas to minimize potential for degradation. Storage areas will be access limited.

8. Analytical Procedures

This section supplements Section 7.0 of the MQAP. Analytical methods will be USEPA approved unless non-standard methods are required to evaluate the presence of unanticipated or unusual compounds. Additional USEPA-approved methods that may be utilized are published in references listed below. The primary analytical methods anticipated to be utilized for samples collected during RAAP activities are listed in Table 6-1. The analytical methods are referenced in:

- Test Methods for Evaluating Solid Waste, Physical Chemical Methods, 3rd edition, SW-846, 1997 as amended;
- 40 CFR Part 136, Guidelines Establishing Test Procedures for the Analysis of Pollutants under the Clean Water Act;
- Standard Methods for the Examination of Water and Wastewater, APHA, AWWA, WEF, 21st Edition, 2005; and
- Methods for Chemical Analysis of Water and Wastes, EPA-600/4-79-020, Revised March 1983.

The primary parameter lists that may be reported and associated MDLs, RLs and screening standards are identified in Tables 8-1 through 8-6.

Where non-standard analytical chemistry methods are required, the Project Chemist will review performance data with the laboratory for any non-standard method prior to utilization of the procedure. The method for determination of dissolved light hydrocarbons is a non-standard method developed by Microseeps to detect very low concentrations of target compounds in groundwater. This is the only method currently anticipated that is not an EPA approved method.

Specific performance criteria, including QA protocols, for each analytical method are documented in the published methods and laboratory SOPs and the laboratory QAM. The laboratory SOPs will be examined as necessary. Note that “QAM” is a generic term for the laboratory QA document, which describes the laboratory program to ensure data of known quality are generated. The Empirical QAM is provided in Appendix A. The Air Toxics QAM is provided as Appendix B. The SGS Environmental Services (Dioxin/Furans) and Microseeps (dissolved light hydrocarbons) QAMs are included by reference to this document.

8.1 Physical/Geotechnical Analysis

Soil samples may require the determination of physical/geotechnical parameters. Analyses will be conducted for the following:

- Grain-size analysis (ASTM D 422);
- Atterberg limits (ASTM D 4318);
- Soil moisture content (ASTM D 2216);
- Total organic carbon (Walkley-Black Method);
- pH (ASTM D 4972): and
- Cation Exchange Capacity.

8.2 Instrument/Equipment Testing, Inspection, and Maintenance Requirements

Primary calibration information is presented in Section 7.0 of the MQAP. Laboratory and field instruments and equipment used for sample analysis will be serviced and maintained by qualified personnel. Procedures will be implemented to ensure that instruments are operating properly and that calibrations are correct prior to analysis and reporting of any sample parameters.

8.2.1 Field Equipment Maintenance Field Equipment Maintenance

ARCADIS primarily rents equipment as necessary to complete field operations and acquire the necessary data. All equipment will be inspected upon receipt to ensure that it is in working order. Field personnel will be familiar with the appropriate calibration and use of all rental equipment. Supplier, type of instrument, and instrument identification numbers will be recorded in the field documentation. Calibration of all rental equipment will be verified.

Additional information for Field instrumentation is included in Section 7.4 of the MQAP.

8.2.2 Laboratory Equipment Maintenance

The laboratory must maintain an adequate stock of spare parts and consumables for all analytical equipment. Routine preventive maintenance procedures should be documented in the laboratory SOPs and/or QAM. Maintenance performed on each piece of equipment must be documented in a maintenance logbook. Daily checks of the laboratory deionized water and other support systems will be performed. The laboratory will have backup instrumentation or a process in place for most of the analytical equipment to minimize potential adverse impacts on data quality due to instrument malfunction. For example, the laboratory should have duplicate instrumentation and/or maintain service agreements for rapid response with the manufacturer major laboratory instruments (e.g., GC/MS, ICP).

8.3 Instrument Calibration and Frequency

All instruments and equipment used during sampling and analysis will be operated, calibrated, and maintained according to the manufacturer's guidelines and recommendations, as well as criteria set forth in the applicable analytical methodologies and SOPs. The laboratory QAM (Appendix A) provides brief descriptions of instrument calibration procedures to be performed by the analytical laboratories. Personnel properly trained in these procedures will perform operation, calibration, and maintenance of all instruments. Documentation of all routine and special maintenance and calibration information will be maintained in an appropriate logbook or reference file and will be available for inspection. All laboratory instrument calibration is set forth in analytical method SOPs.

Field instrument calibration will be performed in accordance with the applicable SOP. Table 8-7 lists typical monitoring equipment used during fieldwork. This equipment is representative of instruments typically required for RAAP GW and field sampling operations. All field personnel receive annual refresher training on the field operation of all health and safety related equipment, which includes calibration procedures. Brief descriptions of calibration procedures for major field instruments are provided in Table 8-7. All equipment calibration performed in the field must be recorded on the field instrument calibration forms and the documentation will be retained in the project file.

8.4 Inspection/Acceptance Requirements for Supplies and Consumables

Acquisition and/or purchase of material, equipment, and services will be prepared, reviewed, and approved in accordance with the requirements laboratory SOPs or as set forth in the ARCADIS subcontracting procedures, as applicable.

8.4.1 Standard Reagent Receipt and Traceability

For analytical laboratory operations, all standards are obtained directly from USEPA or through a reliable commercial supplier with a proven record for quality, traceable standards. All commercially supplied standards must be traceable to USEPA or National Institute of Standards and Technology (NIST) reference standards, and appropriate documentation will be obtained from the supplier. The certificates will be kept on file in a central location. When standards are received, they will be documented with the following: date received, chemical, lot number, concentration, and date opened or expiration date. When standards are prepared from these source materials, information will be included in a logbook with date of preparation, lot source, amount used, final volumes, resulting concentration, and preparer's initials. Laboratory SOPs and standards/reagent records will be reviewed during laboratory audits or if QC problems arise to ensure traceability requirements are met.

For field operations, standards are primarily applicable to chemical preservatives as described in Section 6.2 and field instrument calibration solutions for pH, conductivity, and turbidity. Chemical preservatives are typically obtained from the laboratory that is responsible for maintaining the traceability records. Field instrument calibration standards are obtained from chemical suppliers and records maintained by ARCADIS.

8.4.2 Field Sampling Equipment Procedures

Field supplies and equipment will be obtained from a reputable and reliable distribution company. The Field Operations Leader will inspect all supplies and equipment upon receipt at the site to verify that the correct materials were received. ARCADIS has established a program for maintaining field equipment to ensure that the equipment is available in good working order when and where it is needed. This program consists of the following elements:

- A list of reputable and reliable equipment rental suppliers to provide additional or specialized instrumentation as necessary to meet project requirements;

- An equipment manual is obtained from the rental supplier and kept on site during field activities as a guide to calibration and maintenance;

- Field personnel are trained in the proper use and care of equipment on an as-needed basis;

- MWP and/ or ARCADIS SOPs for field instrument used will be utilized. New SOPs shall be prepared, as necessary, to encompass appropriate field activities;

- Applicable SOPs will be available to field personnel for all work performed;

- The Field Operations Leader is responsible to make sure that the equipment is tested, cleaned, charged, and calibrated in accordance with the manufacturer's instructions before being taken to the job site; and

- A calibration/maintenance log accompanies each piece of equipment and is used to identify drift in the calibration over time, which might indicate the need for replacement of sensors or factory calibration.

8.5 Field Quality Control Elements

QC components that will be used by ARCADIS during operations at RAAP are presented below and in Section 8.0 of the MQAP. The quality components include the field QC samples and the laboratory QC elements. Rinse blanks (R), TBs, and field duplicates will be collected during the acquisition of environmental samples at RAAP. Table 8-8 presents guidelines for the collection of QC samples that will be taken in conjunction with environmental sampling. Field QC acceptance criteria are summarized in Table 8-9.

Miscellaneous QC samples may also include the analysis of source water, filters, and monitor well drilling fluids (if used). Because the water supply source is used in decontamination and well drilling activities, it may be necessary to determine the possibility for the introduction of outside contaminants. Filters may be used to evaluate dissolved constituents in GW. Filter blanks will be prepared to evaluate the potential contribution of constituents of interest to the samples. Filter blanks will be collected, preserved, and analyzed in the same manner as the field samples that they represent. Drilling fluids that are used during well installation may also be analyzed in order to assess the possibility of mud constituents affecting GW samples. Miscellaneous field QC samples will be defined and discussed in the OU-Specific Work Plan.

8.6 Laboratory Quality Control Elements

The laboratory QC elements are summarized in Table 8-10. Specific laboratory analytical QC criteria and corrective actions are summarized in Tables 8-11 through 8-17.

Analytical performance is monitored through various QC samples and spikes, such as laboratory method blanks, surrogate spikes, laboratory control sample (LCS), MS/MSDs and replicate samples. All QC samples are performed on the basis of a laboratory batch. Two basic types of batches are used: the preparation batch and the analytical batch. The preparation batch includes all samples processed as a unit during organic sample preparation, metals digestion, or wet chemistry preparation. Preparation batches will not exceed 20 samples excluding associated QC samples. The analytical batch consists of all samples analyzed together in the actual analytical sequence and is also limited to a maximum of 10 or 20 samples based on the method. The QC samples associated with sample preparation include method blanks, laboratory control samples (and duplicates), and matrix spikes (and duplicates). Surrogates are introduced into samples during preparation for extractable organic constituents or prior to purging for VOCs. For some analyses, such as volatile organics, the analytical batch is equivalent to the preparation batch. The analytical sequence includes calibration standards, instrument blanks, and reference standards.

Instances may arise where elevated concentrations of target analytes/compounds, non-homogeneous samples, or matrix interferences preclude achieving the detection limits or associated QC target criteria in a specific sample. In such instances, data will be examined on a case-by-case basis during the data validation process to determine the usability of the reported values. The laboratory will report the reason for deviations from these detection limits or noncompliance with QC criteria in the case narrative. The laboratory QC samples listed below will be prepared and analyzed at the frequency presented in Table 8-18.

The laboratory-specific QC criteria are provided in appendix A (Empirical) and B (Air Topics) SGS.

Following is a discussion of each type of QC sample utilized in the analytical laboratories.

8.6.1 Laboratory Method Blank

A laboratory method blank is an analyte-free material of similar matrix processed in the same manner, in the same analytical batch, and at the same time as a project sample. The blank is prepared using American Society of Testing Materials (ASTM) Type II water when analyzing water samples and, where practical, pre-cleaned sand or other solid material, such as sodium sulfate, when analyzing solid samples. The laboratory method blank sample is prepared in the same batch with the project samples at a frequency of 1 laboratory method blank per batch of 20 (or fewer) project samples for the given matrix type. The laboratory method blanks serve to demonstrate a contamination-free environment in the laboratory, reagents, and glassware utilized in sample preparation and analysis. The goal is for method blanks to be free of contamination or at a maximum less than the RL. Low-level contamination may be present, but must be less than RLs for undiluted samples. If contaminants are present in the method blank but not in project samples, no further action is required. Where blank contamination exceeds general method guidance criteria, the laboratory shall re-prepare and re-analyze the samples or shall contact the ARCADIS Project Chemist for determination of appropriate corrective action. Qualification of constituents detected in method blanks and in associated field samples will be based on the criteria set forth in the validation section of this QAPP. All sources of contamination that are not common laboratory contaminants as defined in the method SOPs must be investigated as part of the corrective action process.

8.6.2 Surrogate Standards

For certain organic methods, all samples, including the method blanks and QC samples, are spiked with a set of specific surrogate standards to monitor the accuracy of the analytical determination. Surrogate spikes are added at the start of the laboratory preparation process. Surrogate compounds are not typically found in environmental samples. QC criteria for surrogate recoveries are method- and matrix-specific. Surrogate recoveries must be within QC limits for method blanks and LCS samples to demonstrate acceptable method performance. If surrogate recoveries are outside QC criteria for method blanks or LCS samples, corrective action is required and the Project Chemist should be notified. The percent recovery of surrogates in a specific sample provides an indication of the total accuracy of the analytical method in that specific sample only. Surrogate recoveries that are outside QC criteria for a sample indicate a potential matrix effect. Matrix effects must be verified based on review of recoveries in the method blank or LCS, sample reanalysis, or evaluation of interfering compounds. Sample clean-up procedures required by the laboratory SOPs

must be implemented to alleviate potential matrix problems. Surrogate recoveries are calculated using the following formula.

$$\%R = \frac{SR}{SA} \times 100$$

Where:

%R = % Recovery

SR = Sample Result

SA = Surrogate Concentration Added

8.6.3 Laboratory Control Samples and Laboratory Control Sample Duplicates

An LCS or LCS Duplicate (LCSD) consists of ASTM Type II water and, where practical, pre-cleaned sand or sodium sulfate for solid matrices, or a purchased performance testing sample. Type II water is defined (D1193-91- Standard Specification for Reagent Water) by ASTM as “water that has greater than 1 megaohm-cm resistivity”. The referenced ASTM method covers requirements for water suitable for use in methods of chemical analysis and physical testing. The source of the chemicals utilized for LCS spiking will be from a different supply source than the calibration standards. Where second source standards are not available, the LCS must be spiked with materials from a separate manufacturing lot of the standard. The analytical laboratory will maintain complete records of standards tracking and preparation which will be available for review as necessary. Any deviation from utilization of second source standards will be approved by the Project Chemist.

The LCS is generally spiked with all of the analytes of interest near the mid-point of the calibration range as defined by the method. In some instances, spiking with a subset of the target compounds will be acceptable for the LCS where permissible in the SW-846 method protocol and with approval of the Project Chemist. The LCS is processed under the same sample preparation, surrogate and internal standards addition, and analytical protocols as the project samples. LCSs are analyzed at the frequency of 1 per batch of 20 samples or fewer of similar matrixes. The recovery of target analytes in the LCS provides an evaluation of method performance and accuracy. Method control may be established based on the subset of compounds listed in the method. LCSDs are analyzed with some methods but are not required QA components. LCSDs are

prepared and analyzed by the same protocols as the LCS. LCSD analyses provide precision evaluation of the method performance in addition to the accuracy information.

Laboratory QC criteria for LCSs and LCSDs are established for each method and matrix. Appendices G and H list the control limits for the laboratories performing analyses for MLAAP. The laboratory will update the QC limits annually. The LCS recovery of the method-specific control compounds/analytes must be within the laboratory-established control limits to demonstrate acceptable method performance. If the LCS recoveries are outside QC criteria for more than a few target analytes, recoveries are significantly low (<10 percent) and corrective action is required. After corrective action is complete, sample re-analysis is required for the failed parameters. If LCS recoveries exceed the QC criteria, and that parameter is not detected in any of the samples, re-analysis is not necessary. For any other deviations from the LCS control limits that cannot be resolved by sample re-analysis within holding times, the Project Chemist must be notified immediately. If critical samples are affected, the ARCADIS Task Manager may determine that resampling is required.

8.6.4 Matrix Spike and Matrix Spike Duplicate Samples

The MS and MSD samples consist of a project sample processed as three separate samples. Additional sample volume will be collected in the field, identified on the COC, and provided to the laboratory for use as the MS and MSD samples. In addition to the regular addition of monitoring standards (internal standards, surrogate), spiking analytes are added to the second sample aliquot. Generally, all method target analytes, if compatible, are added. A subset of target analytes may be used if indicated in the method SOP. An MS and MSD will be prepared for every batch of 20 samples (or fewer) for a given matrix unless sufficient sample volume is not available. Where site specific MSs cannot be performed, the laboratory shall include a batch MS/MSD or blank spike for additional evaluation of method performance in accordance with SW-846 method protocols and the laboratory SOP. Percent recoveries for batch specific MS/MSDs will be utilized only to evaluate method performance. Site samples will not be qualified based solely on the spike recoveries in matrices from other locations where the batch LCS is in control. Equipment and TBs must not be utilized for matrix spike evaluation. MS/MSD recoveries are a measure of the performance of the method on the matrices of samples being analyzed. MS recoveries outside the control limits for batches where the LCS is demonstrated to be in control indicate potential matrix effects. Sample clean-up procedures may be warranted for samples with severe matrix effects. The laboratory shall notify the Project Chemist of instances of extreme matrix effects on the analytical data to determine appropriate corrective action.

The percent recovery (%R) formula is as follows:

$$\%R = \frac{SSR - SR}{SA} \times 100$$

Where:

SSR = Spike Sample Result

SR = Sample Result

SA = Spike Added

MS and MSD recovery control limits will be based on laboratory established control limits for the methods performed. The Project Chemist will review the laboratory control limits prior to approval for use for project samples.

The RPD between the MS and MSD recoveries is calculated by the laboratory utilizing the following formula.

$$RPD = \left(\frac{PR - DR}{\frac{1}{2}(PR + DR)} \right) \times 100$$

Where:

PR = Primary Sample Result

DR = Duplicate Sample Result

The laboratory-derived advisory control limit for RPD will be utilized for evaluation of precision for MS pairs. Laboratory control limits are provided in Appendices G and H.

8.6.5 Laboratory Replicate Sample

A laboratory replicate consists of a second aliquot selected by the laboratory from the same project sample. These types of QC samples are primarily used in inorganic analyses including general chemistry techniques. Selection of replicate samples from a heterogeneous matrix requires homogenization to ensure that representative portions are analyzed. One sample per batch of 20 samples or fewer per matrix is analyzed in lieu of an MSD. The duplicate is prepared for methods that typically show concentrations of target analytes above MDLs, such as wet chemistry methods. The RPDs between the recoveries in the original and duplicate spikes measure the precision of the analytical method on the actual project samples. These limits will be utilized to evaluate laboratory precision for replicate samples prepared in the laboratory for methods where MSDs are not appropriate. If all other QC criteria are met, RPD results outside control limits indicate potential matrix effects and non-homogeneity of the sample. The laboratory shall investigate significant deviations in the RPD results by observing the sample to determine any visual heterogeneity or reviewing sample data for matrix interference. If visual observation does not indicate a potential problem, the sample may be re-analyzed. Potential matrix effects are reported and discussed in the case narrative. The RPD is calculated using the same formula as the RPD for the MS/MSD.

8.6.6 Calibration Verification Standards

A standard is obtained from a different source or, at a minimum, a different lot from that of the calibration standard. A check standard result is used to verify an existing calibration or calibration curve. The check standard provides information on the accuracy of the instrumental analytical method independent of various sample matrices. Calibration verification standards are analyzed with each analytical batch as applicable to the analytical method and SOP.

8.6.7 Method-Specific QC Samples

The laboratory will follow all specific quality processes as defined by the analytical method and laboratory SOP. Method-specific QC samples may include analysis of other QC samples or standards identified in the specific method SOP. Method-specific QC samples or standards include internal standards for gas chromatography (GC) and/or GC/mass spectroscopy (GC/MS) methods, post-digestion spikes and serial dilutions for metals analysis, and interference check samples for ICP analysis.

8.6.8 Performance Checks

The laboratory will perform analyses of performance test samples as required to maintain NELAP and other applicable accreditations. The Project Chemist will review laboratory performance test sample results on a semiannual basis. In the event that the laboratory fails any performance test parameters that impact the project samples, the laboratory will immediately notify the Project Chemist to identify appropriate corrective action implementation and to determine if any project data have been impacted.

9. Data Reduction, Validation, Reporting, and Management

In general, EPA-approved Methods will be performed for analytical work associated with PBC2. The method for quantitation of dissolved light hydrocarbons will be performed by Microseeps Laboratories, Inc., Pittsburg, PA. This method is a non-standard method to achieve very low detection limits for the compounds of interest during the monitoring of in-situ remediation systems. All other methods are EPA approved.

All laboratories performing analytical methods will be accredited under the NELAP. Additional details for the laboratory deliverables may be found in Section 9.8.3 of the MQAP and Section 4.2.4 of this document. Analytical data reports will be included in the primary investigation or study report in which the data are presented.

9.1 Detection and Reporting Limits

The laboratory MDLs and quantitative RLs are provided in Tables 8-11 through 8-17.

9.2 Rounding Rules

This section supplements Section 9.2 of the MQAP. Rounding to significant figures will be in accordance with current EPA method guidelines. The reported values must match the electronic data and utilize the same rounding routines.

9.3 Electronic Data Management

Electronic data management provides the ability to track samples and results from work plan implementation to the final report. The surveyor will provide coordinates for all sample locations in electronic format. The Field Operations Leader will review all field data for accuracy. Field data, as appropriate or applicable, will be manually entered into spreadsheet for incorporation into the project database. Risk evaluation screening standards will also be uploaded to the database.

ARCADIS will use the Environmental Quality Information Systems (EQuIS) data management system to handle environmental data for the RAAP project. EQuIS is a comprehensive geo-environmental data management database designed to store analytical test data and related data. EQuIS can be used for report and chart generation and is integrated with multiple statistical, numerical modeling, and data visualization tools.

The laboratory will provide an EDD for all analytical reports in accordance with requirements for upload to the EQuIS database system. Summary QC data will be included in the EDD to allow electronic screening of certain QC parameters.

The Project Chemist or designee will review approximately 5 percent of electronic laboratory and field data to verify the results against the hard copy and check for transcription errors. A greater than 15 percent discrepancy rate in two consecutive datasets will require additional review and verification.

Historical site data will be imported into the project database as necessary to support the PBC2. Data qualifiers and annotations previously applied will be incorporated. It is assumed that historical qualification has been applied consistent with CERCLA requirements. Qualification protocols for data generated under this QAPA and associated documents are described in Section 9.6 and are consistent with CERCLA guidance.

9.4 Data Validation

This section provides supplemental information associated with Section 9.5 of the MQAP. Data validation and usability criteria set forth in the MQAP as appended by this QAPA shall be followed unless otherwise amended in the area specific Work Plan.

9.4.1 Data Review, Validation, and Verification Requirements

Manual combined with electronic data validation will be conducted by a data validator not directly associated with the field-sampling program. The Project Chemist will oversee the performance of data validation functions. Data validation will be performed by knowledgeable and experienced individuals who can best perform evaluations within the necessary validation components. Validation staff qualifications will include experience with each of the elements required for the data verification and validation including ensuring that the measuring system meets the user's needs, assigning qualifiers to individual data values, assessing the relevancy of performance criteria, and concluding that data can proceed to quality assessment and reporting.

9.4.2 Validation and Verification Methods

Data validation will be conducted as set forth in this Section and Section 9.5.2 of the MQAP. Validation criteria will be based on these QA documents plus the analytical method performance criteria, laboratory QAM, laboratory control limits, USEPA Region

III guidance, USEPA Region III Modifications and professional judgment. The USEPA National Functional Guidelines (NFGs) for Organic and Inorganic data review will primarily be utilized as guidance for method qualification because the USEPA Contract Laboratory Program (CLP) methods will not be performed.

For samples collected in support of contaminant delineation, risk assessment, and confirmation of remedial goal attainment, 100 percent of the data will undergo Region III Manual Levels M-2/IM-1 data verification and validation. Approximately 10 percent of samples, collected for the above purpose, will additionally be validated in accordance with Region III M-3/IM-2. Selection of data packages for in-depth review will be random across the time period of sample collection. Levels M-3 and IM-2 will be performed on an SDG or complete laboratory report basis. Individual samples will not be singled out for particular levels of validation.

Samples collected in support of long-term operations and maintenance of selected remedies, pilot or bench scale studies, wastewater discharge compliance, or waste characterization for disposal will not be validated. If anomalous results are observed, a Level M-1/IM-1 review will be performed. Additional verification validation will be performed as necessary if this level of review indicates potential deficiencies with laboratory performance.

Data validation will be summarized in a checklist style report documenting the items reviewed with text explanations and notations of deficiencies and a summary of the qualifications applied to the analytical data. For data that will undergo the M-2/M-3/IM-2 validations, field documents will be reviewed within the perspective of impact to data quality. Any issues noted in field documentation or records that could impact data usability or quality will be noted in the validation reports.

9.5 Reconciliation with Data Usability Requirements

For routine assessments of data quality, ARCADIS will implement the data validation procedures described in Section 9.0 of the MQAP as appended by this QAPA. The data validators will assign appropriate data qualifiers to indicate limitations on the data. The Project Chemistry team will be responsible for evaluating compliance with project requirements. Deviations from the analytical performance criteria will be documented in the data validation reports.

The Project Chemist will work with the final users of the data in performing overall data quality assessments. The data quality assessment may include some or all the following steps:

- Data that are determined to be incomplete or not usable for the project will be discussed with the project team. If critical data points are involved which impact the ability to complete the project objectives, the data users will report immediately to the TM. The TM will discuss the resolution of the issue with the ARCADIS PM and implement the necessary corrective actions (for example, resampling);

- Data that are non-detect but have RLs elevated due to blank contamination or matrix interference will be compared to screening values (see Appendices B and C). If RLs exceed the screening values, then the results will be handled as appropriate for data use; and

- Data qualified as estimated (biased high, biased low) will be utilized if it is determined that the data are useable for their intended purpose. If an estimated result is close to a screening value, then there is uncertainty in any conclusions as to whether the result exceeds the screening value. The data user must evaluate the potential uncertainty in developing recommendations for the site. If estimated results become critical data points in making final decisions on the site, the PM and TM should evaluate the use of the results and may consider the data point incomplete.

Data validation codes relate to identification (confidence concerning the presence or absence of compounds) and quantitation of target parameters. The standard data validation codes that will be utilized are defined below:

Code	Definition
R	Data point is unusable due to serious deficiencies in analytical and QC criteria. The presence or absence of the analyte/compound can not be verified
UB	Not detected substantially above the level reported in laboratory or field blanks. For organics - 5X (10X for common lab contaminants) or for metals - 10X. Data point considered non-detect at the value qualified.

Code	Definition
U	Analyte/Compound not detected. The associated value indicates the concentration above which the result would be considered a quantitative value.
J	Reported value is considered an approximate concentration.
K	Estimated value, biased high.
L	Estimated value, biased low.
UJ, UK, UL	Analyte/compound not detected above the quantitation limit. However, the reported quantitation limit is approximate (biased high, biased low).

The ultimate data assessment process involves comparing analytical results to screening values and background concentrations to determine whether the contamination present is site related (i.e., above background levels) or significant (i.e., above screening values). Additional data assessment may be performed on site-by-site basis. Any additional procedures for data quality assessment will be provided in the area specific work plan.

10. Assessment/Oversight

Assessment and oversight procedures for the RAAP activities will be implemented in accordance with the MQAP, this QAPA, the PMP and other applicable documents. The QAPA in conjunction with the MQAP outlines general roles and responsibilities for the project team. Additional procedures will be developed as necessary to meet the DQOs of a specific RAAP Area of Concern or SWMU and will be presented in an addendum to the QAPA or included in the site specific Work Plan. The following section supplements Section 11.0 of the MQAP.

10.1 Assessments and Response Actions

Assessment activities include management and assessments, technical systems audits, and performance evaluations. Management assessments include routinely scheduled meetings and conference calls to evaluate staff utilization. Assignment of qualified personnel to RAAP projects, maintenance of schedules and budgets, and quality of project deliverables are verified as part of these assessments. Performance evaluations are used to ensure that trained and qualified staff is utilized for the project. Technical assessment activities applicable to RAAP projects include peer review, data quality reviews, and technical system audits (i.e., laboratory and field). Technical systems audits include review and evaluation of field and laboratory performance to assess the implementation of quality programs and directives. Procedures for peer review and technical assessments are summarized briefly below. Both the overall and direct technical assessment activities may result in the need for corrective action. The procedure for implementing a corrective action response program for both field and laboratory situations are summarized briefly below.

10.1.1 Field Inspections

The Field Operations Manager will be responsible for inspecting all field activities to verify compliance of the activities with the project plans, Health and Safety programs, and project QA documents.

10.1.2 Laboratory Audits

The laboratories must implement a comprehensive program of internal audits to verify the compliance of their analytical and management systems with the SOPs and QA Manuals. The laboratory may be requested to perform a project-specific audit to verify compliance with RAAP project requirements. The laboratory must be accredited under

NELAP and maintain current accreditation for RAAP methods and parameters where accreditation is available through the primary accrediting authority. No laboratory audits are planned by ARCADIS.

No outside laboratory audits are anticipated. The laboratory NELAP audit reports will be reviewed by the Project Chemist, as appropriate.

10.2 Corrective Action

Corrective actions will be implemented as necessary to insure data and project quality. In conjunction with the QA Manager and Project Chemist, the TM is responsible for initiating and implementing corrective action in the field. The PM and/or TMs are responsible for implementing, as necessary, corrective action in office settings. The laboratory PM, in conjunction with the laboratory technical staff and QA manager, is responsible for implementing corrective action in the laboratory. It is their combined responsibility to ensure that all analytical procedures are followed as specified and that the data generated meet the prescribed acceptance criteria. Any specific corrective actions necessary will be clearly documented in the logbooks or analytical reports.

10.2.1 Field Corrective Action Scenarios

The need for corrective action in the field may be determined by technical assessments or by more direct means such as equipment malfunction. Once a problem has been identified, it may be addressed immediately or an audit report may serve as notification to project management staff that corrective action is necessary. Immediate corrective actions taken in the field will be documented in the project logbook. Corrective actions may include, but are not limited to:

- Correcting equipment decontamination or sample handling procedures if field blanks indicate contamination;
- Recalibrating field instruments and checking battery charge;
- Training field personnel in correct sample handling or collection procedures; and
- Accepting data with an acknowledged level of uncertainty.

After a corrective action has been implemented, its effectiveness will be verified. If the action does not resolve the problem, appropriate personnel will be assigned to investigate and effectively remedy the problem.

Implementation of a Field Readiness Assessment (FRA) prior to start of fieldwork, as specified by SWP HSP-1.11, "Field Readiness Assessment Process," is required. The FRA will be constructed to determine readiness of the field activities to be performed. A FRA will be conducted:

- Prior to initial start of major phases of fieldwork;
- Prior to initiation of any significant change to the scope of work;
- As required in the Task Hazard Analysis (Exhibit 1 of the HSPA); or
- Anytime deemed necessary by the Health and Safety Manager, QA/QC Manager, or the PM.

Work considered routine (collection of water levels, routine system maintenance established in the existing work plans, etc.) may be addressed in a single FRA conducted at the start of fieldwork. Each event does not require an FRA to be conducted. Work considered "skill of the craft" (utilization of a plumber to hook water lines, etc.) is generally exempt from the FRA except the ARCADIS Site Manager or Field Operations Leader will ensure the work activity will not create a safety concern or create an unplanned interruption of site activities. This may be conducted through implementation of an FRA.

An example FRA template is presented in the HSPA.

10.2.2 Laboratory Corrective Action Scenarios

Out-of-control QC data, laboratory audits, or outside data review may determine the need for corrective action in the laboratory. Corrective actions may include, but are not limited to:

- Reanalyzing samples, if holding times permit;
- Correcting laboratory procedures;

- Recalibrating instruments using freshly prepared standards;
- Replacing solvents or other reagents that give unacceptable blank values;
- Training additional laboratory personnel in correct sample preparation and analysis procedures; and
- Accepting data with an acknowledged level of uncertainty.

Specific laboratory corrective actions for analytical deficiencies must be consistent with the analytical method. The laboratory corrective actions must be defined in analytical SOPs. Any deviations from the analytical SOP require corrective actions and documentation with approval of the ARCADIS Project Chemist. Whenever the ARCADIS Project Chemist deems corrective action necessary, the laboratory PM will ensure that the following steps are taken:

- The cause of the problem is investigated and identified;
- Appropriate corrective action is determined;
- Corrective action is implemented and the effectiveness verified by the laboratory QA Officer; and
- Documentation of the corrective action verification is provided to the Project Chemist in a timely manner.

11. References

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Tables

Table 2-1
Quality Assurance Measures Discussed in the MQAP
Radford Army Ammunition Plant, Radford, Virginia

Quality Assurance Measure	Section in MQAP	SOP No. (MWP Appendix A)
Project Organization and Responsibilities	2.0	--
Lines of Authority	2.2	--
Chemical Data Measurements	3.2	--
Levels of Concern	3.3	--
Site Investigation	4.0/5.0	20.1, 20.2, 20.3, 20.5, 20.9, 20.11, 20.12, 30.1, 30.2, 30.7, 30.8, 30.9, 40.1, 40.2, 40.3, 50.1, 50.2 70.1, 80.1
Remediation System Monitoring	NA	--
Documentation Requirements	5.6	10.1, 10.2, 10.3, 50.1
Chain-of-custody Requirements	5.7	10.4, 50.2
Calibration Procedures	7.0	90.1
Data Reduction, Validation, Reporting, and Management	9.0	--
Corrective Action	10.0	--
Quality Assessments	11.0	--

NA – Not Addressed

Table 6-1
Summary of Methods, Containers, Preservatives, and Holding Times
Radford Army Ammunition Plant
Radford, Virginia

Parameter	Matrix	Preparation Method	Analytical Method	Container	Preservative	Holding Time (a)
Primary Parameters						
TCL VOCs	Water	5030, 5032	8260	3 x 40-mL vial with Teflon-lined septum	Cool 4°C, pH<2 HCl	14 days
	Solid	5035	8260	3 x Encore™ ®	Cool 4°C	48 hours to preservation; 14 days to analysis
TCL SVOCs	Water	3510, 3520 (b)	8270	1 x 1-L amber G	Cool 4°C	7 days to extraction and 40 to analysis
	Solid	3540, 3550 (b)	8270	1 x 8-oz amber G	Cool 4°C	14 days to extract and 40 to analysis
PAHs	Water	3510, 3520 (b)	8270 (Low Level)	1 x 1-L amber G	Cool 4°C	7 days to extract and 40 to analysis
	Solid	3540, 3550 (b)	8270 (Low Level)	1 x 8-oz amber G	Cool 4°C	14 days to extract and 40 to analysis
TCL PCBs	Water	3510, 3520 (b)	8082	1 x 1-L amber G	Cool 4°C	7 days to extract and 40 to analysis
	Solid	3540, 3550 (b)	8082	1 x 8-oz amber G	Cool 4°C	14 days to extract and 40 to analysis
TCL Organochlorine Pestides	Water	3510, 3520 (b)	8081	1 x 1-L amber G	Cool 4°C	7 days to extract and 40 to analysis
	Solid	3540, 3550 (b)	8081	1 x 8-oz amber G	Cool 4°C	14 days to extract and 40 to analysis
Organochlorine Herbicides	Water	NA	8151	1 x 1-L amber G	Cool 4°C	7 days to extract and 40 to analysis
	Solid	NA	8151	1 x 8-oz amber G	Cool 4°C	14 days to extract and 40 to analysis
Explosives	Water	NA	8330, 8332, 8095	1 x 1-L amber G	Cool 4°C	7 days to extract and 40 to analysis

Table 6-1
Summary of Methods, Containers, Preservatives, and Holding Times
Radford Army Ammunition Plant
Radford, Virginia

Parameter	Matrix	Preparation Method	Analytical Method	Container	Preservative	Holding Time (a)
	Solid	NA	8330, 8332, 8095	1 x 8-oz amber G	Cool 4°C	14 days to extract and 40 to analysis
Metals (except Mercury)	Water	3005, 3010	6010 / 6020	1 x 1-L PE	pH <2 with HNO_3, Cool 4°C	6 months
	Solid	3050, 3051	6010	1 x 8-oz amber G	Cool 4°C	6 months
Mercury	Water	NA	7470	1 x 1-L PE	pH <2 with HNO_3, Cool 4°C	28 days
	Solid	NA	7471	1 x 8-oz amber G	Cool 4°C	28 days
Cyanide (Total)	Water	NA	9010 / 9012 / 9014	1 x 1-L PE	pH >12 with NaOH, Cool °4C	14 days
	Solid	NA	9010 / 9012 / 9014	1 x 8-oz amber G	Cool 4°C	14 days
Perchlorate	Water	NA	314.1	1 x 120-ml PE	Cool 4°C	28 days
	Solid	NA	314.1	1 x 4-oz PE	Cool 4°C	28 days
Dioxins/Furans	Water	NA	8290	2 x 1-L amber G + 2 x 40-ml vials	Cool 4°C	30 days to extract and 45 to analysis
	Solid	NA	8290	1 x 8-oz amber G	Cool 4°C	30 days to extract and 45 to analysis
Waste Characterization Parameters						
TCLP Metals	Solid	1311 3005, 3010	6010, 6020 & 7470	1 x 1-L wide mouth G	Cool 4°C	14 days from collection to Leach
TCLP VOCs	Solid	1311 5030, 5032	8260	1 x 4-oz G packed full	Cool 4°C	14 days from collection to Leach
TCLP SVOCs	Solid	1311 3510, 3520	8270	1 x 1-L wide mouth G	Cool 4°C	14 days from collection to Leach
TCLP Pest/PCBs	Solid	1311 3510, 3520	8081/8082	1 x 1-L wide mouth G	Cool 4°C	14 days from collection to Leach
Ignitability	Solid	Na	1010	250 ml wide mouth G	Cool 4°C	NA
Reactivity	Solid	Na	9010 / 9012/ 9014	250 ml wide mouth G	Cool 4°C	Sulfide 7 days

Table 6-1
Summary of Methods, Containers, Preservatives, and Holding Times
Radford Army Ammunition Plant
Radford, Virginia

Parameter	Matrix	Preparation Method	Analytical Method	Container	Preservative	Holding Time (a)
			and 9034			Cyanide 14 days
Corrosivity (pH)	Solid	NA	9045	250 ml wide mouth G	Cool 4°C	Analyze ASAP
General Chemistry Parameters						
MNA Gases	Water	NA	AM20GAX	4 x 40-mL vial with butyl rubber-lined septum	Cool 4°C	14 days (c)
Total & Dissolved Iron & Manganese	Water	3005, 3010	6010 / 6020	1 x 1-L PE	pH <2 with HNO_3	6 months
Alkalinity	Water	NA	SM 2320 B	120 ml PE	Cool 4°C	14 days
Ammonia	Water	NA	350.1 /4500-NH_3	120 ml PE	pH <2 with H_2SO_4; Cool 4°C	28 days
Chemical Oxygen Demand (COD)	Water	NA	410.3 / SM 5220 C / Hach 8000	120 ml PE	pH <2 with H_2SO_4; Cool 4°C	28 days
Chloride	Water	NA	SM 4500-Cl / 300	120 ml PE	Cool 4°C	28 days
Ferrous Iron	Water	NA	SM3500-FE-D	250 ml PE	None	Analyze ASAP
Hardness		NA	130.1	250 ml PE	pH <2 with HNO_3; Cool 4°C	6 months
Nitrate	Water	NA	353.2 / 300	120 ml PE	Cool 4°C	2 days
Nitrite	Water	NA	353.2 / 300	120 ml PE	Cool 4°C	2 days
Nitrate/Nitrite	Water	NA	353.2 / 300	120 ml PE	pH <2 with H_2SO_4	28 days
Phosphate	Water	NA	300	120 ml PE	pH <2 with H_2SO_4	28 days
Sulfate	Water	NA	9038 / 9056 / 300	120 ml PE	Cool 4°C	28 days
Sulfide	Water	NA	9034	500 ml PE	2 ml ZnAc; Cool 4°C	7 days
Total Dissolved Solids (TDS)	Water	NA	SM 2540 C	500 ml PE	Cool 4°C	7 days
Total Suspended Solids (TSS)	Water	NA	SM 2540 D	500 ml PE	Cool 4°C	7 days

Table 6-1
Summary of Methods, Containers, Preservatives, and Holding Times
Radford Army Ammunition Plant
Radford, Virginia

Parameter	Matrix	Preparation Method	Analytical Method	Container	Preservative	Holding Time (a)
Total Organic Carbon (TOC)	Water	NA	SM 5310 C	125 ml amber G	pH <2 with HCl or H_2SO_4, Cool 4°C	28 days
Dissolved Organic Carbon (DOC)	Water	NA	SM 5310 C	125 ml amber G	AFTER FILTRATION: pH <2 with HCl or H_2SO_4, Cool 4°C	28 days

Maximum holding time allowed from date of collection.
Clean-up methods may be applicable if matrix interference is encountered. Clean-up methods may include alumina (Method 3610), florisil (Method 3620), silica gel (Method 3630), gel permeation chromatography (GPC) (Method 3640), and sulfur (Method 3660). Selection of appropriate method is based on nature of interference and target compounds.
This holding time is a contractual holding time that has been established by ARCADIS.

°C – Degrees centigrade
G – glass
MNA- Monitored Natural Attenuation
NA – Not Applicable
PE – Polyethylene
SVOCs – Semivolatile Organic Compounds
TAL – Target Analyte List OLM
TCL – Target Compound List OLM 3.2
TCLP – Toxicity Characteristic Leaching Procedure
VOCs – Volatile Organic Compounds

Table 8-1
Summary of Analyte Method Detection Limits, Reporting Limits, and Risk Screening Levels for TCL VOCs (Method 8260B)
Soil and Water Samples MQAP Addendum PBC-2
Radford Army Ammunition Plant,
Radford, Virginia

Compound	CAS Number	Laboratory-Specific Method Detection and Reporting Limits (a)				USEPA MCLs	USEPA Region III Risk-Based Concentrations (b)									USEPA Region III BTAG Screening Levels (c)		
		Soil		Water			Tap Water			Soil Industrial			Soil Residential			Aqueous Fresh Water	Soil	Sediment
		MDL	Reporting Limit	MDL	Reporting Limit	MCL	C/N	RBC	Adjusted RBC	C/N	RBC	Adjusted RBC	C/N	RBC	Adjusted RBC			
		mg/kg	mg/kg	ug/L	ug/L	ug/L		ug/L	ug/L		mg/kg	mg/kg		mg/kg	mg/kg	ug/L	mg/kg	mg/kg
1,1,1-Trichloroethane	71-55-6	0.001	0.005	0.33	1		N	1.70E+03	1.70E+02	N	2.90E+05	2.90E+04	N	2.20E+04	2.20E+03	1.10E+01	3.00E-01	3.00E-02
1,1,2,2-Tetrachloroethane	79-34-5	0.001	0.005	0.33	1	--	C	5.30E-02	5.30E-02	C	1.40E+01	1.40E+01	C	3.20E+00	3.20E+00	6.10E+02	3.00E-01	1.40E+00
1,1,2-Trichloro-1,2,2-trifluoroethane	76-13-1	0.001	0.005	0.5	1	--	N	5.90E+04	5.90E+03	N	3.10E+07	3.10E+06	N	2.30E+06	2.30E+05	--	-	--
1,1,2-Trichloroethane	79-00-5	0.001	0.005	0.33	1	--	C	1.90E-01	1.90E-01	C	5.00E+01	5.00E+01	C	1.10E+01	1.10E+01	1.20E+03	3.00E-01	1.20E+00
1,1-Dichloroethane	75-34-3	0.001	0.005	0.33	1	--	N	9.00E+02	9.00E+01	N	2.00E+05	2.00E+04	N	1.60E+04	1.60E+03	4.70E+01	3.00E-01	--
1,1-Dichloroethene	75-35-4	0.001	0.005	0.42	1	--	N	3.50E+02	3.50E+01	N	5.10E+04	5.10E+03	N	3.90E+03	3.90E+02	2.50E+01	-	3.10E-02
1,2,4-Trichlorobenzene	120-82-1	0.001	0.005	0.57	2	7.00E+01	N	6.10E+01	6.10E+00	N	1.00E+04	1.00E+03	N	7.80E+02	7.80E+01	2.40E+01	1.00E-01	2.10E+00
1,2-Dibromo-3-chloropropane	96-12-8	0.001	0.005	0.33	2	-	C	2.00E-04	2.00E-04	C	3.60E+00	3.60E+00	C	2.00E-01	2.00E-01	--	-	--
1,2-Dibromoethane	106-93-4	0.001	0.005	0.33	1	-	C	5.30E-03	5.30E-03	C	1.40E+00	1.40E+00	C	3.20E-01	3.20E-01	--	5.00E+00	--
1,2-Dichlorobenzene	95-50-1	0.001	0.005	0.33	1	-	N	2.70E+02	2.70E+01	N	9.20E+04	9.20E+03	N	7.00E+03	7.00E+02	7.00E-01	1.00E-01	1.70E-02
1,2-Dichloroethane	107-06-2	0.001	0.005	0.33	1	-	C	1.20E-01	1.20E-01	C	3.10E+01	3.10E+01	C	7.00E+00	7.00E+00	1.00E+02	8.70E+02	--
1,2-Dichloropropane	78-87-5	0.001	0.005	0.33	1	5.00E+00	C	1.60E-01	1.60E-01	C	4.20E+01	4.20E+01	C	9.40E+00	9.40E+00	--	3.00E-01	--
1,3-Dichlorobenzene	541-73-1	0.001	0.005	0.38	1	-	N	1.80E+01	1.80E+00	N	3.10E+03	3.10E+02	N	2.30E+02	2.30E+01	1.50E+02	-	4.40E+00
1,4-Dichlorobenzene	106-46-7	0.001	0.005	0.33	1	-	C	4.70E-01	4.70E-01	C	1.20E+02	1.20E+02	C	2.70E+01	2.70E+01	2.60E+01	1.00E-01	6.00E-01
2-Butanone	78-93-3	0.002	0.01	1.5	10	--	N	7.00E+03	7.00E+02	N	6.10E+05	6.10E+04	N	4.70E+04	4.70E+03	1.40E+04	-	--
2-Hexanone	591-78-6	0.002	0.01	1	5	--	--	--	--	--	--	--	--	--	--	9.90E+01	-	--
4-Methyl-2-pentanone	108-10-1	0.001	0.01	1.5	5	--	N	6.30E+03	6.30E+02	--	--	--	--	--	--	1.70E+02	1.00E+02	--
Acetone	67-64-1	0.002	0.05	3.3	10	--	N	5.50E+03	5.50E+02	N	9.20E+05	9.20E+04	N	7.00E+04	7.00E+03	1.50E+03	-	--
Benzene	71-43-2	0.001	0.005	0.33	1	5.00E+00	C	3.40E-01	3.40E-01	C	5.20E+01	5.20E+01	C	1.20E+01	1.20E+01	3.70E+02	1.00E-01	--
Bromodichloromethane	75-27-4	0.001	0.005	0.33	1	8.00E+01	C	1.70E-01	1.70E-01	C	4.60E+01	4.60E+01	C	1.00E+01	1.00E+01	--	4.50E+02	--
Bromoform	75-25-2	0.001	0.005	0.5	1	8.00E+01	C	8.50E+00	8.50E+00	C	3.60E+02	3.60E+02	C	8.10E+01	8.10E+01	3.20E+02	-	6.50E-01
Bromomethane	74-83-9	0.001	0.01	0.5	2	-	N	8.50E+00	8.50E-01	N	1.40E+03	1.40E+02	N	1.10E+02	1.10E+01	--	-	--
Carbon disulfide	75-15-0	0.001	0.005	0.33	1	-	N	1.00E+03	1.00E+02	N	1.00E+05	1.00E+04	N	7.80E+03	7.80E+02	9.20E-01	-	8.50E-04
Carbon tetrachloride	56-23-5	0.001	0.005	0.33	1	5.00E+00	C	1.60E-01	1.60E-01	C	2.20E+01	2.20E+01	C	4.90E+00	4.90E+00	1.30E+01	3.00E-01	6.40E-02
Chlorobenzene	108-90-7	0.001	0.005	0.33	1	1.00E+02	N	9.00E+01	9.00E+00	N	2.00E+04	2.00E+03	N	1.60E+03	1.60E+02	1.30E+00	1.00E-01	8.40E-03
Chloroethane	75-00-3	0.001	0.01	0.5	2	-	C	3.60E+00	3.60E+00	C	9.90E+02	9.90E+02	C	2.20E+02	2.20E+02	--	-	--
Chloroform	67-66-3	0.001	0.005	0.33	1	8.00E+01	C	1.50E-01	1.50E-01	N	1.00E+04	1.00E+03	N	7.80E+02	7.80E+01	1.80E+00	3.00E-01	--
Chloromethane	74-87-3	0.001	0.01	0.5	2	-	N	1.90E+02	1.90E+01	--	--	--	--	--	--	--	-	--
cis-1,2-Dichloroethene	156-59-2	0.001	0.005	0.44	1	7.00E+01	N	6.10E+01	6.10E+00	N	1.00E+04	1.00E+03	N	7.80E+02	7.80E+01	--	3.00E-01	--
cis-1,3-Dichloropropene	10061-01-5	0.001	0.005	0.33	1	5.00E+00	C	4.40E-01	4.40E-01	C	2.90E+01	2.90E+01	C	6.40E+00	6.40E+00	--	3.00E-01	--
Cyclohexane	110-82-7	0.001	0.005	0.33	2	-	N	1.20E+04	1.20E+03	--	--	--	--	--	--	--	-	--
Dibromochloromethane	124-48-1	0.001	0.005	0.33	1	6.00E+01	C	1.30E-01	1.30E-01	C	3.40E+01	3.40E+01	C	7.60E+00	7.60E+00	--	-	--
Dichlorodifluoromethane	75-71-8	0.001	0.01	0.5	2	--	N	3.50E+02	3.50E+01	N	2.00E+05	2.00E+04	N	1.60E+04	1.60E+03	--	-	--
Ethylbenzene	100-41-4	0.001	0.005	0.35	1	7.00E+02	N	1.30E+03	1.30E+02	N	1.00E+05	1.00E+04	N	7.80E+03	7.80E+02	9.00E+01	1.00E-01	1.10E+00
Isopropylbenzene	98-82-8	0.001	0.005	0.33	1	--	N	6.60E+02	6.60E+01	N	1.00E+05	1.00E+04	N	7.80E+03	7.80E+02	2.60E+00	-	8.60E-02
Methyl acetate	79-20-9	0.002	0.005	0.87	2	--	N	6.10E+03	6.10E+02	N	1.00E+06	1.00E+05	N	7.80E+04	7.80E+03	--	-	--
methyl tert-Butyl ether	1634-04-4	0.001	0.005	0.33	1	--	C	2.60E+00	2.60E+00	C	7.20E+02	7.20E+02	C	1.60E+02	1.60E+02	1.10E+04	-	--

Table 8-1
Summary of Analyte Method Detection Limits, Reporting Limits, and Risk Screening Levels for TCL VOCs (Method 8260B)
Soil and Water Samples MQAP Addendum PBC-2
Radford Army Ammunition Plant,
Radford, Virginia

Compound	CAS Number	Laboratory-Specific Method Detection and Reporting Limits (a)				USEPA MCLs	USEPA Region III Risk-Based Concentrations (b)									USEPA Region III BTAG Screening Levels (c)		
		Soil		Water			Tap Water			Soil Industrial			Soil Residential			Aqueous Fresh Water	Soil	Sediment
		MDL	Reporting Limit	MDL	Reporting Limit	MCL	C/N	RBC	Adjusted RBC	C/N	RBC	Adjusted RBC	C/N	RBC	Adjusted RBC			
		mg/kg	mg/kg	ug/L	ug/L	ug/L		ug/L	ug/L		mg/kg	mg/kg		mg/kg	mg/kg	ug/L	mg/kg	mg/kg
Methylcyclohexane	108-87-2	0.001	0.005	0.33	1	--	N	6.30E+03	6.30E+02	--	--	--	--	--	--	--	-	--
Methylene chloride	75-09-2	0.001	0.04	0.66	2	--	C	4.10E+00	4.10E+00	C	3.80E+02	3.80E+02	C	8.50E+01	8.50E+01	9.80E+01	3.00E-01	--
Styrene	100-42-5	0.001	0.005	0.33	1	1.00E+02	N	1.60E+03	1.60E+02	N	2.00E+05	2.00E+04	N	1.60E+04	1.60E+03	7.20E+01	1.00E-01	5.60E-01
Tetrachloroethene	127-18-4	0.001	0.005	0.33	1	5.00E+00	C	1.00E-01	1.00E-01	C	5.30E+00	5.30E+00	C	1.20E+00	1.20E+00	1.10E+02	3.00E-01	4.70E-01
Toluene	108-88-3	0.001	0.005	0.33	1	1.00E+03	N	2.30E+03	2.30E+02	N	8.20E+04	8.20E+03	N	6.30E+03	6.30E+02	2.00E+00	1.00E-01	--
trans-1,2-Dichloroethene	156-60-5	0.001	0.005	0.4	1	1.00E+02	N	1.10E+02	1.10E+01	N	2.00E+04	2.00E+03	N	1.60E+03	1.60E+02	9.70E+02	3.00E-01	1.10E+00
trans-1,3-Dichloropropene	10061-02-6	0.001	0.005	0.33	1	-	C	4.40E-01	4.40E-01	C	2.90E+01	2.90E+01	C	6.40E+00	6.40E+00	--	3.00E-01	--
Trichloroethene	79-01-6	0.001	0.005	0.33	1	5.00E+00	C	2.60E-02	2.60E-02	C	7.20E+00	7.20E+00	C	1.60E+00	1.60E+00	2.10E+01	3.00E-01	9.70E-02
Trichlorofluoromethane	75-69-4	0.001	0.01	0.5	2		N	1.30E+03	1.30E+02	N	3.10E+05	3.10E+04	N	2.30E+04	2.30E+03		-	--
Vinyl Chloride	75-01-4	0.001	0.01	0.5	2	2.00E+00	C	1.50E-02	1.50E-02	-	--	-	C	9.00E-02	9.00E-02	9.30E+02	3.00E-01	--
Xylenes	1330-20-7	0.002	0.005	0.33	1	1.00E+04	N	2.10E+02	2.10E+01	N	2.00E+05	2.00E+04	N	1.60E+04	1.60E+03	1.30E+01	1.00E-01	--

Notes:

(a) Method Detection Limits and Reporting Limits provided by Empirical Laboratories, LLC

(b) USEPA Region 3 Risk-based Concentrations (October 2007)

(c) BTAG Screening Levels [1995 (soil), 2004 (surface water and sediment)].

Acronyms:

-- = Screening level unavailable.
BTAG = Biological Technical Assistance Group
CAS = Chemical Abstract Service
C!/N = RBC at HI of 0.1 < RBC-c; RBC from alternate RBC table.
C= RBC based cancer endpoint.
MCL = Maximum Contaminant Level
MDL = Method Detection Limit
mg/kg = Milligram Per kilogram
N = RBC based on non-carcinogenic endpoint.
PCBs = Polychlorinated Biphenyls
RBC = USEPA Region III Risk
RL = Reporting Limit
TCL = Target Compound List
ug/L = Microgram Per liter
VOC = volatile organic compound

Table 8-2
Summary of Analyte Method Detection Limits, Reporting Limits, and Risk Screening Levels for TCL SVOCs (Method 8270C)
Soil and Water Samples MQAP Addendum - PBC2
Radford Army Ammunition Plant,
Radford, Virginia

Compound	CAS Number	Laboratory-Specific Method Detection and Reporting Limits (a)				USEPA MCLs	USEPA Region III Risk-Based Concentrations (b)									USEPA Region III BTAG Screening Levels (c)		
		Soil		Water			Tap Water			Soil Industrial			Soil Residential			Aqueous Fresh Water	Soil	Sediment
		MDL	Reporting Limit	MDL	Reporting Limit	MCL	C/N	RBC	Adjusted RBC	C/N	RBC	Adjusted RBC	C/N	RBC	Adjusted RBC			
		mg/kg	mg/kg	M ug/L	M ug/L	M ug/L		M ug/L	M ug/L		mg/kg	mg/kg		mg/kg	mg/kg	M ug/L	mg/kg	mg/kg
1,1'-Biphenyl	92-52-4	0.1	0.33	1	5		N	3.00E+02	3.00E+01	N	5.10E+04	5.10E+03	N	3.90E+03	3.90E+02	1.40E+01	-	1.20E+00
2,2'-oxybis(1-Chloropropane)	108-60-1	0.1	0.33	1	5	--	C		2.60E-01	C	4.10E+01	4.10E+01	C	9.10E+00	9.10E+00	--	-	--
2,4,5-Trichlorophenol	95-95-4	0.1	0.33	1	5	--	N	3.70E+03	3.70E+02	N	1.00E+05	1.00E+04	N	7.80E+03	7.80E+02	--	1.00E-01	--
2,4,6-Trichlorophenol	88-06-2	0.1	0.33	1	5	--	C	6.10E+00	6.10E+00	C	2.60E+02	2.60E+02	C	5.80E+01	5.80E+01	4.90E+00	1.00E-01	2.10E-01
2,4-Dichlorophenol	120-83-2	0.1	0.33	1	5	--	N	1.10E+02	1.10E+01	N	3.10E+03	3.10E+02	N	2.30E+02	2.30E+01	1.10E+01	1.00E-01	1.20E-01
2,4-Dimethylphenol	105-67-9	0.1	1.3	2	20	--	N	7.30E+02	7.30E+01	N	2.00E+04	2.00E+03	N	1.60E+03	1.60E+02	--	1.00E-01	2.90E-02
2,4-Dinitrophenol	51-28-5	0.167	3.3	7	50	--	N	7.30E+01	7.30E+00	N	2.00E+03	2.00E+02	N	1.60E+02	1.60E+01	--	1.00E-01	--
2,4-Dinitrotoluene	121-14-2	0.1	0.33	1	5	--	N	7.30E+01	7.30E+00	N	2.00E+03	2.00E+02	N	1.60E+02	1.60E+01	4.40E+01	-	4.20E-02
2,6-Dinitrotoluene	606-20-2	0.1	0.33	1	5	--	N	3.70E+01	3.70E+00	N	1.00E+03	1.00E+02	N	7.80E+01	7.80E+00	8.10E+01	-	--
2-Chloronaphthalene	91-58-7	0.1	0.33	1.5	5	--	N	4.90E+02	4.90E+01	N	8.20E+04	8.20E+03	N	6.30E+03	6.30E+02	--	-	--
2-Chlorophenol	95-57-8	0.1	0.33	1.5	5	--	N	3.00E+01	3.00E+00	N	5.10E+03	5.10E+02	N	3.90E+02	3.90E+01	2.40E+01	1.00E-01	3.10E-02
2-Methylnaphthalene	91-57-6	0.1	0.33	1	5	--	N	2.40E+01	2.40E+00	N	4.10E+03	4.10E+02	N	3.10E+02	3.10E+01	4.70E+00	-	2.00E-02
2-Methylphenol	95-48-7	0.1	0.33	1	5	--	N	1.80E+03	1.80E+02	N	5.10E+04	5.10E+03	N	3.90E+03	3.90E+02	1.30E+01	1.00E-01	--
2-Nitroaniline	88-74-4	0.1	1.3	1	20	--	--	--	--	--	--	--	--	--	--	--	-	--
2-Nitrophenol	88-75-5	0.1	0.33	1	5	--	--	--	--	--	--	--	--	--	--	1.90E+03	-	--
3,3'-Dichlorobenzidine	91-94-1	0.167	0.33	1.5	5	--	C	1.50E-01	1.50E-01	C	6.40E+00	6.40E+00	C	1.40E+00	1.40E+00	4.50E+00	-	1.30E-01
3-Nitroaniline	99-09-2	0.167	1.3	1.5	20	--	--	--	--	--	--	--	--	--	--	--	-	--
4,6-Dinitro-2-methylphenol	534-52-1	0.167	1.3	2.5	20	--	--	--	--	--	--	--	--	--	--	--	-	--
4-Bromophenyl-phenylether	101-55-3	0.1	0.33	1	5	--	--	--	--	--	--	--	--	--	--	1.50E+00	-	1.20E+00
4-Chloro-3-Methylphenol	59-50-7	0.1	0.33	1	5	--	--	--	--	--	--	--	--	--	--	--	-	--
4-Chloroaniline	106-47-8	0.1	0.33	1	5	--	N	1.50E+02	1.50E+01	N	4.10E+03	4.10E+02	N	3.10E+02	3.10E+01	2.30E+02	-	--
4-Chlorophenyl-phenylether	7005-72-3	0.1	0.33	1.5	5	--	--	--	--	--	--	--	--	--	--	--	-	0.00E+00
4-Methylphenol	106-44-5	0.1	0.33	1	5	--	N	1.80E+02	1.80E+01	N	5.10E+03	5.10E+02	N	3.90E+02	3.90E+01	5.40E+02	1.00E-01	6.70E-01
4-Nitroaniline	100-01-6	0.1	1.3	1	20	--	--	--	--	--	--	--	--	--	--	--	-	--
4-Nitrophenol	100-02-7	0.1	1.3	3	20	--	-	--	-	-	--	-	-	--	-	6.00E+01	1.00E-01	--
Acenaphthene	83-32-9	0.1	0.33	1.5	5	--	N	3.70E+02	3.70E+01	N	6.10E+04	6.10E+03	N	4.70E+03	4.70E+02	5.80E+00	1.00E-01	6.70E-03
Acenaphthylene [1]	208-96-8	0.1	0.33	1.5	5	--	N	1.80E+02	1.80E+01	N	3.10E+04	3.10E+03	N	2.30E+03	2.30E+02	--	1.00E-01	5.90E-03
Acetophenone	98-86-2	0.1	0.33	1	5	--	N	6.10E+02	6.10E+01	N	1.00E+05	1.00E+04	N	7.80E+03	7.80E+02	--	-	--
Anthracene	120-12-7	0.1	0.33	1	5	--	N	1.80E+03	1.80E+02	N	3.10E+05	3.10E+04	N	2.30E+04	2.30E+03	1.20E-02	1.00E-01	5.70E-02
Atrazine	1912-24-9	0.1	0.33	1	5	3.00E+00	C	3.00E-01	3.00E-01	C	1.30E+01	1.30E+01	C	2.90E+00	2.90E+00	1.80E+00	-	6.60E-03
Benzaldehyde	100-52-7	0.1	0.33	1	5	--	N	3.70E+03	3.70E+02	N	1.00E+05	1.00E+04	N	7.80E+03	7.80E+02	--	-	--
Benzo(a)anthracene	56-55-3	0.1	0.33	1	5	--	C	3.00E-02	3.00E-02	C	3.90E+00	3.90E+00	C	2.20E-01	2.20E-01	1.80E-02	1.00E-01	1.10E-01
Benzo(a)pyrene	50-32-8	0.1	0.33	1	5	2.00E-01	C	3.00E-03	3.00E-03	C	3.90E-01	3.90E-01	C	2.20E-02	2.20E-02	1.50E-02	1.00E-01	1.50E-01
Benzo(b)fluoranthene	205-99-2	0.1	0.33	1	5	--	C	3.00E-02	3.00E-02	C	3.90E+00	3.90E+00	C	2.20E-01	2.20E-01	--	1.00E-01	--
Benzo(g,h,i)perylene [1]	191-24-2	0.1	0.33	1.5	5	--	N	1.80E+02	1.80E+01	N	3.10E+04	3.10E+03	N	2.30E+03	2.30E+02	--	1.00E-01	1.70E-01
Benzo(k)fluoranthene	207-08-9	0.1	0.33	1	5	--	C	3.00E-01	3.00E-01	C	3.90E+01	3.90E+01	C	2.20E+00	2.20E+00	--	1.00E-01	2.40E-01
Bis(2-chloroethoxy)methane	111-91-1	0.1	0.33	1	5	--	--	--	--	--	--	--	--	--	--	--	-	--

Table 8-2
Summary of Analyte Method Detection Limits, Reporting Limits, and Risk Screening Levels for TCL SVOCs (Method 8270C)
Soil and Water Samples MQAP Addendum - PBC2
Radford Army Ammunition Plant,
Radford, Virginia

Compound	CAS Number	Laboratory-Specific Method Detection and Reporting Limits (a)				USEPA MCLs	USEPA Region III Risk-Based Concentrations (b)									USEPA Region III BTAG Screening Levels (c)		
		Soil		Water			Tap Water			Soil Industrial			Soil Residential			Aqueous Fresh Water	Soil	Sediment
		MDL	Reporting Limit	MDL	Reporting Limit	MCL	C/N	RBC	Adjusted RBC	C/N	RBC	Adjusted RBC	C/N	RBC	Adjusted RBC			
		mg/kg	mg/kg	M ug/L	M ug/L	M ug/L		M ug/L	M ug/L		mg/kg	mg/kg		mg/kg	mg/kg	M ug/L	mg/kg	mg/kg
Bis(2-chloroethyl)ether	111-44-4	0.167	0.33	2.5	2	--	C	9.60E-03	9.60E-03	C	2.60E+00	2.60E+00	C	5.80E-01	5.80E-01	--	-	--
Bis(2-ethylhexyl)phthalate	117-81-7	0.1	0.33	1	5	6.00E+00	C	4.80E+00	4.80E+00	C	2.00E+02	2.00E+02	C	4.60E+01	4.60E+01	1.60E+01	-	1.80E-01
Butylbenzylphthalate	85-68-7	0.1	0.33	1	5	--	N	7.30E+03	7.30E+02	N	2.00E+05	2.00E+04	N	1.60E+04	1.60E+03	1.90E+01	-	1.10E+01
Caprolactam	105-60-2	0.1	0.33	1	5	--	N	1.80E+04	1.80E+03	N	5.10E+05	5.10E+04	N	3.90E+04	3.90E+03	--	-	--
Carbazole	86-74-8	0.1	0.67	1	10	--	C	3.30E+00	3.30E+00	C	1.40E+02	1.40E+02	C	3.20E+01	3.20E+01	--	-	--
Chrysene	218-01-9	0.1	0.33	1	5	--	C	3.00E+00	3.00E+00	C	3.90E+02	3.90E+02	C	2.20E+01	2.20E+01	--	1.00E-01	1.70E-01
Dibenz(a,h)anthracene	53-70-3	0.1	0.33	1	5	--	C	3.00E-03	3.00E-03	C	3.90E-01	3.90E-01	C	2.20E-02	2.20E-02	--	1.00E-01	3.30E-02
Dibenzofuran	132-64-9	0.1	0.33	1	5	--	--	--	--	--	--	--	--	--	--	3.70E+00	-	4.20E-01
Diethylphthalate	84-66-2	0.1	0.33	1	5	--	N	2.90E+04	2.90E+03	N	8.20E+05	8.20E+04	N	6.30E+04	6.30E+03	2.10E+02	-	6.00E-01
Dimethylphthalate	131-11-3	0.1	0.33	1	5	--	--	--	--	--	--	--	--	--	--	--	-	--
Di-n-butylphthalate	84-74-2	0.1	0.33	1	5	--	N	3.70E+03	3.70E+02	N	1.00E+05	1.00E+04	N	7.80E+03	7.80E+02	1.90E+01	-	6.50E+00
Di-n-octylphthalate	117-84-0	0.1	0.33	1	5	--	--	--	--	--	--	--	--	--	--	2.20E+01	-	--
Fluoranthene	206-44-0	0.1	0.33	1	5	--	N	1.50E+03	1.50E+02	N	4.10E+04	4.10E+03	N	3.10E+03	3.10E+02	4.00E-02	1.00E-01	4.20E-01
Fluorene	86-73-7	0.1	0.33	1.5	5		N	2.40E+02	2.40E+01	N	4.10E+04	4.10E+03	N	3.10E+03	3.10E+02	3.00E+00	1.00E-01	7.70E-02
Hexachlorobenzene	118-74-1	0.1	0.33	1	5	1.00E+00	C	4.20E-02	4.20E-02	C	1.80E+00	1.80E+00	C	4.00E-01	4.00E-01	3.00E-04	-	2.00E-02
Hexachlorobutadiene	87-68-3	0.1	0.33	1.5	5	--	C!/N	8.60E-01	7.30E-01	C!/N	3.70E+01	2.00E+01	C!/N	8.20E+00	1.60E+00	1.30E+00	-	--
Hexachlorocyclopentadiene	77-47-4	0.1	0.33	1	5	5.00E+01	N	2.20E+02	2.20E+01	N	6.10E+03	6.10E+02	N	4.70E+02	4.70E+01	--	-	--
Hexachloroethane	67-72-1	0.1	0.33	2.5	5	--	C!/N	4.80E+00	3.70E+00	C!/N	2.00E+02	1.00E+02	C!/N	4.60E+01	7.80E+00	1.20E+01	-	1.00E+00
Indeno(1,2,3-cd)pyrene	193-39-5	0.15	0.33	1.5	5	--	C	3.00E-02	3.00E-02	C	3.90E+00	3.90E+00	C	2.20E-01	2.20E-01	--	1.00E-01	1.70E-02
Isophorone	78-59-1	0.1	0.33	1	5	--	C	7.00E+01	7.00E+01	C	3.00E+03	3.00E+03	C	6.70E+02	6.70E+02	--	-	--
Naphthalene	91-20-3	0.1	0.33	1.5	5	--	N	6.50E+00	6.50E-01	N	2.00E+04	2.00E+03	N	1.60E+03	1.60E+02	1.10E+00	1.00E-01	1.80E-01
Nitrobenzene	98-95-3	0.1	0.33	1	5	--	N	3.50E+00	3.50E-01	N	5.10E+02	5.10E+01	N	3.90E+01	3.90E+00	--	-	--
N-Nitrosodi-n-propylamine	621-64-7	0.1	0.33	1.5	5	--	C	9.60E-03	9.60E-03	C	4.10E-01	4.10E-01	C	9.10E-02	9.10E-02	--	-	--
N-Nitrosodiphenylamine	86-30-6	0.1	0.33	1	5	--	C	1.40E+01	1.40E+01	C	5.80E+02	5.80E+02	C	1.30E+02	1.30E+02	2.10E+02	-	2.70E+00
Pentachlorophenol	87-86-5	0.1	1.3	1.5	20	1.00E+00	C	5.60E-01	5.60E-01	C	2.40E+01	2.40E+01	C	5.30E+00	5.30E+00	5.00E-01	1.00E-01	5.00E-01
Phenol	108-95-2	0.1	0.33	1	5	--	N	1.10E+04	1.10E+03	N	3.10E+05	3.10E+04	N	2.30E+04	2.30E+03	4.00E+00	1.00E-01	4.20E-01
Pyrene	129-00-0	0.1	0.33	1	5	--	N	1.80E+02	1.80E+01	N	3.10E+04	3.10E+03	N	2.30E+03	2.30E+02	2.50E-02	1.00E-01	2.00E-01
Acenaphthene	83-32-9	0.0014	0.0033	0.011	0.05	--	N	3.70E+02	3.70E+01	N	6.10E+04	6.10E+03	N	4.70E+03	4.70E+02	5.80E+00	1.00E-01	6.70E-03
Acenaphthylene [1]	208-96-8	0.00082	0.0033	0.019	0.05	--	N	1.80E+02	1.80E+01	N	3.10E+04	3.10E+03	N	2.30E+03	2.30E+02	--	1.00E-01	5.90E-03
Anthracene	120-12-7	0.00069	0.0033	0.021	0.05	--	N	1.80E+03	1.80E+02	N	3.10E+05	3.10E+04	N	2.30E+04	2.30E+03	1.20E-02	1.00E-01	5.70E-02
Benzo(a)anthracene	56-55-3	0.00131	0.0033	0.017	0.05	--	C	3.00E-02	3.00E-02	C	3.90E+00	3.90E+00	C	2.20E-01	2.20E-01	1.80E-02	1.00E-01	1.10E-01
Benzo(a)pyrene	50-32-8	0.00118	0.0033	0.017	0.05	2.00E-01	C	3.00E-03	3.00E-03	C	3.90E-01	3.90E-01	C	2.20E-02	2.20E-02	1.50E-02	1.00E-01	1.50E-01
Benzo(b)fluoranthene	205-99-2	0.00126	0.0033	0.018	0.05	--	C	3.00E-02	3.00E-02	C	3.90E+00	3.90E+00	C	2.20E-01	2.20E-01	--	1.00E-01	--
Benzo(g,h,i)perylene [1]	191-24-2	0.0022	0.0033	0.013	0.05	--	N	1.80E+02	1.80E+01	N	3.10E+04	3.10E+03	N	2.30E+03	2.30E+02	--	1.00E-01	1.70E-01
Benzo(k)fluoranthene	207-08-9	0.00123	0.0033	0.012	0.05	--	C	3.00E-01	3.00E-01	C	3.90E+01	3.90E+01	C	2.20E+00	2.20E+00	--	1.00E-01	2.40E-01
Chrysene	218-01-9	0.00094	0.0033	0.012	0.05	--	C	3.00E+00	3.00E+00	C	3.90E+02	3.90E+02	C	2.20E+01	2.20E+01	--	1.00E-01	1.70E-01
Dibenz(a,h)anthracene	53-70-3	0.00085	0.0033	0.02	0.005	--	C	3.00E-03	3.00E-03	C	3.90E-01	3.90E-01	C	2.20E-02	2.20E-02	--	1.00E-01	3.30E-02
Fluoranthene	206-44-0	0.00093	0.0033	0.016	0.05	--	N	1.50E+03	1.50E+02	N	4.10E+04	4.10E+03	N	3.10E+03	3.10E+02	4.00E-02	1.00E-01	4.20E-01

Table 8-2
Summary of Analyte Method Detection Limits, Reporting Limits, and Risk Screening Levels for TCL SVOCs (Method 8270C)
Soil and Water Samples MQAP Addendum - PBC2
Radford Army Ammunition Plant,
Radford, Virginia

Compound	CAS Number	Laboratory-Specific Method Detection and Reporting Limits (a)				USEPA MCLs	USEPA Region III Risk-Based Concentrations (b)									USEPA Region III BTAG Screening Levels (c)		
		Soil		Water			Tap Water			Soil Industrial			Soil Residential			Aqueous Fresh Water	Soil	Sediment
		MDL	Reporting Limit	MDL	Reporting Limit	MCL	C/N	RBC	Adjusted RBC	C/N	RBC	Adjusted RBC	C/N	RBC	Adjusted RBC			
		mg/kg	mg/kg	$M^{ug/L}$	$M^{ug/L}$	$M^{ug/L}$		$M^{ug/L}$	$M^{ug/L}$		mg/kg	mg/kg		mg/kg	mg/kg	$M^{ug/L}$	mg/kg	mg/kg
Fluorene	86-73-7	0.00093	0.0033	0.016	0.05		N	2.40E+02	2.40E+01	N	4.10E+04	4.10E+03	N	3.10E+03	3.10E+02	3.00E+00	1.00E-01	7.70E-02
2-Methylnaphthalene	91-57-6	0.0013	0.0033	0.018	0.05	--	N	2.40E+01	2.40E+00	N	4.10E+03	4.10E+02	N	3.10E+02	3.10E+01	4.70E+00	-	2.00E-02
Indeno(1,2,3-cd)pyrene	193-39-5	0.00108	0.0033	0.018	0.05	--	C	3.00E-02	3.00E-02	C	3.90E+00	3.90E+00	C	2.20E-01	2.20E-01	--	1.00E-01	1.70E-02
Naphthalene	91-20-3	0.00158	0.0033	0.01	0.05	--	N	6.50E+00	6.50E-01	N	2.00E+04	2.00E+03	N	1.60E+03	1.60E+02	1.10E+00	1.00E-01	1.80E-01
Pyrene	129-00-0	0.00072	0.0033	0.024	0.05	--	N	1.80E+02	1.80E+01	N	3.10E+04	3.10E+03	N	2.30E+03	2.30E+02	2.50E-02	1.00E-01	2.00E-01

Notes:

(a) Method Detection Limits and Reporting Limits provided by Empirical Laboratories, LLC

(b) USEPA Region 3 Risk-based Concentrations (October 2007)

(c) BTAG Screening Levels [1995 (soil), 2004 (surface water and sediment)].

Acronyms:

-- = Screening level unavailable.

BTAG = Biological Technical Assistance Group

CAS = Chemical Abstract Service

C!/N = RBC at HI of 0.1 < RBC-c; RBC from alternate RBC table.

C= RBC based cancer endpoint.

MCL = Maximum Contaminant Level

MDL = Method Detection Limit

mg/kg = Milligram Per kilogram

N = RBC based on non-carcinogenic endpoint.

PCBs = Polychlorinated Biphenyls

RBC = USEPA Region III Risk

RL = Reporting Limit

SVOC = Semivolatile organic compound

TCL = Target Compound List

ug/L = Microgram Per liter

Table 8-3
Summary of Analyte Detection Limits, Reporting Limits, and Risk Screening Levels for TAL Metals
(Methods 6010, 6020, 7470)
Soil and Water Samples MQAP Addendum - PBC2
Radford Army Ammunition Plant,
Radford Virginia

Compound	CAS Number	Laboratory-Specific Method Detection and Reporting Limits (a)				USEPA MCLs	USEPA Region III Risk-Based Concentrations (b)									USEPA Region III BTAG Screening Levels (c)		
		Soil		Water			Tap Water			Soil Industrial			Soil Residential			Aqueous Fresh Water	Soil	Sediment
		MDL	Reporting Limit	MDL	Reporting Limit	MCL	C/N	RBC	Adjusted RBC	C/N	RBC	Adjusted RBC	C/N	RBC	Adjusted RBC			
		mg/kg	mg/kg	ug/L	ug/L	ug/L		ug/L	ug/L		mg/kg	mg/kg		mg/kg	mg/kg	ug/L	mg/kg	mg/kg
Aluminum	7429-90-5	15	40	75	200		N	3.70E+04	3.70E+03	N	1.00E+06	1.00E+05	N	7.80E+04	7.80E+03	8.70E+01	1.00E+00	--
Antimony	7440-36-0	1	3	5	15	6.00E+00	N	1.50E+01	1.50E+00	N	4.10E+02	4.10E+01	N	3.10E+01	3.10E+00	3.00E+01	4.80E-01	2.00E+00
Arsenic	7440-38-2	0.6	2	3	10	1.00E+01	C	4.50E-02	4.50E-02	C	1.90E+00	1.90E+00	C	4.30E-01	4.30E-01	5.00E+00	3.30E+02	9.80E+00
Barium	7440-39-3	1	40	5	200	2.00E+03	N	7.30E+03	7.30E+02	N	2.00E+05	2.00E+04	N	1.60E+04	1.60E+03	4.00E+00	4.40E+02	--
Beryllium	7440-41-7	0.2	1	1	5	4.00E+00	N	7.30E+01	7.30E+00	N	2.00E+03	2.00E+02	N	1.60E+02	1.60E+01	6.60E-01	2.00E-02	--
Cadmium	7440-43-9	0.2	1	1	5	5.00E+00	N	1.80E+01	1.80E+00	N	5.10E+02	5.10E+01	N	3.90E+01	3.90E+00	2.50E-01	2.50E+00	9.90E-01
Calcium	7440-70-2	200	1000	1000	5000	--	--	--	--	--	-	--	--	--	--	1.20E+05	--	--
Chromium	7440-47-3	0.4	2	2	10	1.00E+02	N	1.10E+02	1.10E+01	N	3.10E+03	3.10E+02	N	2.30E+02	2.30E+01	8.50E+01	7.50E-03	4.30E+01
Cobalt	7440-48-4	1	3	5	15	--	--	--	--	--	-	--	--	--	--	2.30E+01	1.00E+02	5.00E+01
Copper	7440-50-8	1	5	5	25	1.30E+03	N	1.50E+03	1.50E+02	N	4.10E+04	4.10E+03	N	3.10E+03	3.10E+02	9.00E+00	1.50E+01	3.20E+01
Cyanide	57-12-5	0.25	10	0.125	5	2.00E+02	N	7.30E+02	7.30E+01	N	2.00E+04	2.00E+03	N	1.60E+03	1.60E+02	5.00E+00	5.00E-03	1.00E-01
Iron	7439-89-6	6	20	30	100	--	N	2.60E+04	2.60E+03	N	7.20E+05	7.20E+04	N	5.50E+04	5.50E+03	3.00E+02	1.20E+01	2.00E+04
Lead[2]	7439-92-1	0.3	0.6	1.5	3	1.50E+01	--	--	--	--	7.50E+02	7.50E+02	--	4.00E+02	4.00E+02	2.50E+00	1.00E-02	3.60E+01
Magnesium	7439-95-4	200	1000	1000	5000	--	--	--	--	--	-	--	--	--	--	8.20E+04	4.40E+03	--
Manganese	7439-96-5	0.6	3	5	15	--	N	7.30E+02	7.30E+01	N	2.00E+04	2.00E+03	N	1.60E+03	1.60E+02	1.20E+02	3.30E+02	4.60E+02
Mercury[3]	7439-97-6	0.013	0.033	0.08	0.2	2.00E+00	--	--	--	N	3.10E+02	3.10E+01	N	2.30E+01	2.30E+00	1.00E-01	5.80E-02	1.80E-01
Nickel	7440-02-0	1	8	5	10	--	N	7.30E+02	7.30E+01	N	2.00E+04	2.00E+03	N	1.60E+03	1.60E+02	5.20E+01	2.00E+00	2.30E+01
Potassium	7440-09-7	200	500	1000	2000	--	--	--	--	--	-	--	--	--	--	--	--	--
Selenium	7782-49-2	0.6	1	5	10	5.00E+01	N	1.80E+02	1.80E+01	N	5.10E+03	5.10E+02	N	3.90E+02	3.90E+01	1.00E+00	1.80E+00	2.00E+00
Silver	7440-22-4	0.2	2	2	10	--	N	1.80E+02	1.80E+01	N	5.10E+03	5.10E+02	N	3.90E+02	3.90E+01	3.20E+00	9.80E-06	1.00E+00
Sodium	7440-23-5	200	1000	1000	5000	--	--	--	--	--	-	--	--	--	--	6.80E+05	--	--
Thallium	7440-28-0	0.6	2	3	10	2.00E+00	N	2.60E+00	2.60E-01	N	7.20E+01	7.20E+00	N	5.50E+00	5.50E-01	8.00E-01	1.00E-03	--

Table 8-3
Summary of Analyte Detection Limits, Reporting Limits, and Risk Screening Levels for TAL Metals
(Methods 6010, 6020, 7470)
Soil and Water Samples MQAP Addendum - PBC2
Radford Army Ammunition Plant,
Radford Virginia

Compound	CAS Number	Laboratory-Specific Method Detection and Reporting Limits (a)				USEPA MCLs	USEPA Region III Risk-Based Concentrations (b)									USEPA Region III BTAG Screening Levels (c)		
		Soil		Water			Tap Water			Soil Industrial			Soil Residential			Aqueous Fresh Water	Soil	Sediment
		MDL	Reporting Limit	MDL	Reporting Limit	MCL	C/N	RBC	Adjusted RBC	C/N	RBC	Adjusted RBC	C/N	RBC	Adjusted RBC			
		mg/kg	mg/kg	ug/L	ug/L	ug/L		ug/L	ug/L		mg/kg	mg/kg		mg/kg	mg/kg	ug/L	mg/kg	mg/kg
Vanadium	7440-62-2	1	10	5	50	--	N	3.70E+01	3.70E+00	N	1.00E+03	1.00E+02	N	7.80E+01	7.80E+00	2.00E+01	5.00E-01	--
Zinc	7440-66-6	1	4	10	20	--	N	1.10E+04	1.10E+03	N	3.10E+05	3.10E+04	N	2.30E+04	2.30E+03	1.20E+02	1.00E+01	1.20E+02

Notes:

(a) Method Detection Limits and Reporting Limits provided by Empirical Laboratories, LLC

(b) USEPA Region 3 Risk-based Concentrations (October 2007)

(c) BTAG Screening Levels [1995 (soil), 2004 (surface water and sediment)].

Acronyms:

-- = Screening level unavailable.
BTAG = Biological Technical Assistance Group
CAS = Chemical Abstract Service
C!/N = RBC at HI of 0.1 < RBC-c; RBC from alternate RBC table.
C= RBC based cancer endpoint.
MCL = Maximum Contaminant Level
MDL = Method Detection Limit
mg/kg = Milligram Per kilogram
N = RBC based on non-carcinogenic endpoint.
PCBs = Polychlorinated Biphenyls
RBC = USEPA Region III Risk
RL = Reporting Limit
TCL = Target Compound List
ug/L = Microgram Per liter

Table 8-4
Summary of Analyte MDLs, Reporting Limits, and Risk Screening Levels for TCL Pesticides (8081A), and PCBs (8082), and Herbicides (8151)
Radford Army Ammunition Plant, Radford, Virginia

	CAS Number	Laboratory-Specific Method Detection and Reporting Limits (a)				USEPA MCLs	USEPA Region III Risk-Based Concentrations (b)									USEPA Region III BTAG Screening Levels (c)		
		Soil		Water			Tap Water			Soil Industrial			Soil Residential			Aqueous Fresh Water	Soil	Sediment
		MDL	Reporting Limit	MDL	Reporting Limit	MCL	C/N	RBC	Adjusted RBC	C/N	RBC	Adjusted RBC	C/N	RBC	Adjusted RBC			
		mg/kg	mg/kg	ug/L	ug/L	ug/L		ug/L	ug/L		mg/kg	mg/kg		mg/kg	mg/kg	ug/L	mg/kg	mg/kg
Pesticides by Method 8081A																		
4,4'-DDD	72-54-8	0.0002	0.0005	0.005	0.015		C	2.80E-01	2.80E-01	C	1.20E+01	1.20E+01	C	2.70E+00	2.70E+00	1.10E-02	1.00E-01	4.90E-03
4,4'-DDE	72-55-9	0.0002	0.0005	0.005	0.015	--	C	2.00E-01	2.00E-01	C	8.40E+00	8.40E+00	C	1.90E+00	1.90E+00	--	1.00E-01	3.20E-03
4,4'-DDT	50-29-3	0.0002	0.0005	0.005	0.015	--	C	2.00E-01	2.00E-01	C	8.40E+00	8.40E+00	C	1.90E+00	1.90E+00	1.00E-03	1.00E-01	--
Aldrin	309-00-2	0.0002	0.0005	0.005	0.015	--	C	3.90E-03	3.90E-03	C	1.70E-01	1.70E-01	C	3.80E-02	3.80E-02	3.00E+00	1.00E-01	2.00E-03
alpha-BHC	319-84-6	0.0002	0.0005	0.005	0.015	--	C	1.10E-02	1.10E-02	C	4.50E-01	4.50E-01	C	1.00E-01	1.00E-01	--	1.00E+02	6.00E-03
alpha-Chlordane	5103-71-9	0.0002	0.0005	0.005	0.015	--	C	1.90E-01	1.90E-01	C	8.20E+00	8.20E+00	C	1.80E+00	1.80E+00	--	1.00E-01	--
gamma-Chlordane	5103-74-2	0.0002	0.0005	0.005	0.015	--	C	1.90E-01	1.90E-01	C	8.20E+00	8.20E+00	C	1.80E+00	1.80E+00	--	1.00E-01	--
beta-BHC	319-85-7	0.0002	0.0005	0.005	0.015	--	C	3.70E-02	3.70E-02	C	1.60E+00	1.60E+00	C	3.50E-01	3.50E-01	--	1.00E+02	5.00E-03
delta-BHC	319-86-8	0.0002	0.0005	0.005	0.015	--	C	1.10E-02	1.10E-02	C	4.50E-01	4.50E-01	C	1.00E-01	1.00E-01	1.40E+02	1.00E+02	6.40E+00
Dieldrin	60-57-1	0.0002	0.0005	0.005	0.015	--	C	4.20E-03	4.20E-03	C	1.80E-01	1.80E-01	C	4.00E-02	4.00E-02	5.60E-02	1.00E-01	1.90E-03
Endosulfan I	959-98-8	0.0002	0.0005	0.005	0.015	--	N	2.20E+02	2.20E+01	N	6.10E+03	6.10E+02	N	4.70E+02	4.70E+01	5.10E-02	-	2.90E-03
Endosulfan II	33213-65-9	0.0002	0.0005	0.005	0.015	--	N	2.20E+02	2.20E+01	N	6.10E+03	6.10E+02	N	4.70E+02	4.70E+01	5.10E-02	-	1.40E-02
Endosulfan sulfate	1031-07-8	0.0002	0.0005	0.005	0.015	--	N	2.20E+02	2.20E+01	N	6.10E+03	6.10E+02	N	4.70E+02	4.70E+01	--	-	5.40E-03
Endrin	72-20-8	0.0002	0.0005	0.005	0.015	2.00E+00	N	1.10E+01	1.10E+00	N	3.10E+02	3.10E+01	N	2.30E+01	2.30E+00	3.60E-02	1.00E-01	2.20E-03
Endrin aldehyde	7421-93-4	0.0002	0.0005	0.005	0.015	--	N	1.10E+01	1.10E+00	N	3.10E+02	3.10E+01	N	2.30E+01	2.30E+00	--	1.00E-01	--
Endrin ketone	53494-70-5	0.0002	0.0005	0.005	0.015	--	N	1.10E+01	1.10E+00	N	3.10E+02	3.10E+01	N	2.30E+01	2.30E+00	--	1.00E-01	--
gamma-BHC (Lindane)	58-89-9	0.0002	0.0005	0.005	0.015	2.00E-01	C	5.20E-02	5.20E-02	C	2.20E+00	2.20E+00	C	4.90E-01	4.90E-01	--	1.00E-01	--
Heptachlor	76-44-8	0.0002	0.0005	0.005	0.015	4.00E-01	C	1.50E-02	1.50E-02	C	6.40E-01	6.40E-01	C	1.40E-01	1.40E-01	3.80E-03	1.00E-01	6.80E-02
Heptachlor epoxide	1024-57-3	0.0002	0.0005	0.005	0.015	2.00E-01	C	7.40E-03	7.40E-03	C	3.10E-01	3.10E-01	C	7.00E-02	7.00E-02	3.80E-03	1.00E-01	2.50E-03
Methoxychlor	72-43-5	0.0002	0.0005	0.005	0.015	4.00E+01	N	1.80E+02	1.80E+01	N	5.10E+03	5.10E+02	N	3.90E+02	3.90E+01	1.90E-02	1.00E-01	1.90E-02
Toxaphene	8001-35-2	0.011	0.033	0.33	1	3.00E+00	C	6.10E-02	6.10E-02	C	2.60E+00	2.60E+00	C	5.80E-01	5.80E-01	2.00E-04	-	1.00E-03
Polychlorinated Biphenyls by Method 8082																		
Aroclor 1016	12674-11-2	0.005	0.017	0.125	0.5	0.5	C!/N	9.60E-01	2.60E-01	C!/N	4.10E+01	7.20E+00	N	5.50E+00	5.50E-01	7.40E-05	1.00E-01	--
Aroclor 1221	11104-28-2	0.005	0.017	0.125	0.5	0.5	C	3.30E-02	3.30E-02	C	1.40E+00	1.40E+00	C	3.20E-01	3.20E-01	7.40E-05	1.00E-01	--
Aroclor 1232	11141-16-5	0.005	0.017	0.125	0.5	0.5	C	3.30E-02	3.30E-02	C	1.40E+00	1.40E+00	C	3.20E-01	3.20E-01	7.40E-05	1.00E-01	--
Aroclor 1242	53469-21-9	0.005	0.017	0.125	0.5	0.5	C	3.30E-02	3.30E-02	C	1.40E+00	1.40E+00	C	3.20E-01	3.20E-01	7.40E-05	1.00E-01	--
Aroclor 1248	12672-29-6	0.005	0.017	0.125	0.5	0.5	C	3.30E-02	3.30E-02	C	1.40E+00	1.40E+00	C	3.20E-01	3.20E-01	7.40E-05	1.00E-01	--
Aroclor 1254	11097-69-1	0.005	0.017	0.125	0.5	0.5	C	3.30E-02	3.30E-02	C	1.40E+00	1.40E+00	C!/N	3.20E-01	1.60E-01	7.40E-05	1.00E-01	--
Aroclor 1260	11096-82-5	0.005	0.017	0.125	0.5	0.5	C	3.30E-02	3.30E-02	C	1.40E+00	1.40E+00	C	3.20E-01	3.20E-01	7.40E-05	1.00E-01	--
Herbicides by Method 8151																		
2,4,5-T	93-76-5	0.0025	0.0075	0.025	0.075	--	N	3.65E+02	3.65E+01	N	1.02E+04	1.02E+03	N	7.82E+02	7.82E+01	686	--	12.3
2,4,5-TP (Silvex)	93-72-1	0.025	0.0075	0.025	0.075	5.00E+01	N	2.92E+02	2.92E+01	N	8.18E+03	8.18E+02	N	6.26E+02	6.26E+01	30	--	0.675
2,4-D	94-75-7	0.025	0.075	0.25	0.75	7.00E+01	N	3.65E+02	3.65E+01	N	1.02E+04	1.02E+03	N	7.82E+02	7.82E+01	--	--	--
2-4-DB	94-82-6	0.025	0.075	0.25	0.75	--	N	2.92E+02	2.92E+01	N	8.18E+03	8.18E+02	N	6.26E+02	6.26E+01	--	--	--

Table 8-4
Summary of Analyte MDLs, Reporting Limits, and Risk Screening Levels for TCL Pesticides (8081A), and PCBs (8082), and Herbicides (8151)
Radford Army Ammunition Plant, Radford, Virginia

	CAS Number	Laboratory-Specific Method Detection and Reporting Limits (a)				USEPA MCLs	USEPA Region III Risk-Based Concentrations (b)									USEPA Region III BTAG Screening Levels (c)		
		Soil		Water			Tap Water			Soil Industrial			Soil Residential			Aqueous Fresh Water	Soil	Sediment
		MDL	Reporting Limit	MDL	Reporting Limit	MCL	C/N	RBC	Adjusted RBC	C/N	RBC	Adjusted RBC	C/N	RBC	Adjusted RBC			
		mg/kg	mg/kg	ug/L	ug/L	ug/L		ug/L	ug/L		mg/kg	mg/kg		mg/kg	mg/kg	ug/L	mg/kg	mg/kg
Dalapon	75-99-0	0.0625	0.19	0.625	1.9	2.00E+02	N	1.10E+03	1.10E+02	N	3.07E+04	3.07E+03	N	2.35E+03	2.35E+02	--	--	--
Dicamba	1918-00-9	0.0625	0.19	0.625	1.9	--	N	1.10E+03	1.10E+02	N	3.07E+04	3.07E+03	N	2.35E+03	2.35E+02	--	--	--
Dichlorprop	120-36-5	0.025	0.075	0.25	0.75	--	--	--	--	--	--	--	--	--	--	--	--	--
Dinoseb	88-85-7	0.0125	0.038	0.125	0.38	7.00E+00	N	3.65E+01	3.65E+00	N	1.02E+03	1.02E+02	N	7.82E+01	7.82E+00	0.05	--	0.000611
MCPA	94-74-6	2.5	7.5	25	75	--	N	1.83E+01	1.83E+00	N	5.11E+02	5.11E+01	N	3.91E+01	3.91E+00	--	--	--
MCPP (Mecoprop)	93-65-2	2.5	7.5	25	75	--	N	3.65E+01	3.65E+00	N	1.02E+03	1.02E+02	N	7.82E+01	7.82E+00	--	--	--

Notes:
(a) Method Detection Limits and Reporting Limits provided by Empirical Laboratories, LLC
(b) USEPA Region 3 Risk-based Concentrations (October 2007)
(c) BTAG Screening Levels [1995 (soil), 2004 (surface water and sediment)].

Acronyms:
-- = Screening level unavailable.
BTAG = Biological Technical Assistance Group
CAS = Chemical Abstract Service
C!/N = RBC at HI of 0.1 < RBC-c; RBC from alternate RBC table.
C= RBC based cancer endpoint.
MCL = Maximum Contaminant Level
MDL = Method Detection Limit
mg/kg = Milligram Per kilogram
N = RBC based on non-carcinogenic endpoint.
PCBs = Polychlorinated Biphenyls
RBC = USEPA Region III Risk
RL = Reporting Limit
TCL = Target Compound List
ug/L = Microgram Per liter

Table 8-5
Summary of Analyte Detection Limits, Reporting Limits, and Risk Screening Levels for Explosives (Methods 8330, 8330M, and 8332)
Soil and Water Samples MQAP Addendum - PBC2
Radford Army Ammunition Plant,
Radford, Virginia

	CAS Number	Laboratory-Specific Method Detection and Reporting Limits (a)				USEPA MCLs	USEPA Region III Risk-Based Concentrations (b)									USEPA Region III BTAG Screening Levels (c)		
		Soil		Water			Tap Water			Soil Industrial			Soil Residential			Aqueous Fresh Water	Soil	Sediment
		MDL	Reporting Limit	MDL	Reporting Limit	MCL	C/N	RBC	Adjusted RBC	C/N	RBC	Adjusted RBC	C/N	RBC	Adjusted RBC			
		mg/k	mg/kg	ug/L	ug/L	ug/L		ug/L	ug/L		mg/kg	mg/kg		mg/kg	mg/kg	ug/L	mg/k	mg/kg
Compounds by Method 8330																		
1,3,5-Trinitrobenzene	99-35-4	0.1	0.5	0.1	0.5	NA	N	1.1E+03	1.1E+02	N	3.1E+04	3.1E+03	N	2.3E+03	2.3E+02	--	--	--
1,3-Dinitrobenzene	99-65-0	0.1	0.5	0.1	0.36	NA	N	3.7E+00	3.7E-01	N	1.0E+02	1.0E+01	N	7.8E+00	7.8E-01	--	--	--
2,4,6-Trinitrotoluene	118-96-7	0.1	0.5	0.1	0.5	NA	C/N	2.2E+00	1.8E+00	C!/N	9.5E+01	5.1E+01	C!/N	2.1E+01	3.9E+00	1.0E+02	--	9.2E-02
2,4-Dinitrotoluene	121-14-2	0.13	0.5	0.1	0.5	NA	N	7.3E+01	7.3E+00	N	2.0E+03	2.0E+02	N	1.6E+02	1.6E+01	4.4E+01	--	4.2E-02
2,6-Dinitrotoluene	606-20-2	0.13	0.5	0.1	0.5	NA	N	3.7E+01	3.7E+00	N	1.0E+03	1.0E+02	N	7.8E+01	7.8E+00	8.1E+01	--	--
2-Amino-4,6-dinitrotoluene	35572-78-2	0.15	0.5	0.1	0.5	NA	N	7.3E+01	7.3E+00	N	2.0E+03	2.0E+02	N	1.6E+02	1.6E+01	1.5E+03	--	--
2-Nitrotoluene	88-72-2	0.1	0.5	0.1	0.5	NA	N	6.1E+01	6.1E+00	N	1.0E+04	1.0E+03	N	7.8E+02	7.8E+01		--	--
3-Nitrotoluene	99-08-1	0.15	0.5	0.1	0.5	NA										7.5E+02	--	--
4-Amino-2,6-dinitrotoluene	1946-51-0	0.1	0.5	0.1	0.5	NA	N	7.3E+01	7.3E+00	N	2.0E+03	2.0E+02	N	1.6E+02	1.6E+01		--	--
4-Nitrotoluene	99-99-0	0.1	0.5	0.1	0.5	NA										1.9E+03	--	4.1E+00
HMX	2691-41-0	0.1	0.5	0.1	0.5	NA	N	1.8E+03	1.8E+02	N	5.1E+04	5.1E+03	N	3.9E+03	3.9E+02	1.5E+02	--	--
Nitrobenzene	98-95-3	0.11	0.5	0.1	0.33	NA	N	3.5E+00	3.5E-01	N	5.1E+02	5.1E+01	N	3.9E+01	3.9E+00		--	--
RDX	121-82-4	0.1	0.5	0.1	0.5	NA	C	6.1E-01	6.1E-01	C	2.6E+01	2.6E+01	C	5.8E+00	5.8E+00	3.6E+02	--	1.3E-02
Tetryl (Methyl-2,4,6-trinitrophenylnitramine)	479-45-8	0.1	0.5	0.1	0.5	NA	N	1.5E+02	1.5E+01	N	4.1E+03	4.1E+02	N	3.1E+02	3.1E+01	--	--	--
PETN	78-11-5	1.6	5	1.3	5	NA	--	--	--	--	--	--	--	--	--	8.5E+04	--	--
Compound by Method 8332																		
Nitroglycerin	55-63-0	1.6	4.8	1.3	4.8	NA	N	3.7E+00	3.7E-01	N	1.0E+02	1.0E+01	N	7.8E+00	7.8E-01	1.4E+02	--	--

Notes:
(a) Method Detection Limits and Reporting Limits provided by Empirical Laboratories, LLC
(b) USEPA Region 3 Risk-based Concentrations (October 2007)
(c) BTAG Screening Levels [1995 (soil), 2004 (surface water and sediment)].

Acronyms:
-- = Screening level unavailable.
BTAG = Biological Technical Assistance Group
C!/N = RBC at HI of 0.1 < RBC-c; RBC from alternate RBC table.
C= RBC based cancer endpoint.
CAS = Chemical Abstract Service
HMX = Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine
MCL = Maximum Contaminant Level
MDL = Method Detection Limit
mg/kg = Milligram Per kilogram
N = RBC based on non-carcinogenic endpoint.
PCBs = Polychlorinated Biphenyls
RBC = USEPA Region III Risk
RDX = Hexahydro-1,3,5-trinitro-1,3,5-triazine
RL = Reporting Limit
TCL = Target Compound List
ug/L = Microgram Per liter

Table 8-6
Summary of Analyte Detection Limits, Reporting Limits, and Risk Screening Levels for Dioxin/Furans (Mehtod 8290)
Soil and Water Samples PBC2 Project QAPP Addendum
Radford Army Ammnunition Plant,
Radford, Virginia

Dioxins and Furans by Method 8290	CAS Number	Laboratory-Specific Method Detection and Reporting Limits				USEPA MCLs	USEPA Region III Risk-Based Concentrations									USEPA Region III BTAG Screening Levels		
		Soil		Water			Tap Water			Soil Industrial			Soil Residential			Aqueous Fresh Water	Soil	Sediment
		MDL	Reporting Limit	MDL	Reporting Limit	MCL	C/N	RBC	Adjusted RBC	C/N	RBC	Adjusted RBC	C/N	RBC	Adjusted RBC			
		ppt	ppt	ppq	ppq	ug/L		ug/L	ug/L		mg/kg	mg/kg		mg/kg	mg/kg	ug/L	mg/kg	mg/kg
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	1746-01-6	0.0591	1	0.94	10	3.00E-05	C	4.46E-07	--	C	1.91E-05	--	C	4.26E-06	--	--	--	--
1,2,3,7,8-Pentachlorodibenzo-p-dioxin (PeCDD)	40321-76-4	0.288	5	0.963	50	--	--		--	--	--	--	--	--	--	--	--	--
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)[a]	39227-28-6	0.187	5	1.23	50	--	C	1.08E-05	--	C	4.62E-04	--	C	1.03E-04	--	--	--	--
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)[a]	57653-85-7	0.276	5	2.06	50	--	C	1.08E-05	--	C	4.62E-04	--	C	1.03E-04	--	--	--	--
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (HxCDD)[a]	19408-74-3	0.288	5	1.46	50	--	C	1.08E-05	--	C	4.62E-04	--	C	1.03E-04	--	--	--	--
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (HpCDD)	35822-46-9	0.293	5	3.46	50	--	--	--	--	--	--	--	--	--	--	--	--	--
1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD)	3268-87-9	0.644	10	1.03	100	--	--	--	--	--	--	--	--	--	--	--	--	--
2,3,7,8-Tetrachlorodibenzofuran (TCDF)	51207-31-9	0.162	1	0.563	10	--	--	--	--	--	--	--	--	--	--	--	--	--
1,2,3,7,8-Pentachlorodibenzofuran (PeCDF)	57117-41-6	0.367	5	2.25	50	--	--	--	--	--	--	--	--	--	--	--	--	--
2,3,4,7,8-Pentachlorodibenzofuran (PeCDF)	57117-31-4	0.247	5	1.5	50	--	--	--	--	--	--	--	--	--	--	--	--	--
1,2,3,4,7,8-Hexachlorodibenzofuran (HxCDF)	70648-26-9	0.336	5	2.59	50	--	--	--	--	--	--	--	--	--	--	--	--	--
1,2,3,6,7,8-Hexachlorodibenzofuran (HxCDF)	57117-44-9	0.153	5	2.02	50	--	--	--	--	--	--	--	--	--	--	--	--	--
1,2,3,7,8,9-Hexachlorodibenzofuran (HxCDF)	72918-21-9	1.05	5	2.16	50	--	--	--	--	--	--	--	--	--	--	--	--	--
2,3,4,6,7,8-Hexachlorodibenzofuran (HxCDF)	60851-34-5	0.304	5	2.97	50	--	--	--	--	--	--	--	--	--	--	--	--	--
1,2,3,4,6,7,8-Heptachlorodibenzofuran (HpCDF)	67562-39-4	0.604	5	1.79	50	--	--	--	--	--	--	--	--	--	--	--	--	--
1,2,3,4,7,8,9-Heptachlorodibenzofuran (HpCDF)	55673-89-7	0.257	5	1.94	50	--	--	--	--	--	--	--	--	--	--	--	--	--
1,2,3,4,5,6,7,8-Octachlorodibenzofuran (OCDF)	39001-02-0	0.694	10	2.52	100	--	--	--	--	--	--	--	--	--	--	--	--	--

Notes:
CAS = Chemical Abstract Service
ppt = part per trillion
ppq = part per quadrillion
ug/L = Microgram Per liter
MDL = Method Detection Limit
RL = Reporting Limit
Method Detection Limits provided by SGS Environmental Services, Inc,
-- = No Risk Criteria Available

MCL = Maximum Contaminant Level
BTAG = Biological Technical Assistance Group
Soil - BTAG Screening Draft Values, 1995
Water - BTAG Freshwater Screening Values, 2004
Sediment - BTAG Sediment Screening Values, 2004
RBC = USEPA Region III Risk Based Concentration, Oct 2007
C/N = Carcinogenic /Noncarcinogenic
[a] = RBC value is for Hexachlorodibenzo-p-dioxin mix
[b] = Reporting limit was not low enough to meet screening criteria - but MDL does

Table 8-7
General Field Equipment and Calibration Procedures
Radford Army Ammunition Plant
Radford, Virginia

Instrument or Equipment	Description	Field Calibration Procedure	Performance Criteria	Responsible Personnel
pH/Conductivity, Temperature Meter	Meter designed for field use with battery operation. Range pH: 0 to 14 S.U. Range conductivity: 0 to 2,000 uS.	Instruments are factory-calibrated and automatically compensate for temperature. Calibration of the meters for pH will be completed each day immediately prior to use in accordance with ARCADIS SOPs T106 and/or T131 and the manufacturers recommendations. In general pH meter calibration will include two pH buffers bracketing expected pH range of samples to be measured (i.e. 7.00 and 4.00) with a verification of the slope using a third buffer (4.00 or 10.00) The electrode will be rinsed between buffers and stored in the manufacturer recommended solutions between field measurements. Conductivity calibrations are conducted similarly to the pH calibration utilizing two calibration standards and adjusting the meter to the appropriate values. Calibrations will be verified with a pH buffer at least every 4 hours and at the end of the sampling day.	pH +/- 0.01 S.U. Conductivity at +/- 2%FSD. The instrument will be checked with a pH buffer every 4 hours and at the end of the sampling day. If the response is greater than $\pm$ 0.2 S.U. from the standard, complete re-calibration will be conducted. Conductivity will be checked every 4 hours.	Sample Collection Personnel
pH/Conductivity, Temperature, Dissolved oxygen (DO), Oxidation/ Reduction (REDOX) Meter	YSI Model 600 XL probe with YSI Model 610-D display instrumentation or the QED FC4000. Units must automatically correct for salinity at low DO readings by estimating salinity from temperature and conductivity measurements, and then internally adjusting the DO reading. The probes must contain separate pH, temperature, conductivity, DO, and ORP probes in one unit.	Each day prior to use, the pH, specific conductance, DO, and ORP probes will be calibrated or tested for responsiveness in accordance with ARCADIS SOPs and the manufacturers recommendations. The pH probe will be calibrated utilizing two buffers (pH 7.00, then pH 4.00), and a verification buffer. The ORP probe is then calibrated with the ORP standard solution (Zobell), and the DO probe is checked with saturated air in accordance with manufacturers guidance The probes should be rinsed with deionized water between each calibration solution and following calibration. Used calibration solution is to be discarded. Finally, the conductivity probe is checked with a solution of known conductivity.	Turbidity and DO - +/- 10% pH +/- 0.01 S.U. Conductivity at +/- 2%FSD The instrument calibration will be verified every 4 hours and at the end of the sampling day. For pH, if the calibration check is greater than $\pm$ 0.2 S.U. from the true value, complete calibration will be conducted.	Project Geologist, Sample Collection Personnel

Table 8-7
General Field Equipment and Calibration Procedures
Radford Army Ammunition Plant
Radford, Virginia

Instrument or Equipment	Description	Field Calibration Procedure	Performance Criteria	Responsible Personnel
Turbidimeter	Nephelometer designed for field use with battery operation. Range 0.01 to 1000 NTU.	The unit is factory calibrated. Unit responsiveness will be checked prior to use each day with appropriate standards provided by the supplier. The responsiveness is checked on the 0 to 10 range, 0 to 100 range, and 0 to 1000 range.	+/- 10%	Sample Collection Personnel
HNU Photoionization Detector	Photoionization detector that is a portable, non-destructive trace gas analyzer. Units must be Class I, Division 2, Grade A,B,C,D. Unit must have rechargeable battery, range of 0 to 2000 ppm, and a 10.2 or 11.7 eV lamp. Calibration check gas (e.g., isobutylene must be provided with unit).	Instrument is calibrated internally prior to shipment from the warehouse or every 6 months, whichever is more frequent. In the field, HNUs will be calibrated at the start of each day in accordance with manufacturers instructions. If a significant change in weather occurs during the day (i.e., change in humidity or temperature) or if the unit is turned off for an extended period, the instrument will be recalibrated at prior to use. When an HNU is used to screen samples in the field, periodic ambient readings will also be recorded in the logbook. The general calibration procedure include: • Turn unit on and allow for five minute warm-up; • Set span control for probe being used (10.2 or 11.7); • Set function switch to standby position and adjust zero using zero adjust knob; • Set function switch to the 0 to 200 ppm range; • Connect the analyzer to the regulator and calibration gas cylinder • 0pen the regulator valve and allow the meter reading to stabilize; and • Using the span knob, adjust the meter to the concentration indicated on the calibration gas cylinder.	Meter must be able to adjust properly using the span knob or the lamp may require cleaning.	Site Safety Officer

Table 8-8
Field Quality Control Samples
Radford Army Ammunition Plant, Radford, Virginia

Control	Purpose of Sample	Collection Frequency
Field Duplicate	Ensure precision in sample homogeneity during collection and analysis	20% of field samples per matrix
Rinse Blank	Ensure the decontamination of sampling equipment has been adequately performed; to assess cross contamination and/or incidental contamination to the sample container	1 per 20 samples per matrix per sample technique
Temperature Blank	To verify sample cooler temperature upon receipt at the laboratory	1 per cooler
Trip Blank	To evaluate potential cross contamination of samples during transport or storage.	1 per cooler containing sample requiring VOC analyses

Table 8-9
Field Quality Control Elements Acceptance Criteria
Radford Army Ammunition Plant, Radford, Virginia

Item	DQO	Parameter	Frequency of Association	Criteria Goal
Field Duplicates	P, R	Organics	1 per 10 samples	RPD < 40% Aqueous; difference + RL* RPD < 60% Solid; difference + 2xRL*
Trip Blank	A,R	VOCs in water	1 per cooler with aqueous VOCs	No target analytes detected greater than the RL
Rinse Blank	A,R	Entire	1 per 20 samples per matrix per equipment type requiring decontamination	No target analytes detected greater than the RL
Chain of Custody Forms	R	Entire	Every sample	Filled out correctly to include signatures; no missing or incorrect information.
Representative Sampling Forms	R	Entire	Every sample	Filled out correctly to include signatures; no missing or incorrect information.
Field Logbook	R	Entire	Every sample	Filled out correctly to include analytical parameters; map file data; and applicable coding information.
Field Instrument Calibration Logs	A	Entire	Every measurement	Measurements must have associated calibration reference

A = Accuracy C = Comparability R = Representativeness P = Precision

Table 8-10
Analytical Quality Control Elements
Radford Army Ammunition Plant, Radford, Virginia

Item	DQO	Parameter	Frequency of Association	Criteria Requirement
Analytical Method	C	Entire	Each analysis	Method analyses based on USEPA methods as defined in Section 2.5
Chemical Data Packages	C	Entire	Each lot/batch	Pass peer review and formal QA/QC check.
Laboratory System Controls	A,C,P, R	Entire	During laboratory operations	No deficiencies
Holding Time	A,C,P, R	Entire	Each analysis	No deficiencies (Table 6-1)
Initial and Continuing Calibrations	A, P	Entire	As method applicable	Must meet method criteria and laboratory SOPs.
Method Blanks	A,R	Entire	Each lot/batch	No target analyte detected in the method blanks greater than RL
Laboratory Control Sample (LCS) and LSC Duplicate	A	Entire	Each lot/batch	Must meet criteria as defined in Tables 8-7 through 8-13
Matrix Spike MS, MS Duplicates, and Laboratory Replicates	A,P	Entire	Each lot/batch	Must meet criteria as defined in Tables 8-7 through 8-13
Surrogates	A	Entire	Organic fractions, including QC samples	Must meet criteria as defined in Tables 8-7 through 8-13
Serial dilution and Post Digestion Spike	A	Metals	Inorganic Fractions, Each lot/batch	Must meet criteria as defined in Table 8-10

Legend: A = Accuracy C = Comparability R = Representativeness P = Precision

Table 8-11
Quality Control Method Criteria for Volatile Organic Compounds by USEPA SW-846 8260B
Radford Army Ammunition Plant
Radford, Virginia

Procedure	Frequency	Acceptance Criteria		Corrective Action
Initial Calibration 5-pt curve (linear) 6-pt curve (2^o order)	Set-up, major maintenance, or for drift correction	RRF > 0.10/0.30 for SPCCs RSD < 30% for CCCs response factors RSD for analytes < 15% or r>0.995 (linear) or r^2>0.99 (2^o order)		Sample analysis cannot begin until this criterion is met. Data reviewer should review and judge each target compound against the acceptance criteria.
Initial Calibration Verification	Immediately following initial calibration	A second source full compliment target list with a percent recovery = 75-125%		Sample analysis cannot begin until this criterion is met.
Continuing Calibration Check	Every 12 hours	RRF > 0.10/0.30 for SPCCs %Difference for RF of CCCs ±30% from initial calibration. Mean for analytes < 20% as no individual target exceeds 40%D		Sample analysis cannot begin until this criterion is met. Data reviewer should review and judge each target compound against the acceptance criteria.
Method Blank	Every day/batch.	No target analytes greater than one half of the RL		Document source of contamination. Re-analysis is required for positive results associated with blank contamination.
Tuning BFB	Prior to calibration and every 12 hours	Must meet tuning criteria		Re-tune, re-calibrate, and re-analyze affected sample analyses.
Laboratory Control Spike	Every batch	Standards Full compliment target list	Laboratory generated control limits not to exceed recovery limits listed in the current version of the DOD QSM	Recoveries indicating a low bias require a re-extraction/reanalysis. Recoveries indicating a high bias require a re-extraction/re-analysis for associated positive field samples. Qualify associated data biased high or biased low as appropriate.
Internal Standards	Every sample	Recommended Standards fluorobenzene chlorobenzene-d5 1,4-dichlorobenzene-d4	Retention time ±30 seconds of mid point of initial calibration Area changes within a factor of two (-50% to +100%)	Inspect for malfunction. Demonstrate that system is functioning properly. Reanalyze samples associated with standards outside criteria. A third analytical run may be required at a dilution.

Table 8-11
Quality Control Method Criteria for Volatile Organic Compounds by USEPA SW-846 8260B
Radford Army Ammunition Plant
Radford, Virginia

Procedure	Frequency	Acceptance Criteria		Corrective Action
Surrogate	Every sample	Recommended Standards Toluene-d8 4-Bromofluorobenzene 1,2-Dichloroethane-d4	Laboratory generated control limits not to exceed those listed in the current version of the DOD QSM	If surrogate compounds do not meet criteria, there should be a re-analysis to confirm that the non-compliance is due to the sample matrix effects rather than laboratory deficiencies.
Matrix Spike and Duplicate	1 per 20 per matrix	Standards Full compliment target list	Laboratory generated control limits not to exceed recovery	If MS/MSD results do not meet criteria, the reviewer should review the data in

Table 8-12
Quality Control Method Criteria for Semi-volatile Organic Compounds by USEPA SW-846 8270C
Radford Army Ammunition Plant
Radford, Virginia

Procedure	Frequency	Acceptance Criteria		Corrective Action
Initial calibration 5-pt curve (linear) 6-pt curve (2^o order)	Set-up, major maintenance, or for drift correction	RRF > 0.05 for SPCCs RSD <30% for CCC compounds RSD for target analytes < 15% or r>0.995 (linear) or r^2>0.99 (2^o order)		Sample analysis cannot begin until this criterion is met. Data reviewer should review and judge each target compound against the acceptance criteria.
Initial Calibration Verification	Immediately following every initial calibration	A second source full compliment target list with a 80-120%		Sample analysis cannot begin until this criterion is met.
Continuing Calibration Check	12 hours	RRF > 0.05 for SPCCs %Difference for RF of CCCs ±30% from initial calibration Mean for analytes < 20% as no individual target exceeds 40%D		Sample analysis cannot begin until this criterion is met. Data reviewer should review and judge each target compound against the acceptance criteria.
Internal standards	Every sample	Retention time ±30 seconds from mid point of initial calibration Area changes by a factor of two (-50% to +100%)		Inspect for malfunction. Demonstrate that system is functioning properly. Reanalyze samples with internal standards outside criteria.
Tuning DFTPP	12 hours	Must meet tuning criteria.		Re-tune, re-calibrate, and re-analyze affected sample analyses.
Method Blank	Per extraction batch	No target analytes greater than one half of the RL		Document source of contamination. Re-extraction/re-analysis is required for positive results associated with blank contamination.
Laboratory Control Spike	Every batch	Standards Full compliment target list	Laboratory generated control limits not to exceed recovery limits listed in the current version of the DoD QSM	Recoveries indicating a low bias require a re-extraction/reanalysis. Recoveries indicating a high bias require a re-extraction/re-analysis for associated positive field samples. Qualify associated data biased high or biased low as appropriate.

Table 8-12
Quality Control Method Criteria for Semi-volatile Organic Compounds by USEPA SW-846 8270C
Radford Army Ammunition Plant
Radford, Virginia

Procedure	Frequency	Acceptance Criteria		Corrective Action
Internal Standards	Every sample	Recommended Standards phenanthrene-d10 chrysene-d12 perylene-d12 1,4-dichlorobenzene-d4 naphthalene-d8 acenaphthalene-d10	Retention time ±30 seconds of mid point of initial calibration Area changes within a factor of two (-50% to +100%)	Inspect for malfunction. Demonstrate that system is functioning properly. Reanalyze samples associated with standards outside criteria. A third analytical run may be required at a dilution.
Surrogate Spikes	Every sample	Recommended Standards nitrobenzene-d5 2-fluorobiphenyl p-terphenyl-d14 phenol-d5 2,4,6-tribromophenol 2-fluorophenol	Laboratory generated control limits not to exceed limits listed in the current version of the DoD QSM	If two base/neutral or acid surrogates are out of specification, or if one base/neutral or acid extractable surrogate has a recovery of less than 10%, then there should be a re-extraction and re-analysis to confirm that the non-compliance is due to sample matrix effects rather than laboratory deficiencies.
Matrix Spike and Duplicate	1 per 20 samples per matrix	Standards Full compliment target list	Laboratory generated control limits not to exceed recovery limits listed in the current version of the DoD QSM	If MS/MSD results do not meet criteria, the reviewer should review the data in conjunction with other QC results to identify whether the problem is specific to the QC samples or systematic.

Table 8-13
Quality Control Method Criteria for Explosives by USEPA SW-846 8330 and 8332
Radford Army Ammunition Plant
Radford, Virginia

Procedure	Frequency of QC Procedure	Acceptance Criteria	Corrective Action
Initial Calibration Curve 5-pt curve (linear) 6-pt curve (2^{o} order)	Set-up, major maintenance, or for drift correction for each column used for analysis	%RSD <20% or r>0.995 (linear) or r2>0.99 (2o order)	Sample analysis cannot begin until this criterion is met.
Initial Calibration Verification	Immediately following every initial calibration	A second source full compliment of target list with recovery = 80-120%	Sample analysis cannot begin until this criterion is met.
Continuing Calibration Check	Every ten samples or twelve hours	%D ± 15% of the response factor from the initial curve. The mean may be used as long as no individual target exceeds 30%D	Sample analysis cannot begin until this criterion is met. If criteria are not met, reanalyze the daily standard. If the daily standard fails a second time, initial calibration must be repeated. Data reviewer should review and judge each target compound against the acceptance criteria.
Method Blank	1 per batch	No target analytes detected greater than one half of the RL	Document source of contamination. Re-extraction/re-analysis is required for positive results associated with blank contamination.

Table 8-13
Quality Control Method Criteria for Explosives by USEPA SW-846 8330 and 8332
Radford Army Ammunition Plant
Radford, Virginia

Procedure	Frequency of QC Procedure	Acceptance Criteria		Corrective Action
Laboratory Control Spike	1 per batch	Standards Full compliment target list	Laboratory generated control limits not to exceed recovery limits listed in the current version of the DOD QSM	Recoveries indicating a low bias require a re-extraction/reanalysis. Recoveries indicating a high bias require a re-extraction/re-analysis for associated positive field samples. Qualify associated data biased high or biased low as appropriate.
Surrogate Spikes	Every sample	Standards A similar compound that is not expected to be found at the site	Laboratory generated control limits not to exceed limits listed in the current version of the DOD QSM	If surrogate compounds do not meet criteria, there should be a re-extraction and re-analysis to confirm that the non-compliance is due to the sample matrix effects rather than laboratory deficiencies.
Matrix Spike and Duplicate	1 per 20 samples per matrix	Standards Full compliment target list	Laboratory generated control limits not to exceed recovery limits listed in the current version of the DOD QSM	If MS/MSD results do not meet criteria, the reviewer should review the data in conjunction with other QC results to identify whether the problem is specific to the QC samples or systematic.

Table 8-13
Quality Control Method Criteria for Explosives by USEPA SW-846 8330 and 8332
Radford Army Ammunition Plant
Radford, Virginia

Procedure	Frequency of QC Procedure	Acceptance Criteria	Corrective Action
Target Analyte Confirmation	Every positive detection	RPD < 40%	Report the higher of the two concentrations unless a positive bias is apparent and qualify.

Table 8-14
Quality Control Method Criteria for Target Analyte List Metals by USEAP SW-846 6020/6010B/7471A/7470A/9010C/9012A
Radford Army Ammunition Plant
Radford, Virginia

Procedure	Frequency of QC Procedure	Acceptance Criteria		Corrective Action
Tune (MS) [6020]	Daily	Analyzed a minimum of four times with RSD < 5% for analytes in the solution.		Sample analysis cannot begin until this criterion is met.
Mass Calibration (MS) [6020]	Daily	Difference < 0.1 amu from true value.		Adjust to the correct value.
Resolution Check (MS) [6020]	Daily	Peak width <0.9 amu at 10% peak height		Sample analysis cannot begin until this criterion is met.
Initial Calibration Curve (MS, ICP, Hg, & CN)	Daily, major maintenance, or to correct drift.	MS & ICP Option 1: 1-standard and a blank with a low level standard at RL.	Low level check standard + 20%.	The standards for that element must be re-prepared and re-analyzed again.
		MS & ICP Option 2: 3-standards and a blank	r > 0.995 for each element	
		Hg - 5-standards and a blank	r > 0.995	
		CN - 6 standards and a blank	r > 0.995	
Distilled Standards (CN)	Once per calibration	One high and one low distilled standard within + 10% of the true value		Sample analysis cannot begin until this criterion is met.

Table 8-14
Quality Control Method Criteria for Target Analyte List Metals by USEAP SW-846 6020/6010B/7471A/7470A/9010C/9012A
Radford Army Ammunition Plant
Radford, Virginia

Procedure	Frequency of QC Procedure	Acceptance Criteria	Corrective Action
Initial Calibration Verification (MS, ICP, Hg, & CN)		MS & ICP - A second source full compliment of target list with a percent recovery = 90-110%	Sample analysis cannot begin until this criterion is met.
	Immediately following initial calibration.	Hg - A second source full compliment of target list with a percent recovery = 80-120%	
		CN - A second source full compliment of target list with a percent recovery = 85-115%	
Initial Calibration Blank (MS, ICP, Hg, & CN)	Immediately following initial calibration verification.	No target analytes detected at concentration above 2 X MDL.	Sample analysis cannot proceed until this criterion is met.
Interference Check (MS & ICP)	Beginning of each sample analytical run.	Recovery ±20% of true value.	Terminate the analysis, correct the problem, re-calibrate, re-verify the calibration, and reanalyze associated samples.
Continuing Calibration Check (MS, ICP, Hg, & CN)	Every 10 samples and end of analytical run.	MS & ICP - Recovery ±10%.	Reanalyze; if the CCV fails again, stop analysis, the problem corrected, the instrument recalibrated, and the calibration re-verified prior to continuing sample analyses.
		Hg - Recovery ±20%.	
		CN - Recovery ±15%.	

Table 8-14
Quality Control Method Criteria for Target Analyte List Metals by USEAP SW-846 6020/6010B/7471A/7470A/9010C/9012A
Radford Army Ammunition Plant
Radford, Virginia

Procedure	Frequency of QC Procedure	Acceptance Criteria		Corrective Action
Continuing Calibration Blank (MS, ICP, Hg, & CN)	Every 10 samples and end of analytical run.	No target analytes detected at concentration above 2 X MDL.		Sample sequence should not continue until this criterion is met. Demonstrate "clean". Affected samples will be reanalyzed.
Preparation Blank (MS, ICP, Hg, & CN)	1 per batch per matrix	No target analytes detected at concentration above one half of the RL.		Document source of contamination. Re-digestion/re-analysis is required for positive results associated with blank contamination, unless DQOs are still met.
Laboratory Control Sample (MS, ICP, Hg, & CN)	1 per batch per matrix	Standards Full compliment target list.	80-120% recovery Soil use generated limits	Recoveries indicating a low bias require a redigestion/ reanalysis. Recoveries indicating a high bias require a redigestion/ reanalysis for associated positive field samples. Qualify data biased high or biased low as appropriate.

Table 8-14
Quality Control Method Criteria for Target Analyte List Metals by USEAP SW-846 6020/6010B/7471A/7470A/9010C/9012A
Radford Army Ammunition Plant
Radford, Virginia

Procedure	Frequency of QC Procedure	Acceptance Criteria		Corrective Action
Matrix Spike and Duplicate or Sample Duplicate (MS, ICP, Hg, & CN)	1 per 20 samples per matrix	Standards Full compliment target list.	75-125% recovery; ICP & Hg: RPD<25%; CN: RPD<20%; MS: [analyte]>100xIDL - RPD<20%; Soil use generated limits	Qualify associated data biased high or biased low as appropriate.
Post Digestion Spike (PDS) (MS & ICP)	1 per 20 samples per matrix	Standards Full compliment target list.	75-125% recovery	
Serial Dilution (MS & ICP)	1 per 20 samples per matrix	Used to assess new matrices	For sample results > 5x RL for ICP or > 20x RL for MS, %D between diluted and undiluted sample result <10%.	Chemical or physical interference indicated. Investigate to identify cause.
Internal Standards (MS)	Every Analytical Sequence	Standards & Blanks	80-120% of initial calibration intensity	Terminate the analysis, correct the problem, re-calibrate, re-verify the calibration, and reanalyze associated samples.
		Samples	30-120% of initial calibration intensity	Reanalyze at consecutive five fold dilutions until criteria is met.

Table 8-15
Quality Control Method Criteria for Pesticides, Herbicides, and PCBs by USEPA SW-846 8081A, 8082 and 8151A
Radford Army Ammunition Plant
Radford, Virginia

Procedure	Frequency of QC Procedure	Acceptance Criteria	Corrective Action
Initial calibration curve 5-pt curve (linear) 6-pt curve (2o order)	Set-up, major maintenance	%RSD<20% or r>0.995 (linear) or r2>0.99 (2o order)	Sample analysis cannot begin until this criterion is met.
Initial Calibration Verification	Immediately following every initial calibration	A second source full compliment of target list with a percent recovery = 85-115%	Sample analysis cannot begin until this criterion is met.
Continuing Calibration Check	Bracketing samples	%D recovery ± 15% of the response factor from the initial curve or mean with no individual peak >30%	Sample analysis cannot begin until this criterion is met. If criteria are not met, reanalyze the daily standard. If the daily standard fails a second time, initial calibration must be repeated. Data reviewer should review and judge each target compound against the acceptance criteria.
Endrin/4,4-DDT Breakdown	Bracketing samples	endrin degradation <15%. 4,4-DDT degradation <15%.	If criterion is not met, system must be deactivated and the affected samples reanalyzed.
Instrument Blank	After continuing calibration and highly contaminated samples.	No target analytes detected greater than one half the RL.	Demonstrate "clean". Affected samples will be reanalyzed.
Method Blank	Per extraction batch	No target analytes detected greater than one half the RL.	Document source of contamination. Re-extraction/re-analysis is required for positive results associated with blank contamination.

Table 8-15
Quality Control Method Criteria for Pesticides, Herbicides, and PCBs by USEPA SW-846 8081A, 8082 and 8151A
Radford Army Ammunition Plant
Radford, Virginia

Procedure	Frequency of QC Procedure	Acceptance Criteria		Corrective Action
Laboratory Control Spike	Per extraction batch	Standards Full target list for 8081A and a mix of 1016 & 1260 for 8082	Laboratory generated control limits not to exceed limits listed in the current version of	Recoveries indicating a low bias require a re-extraction/reanalysis. Recoveries indicating a high bias require a re-extraction/re-analysis for associated positive field samples. Qualify associated data biased high or biased low as appropriate.
Surrogate Spikes	Every sample	Standards TCMX and DCB	Laboratory generated control limits not to exceed limits listed in the current version of DOD QSM	Investigate to assess cause, correct the problem, and document actions taken; re-extract and re-analyze sample. Specific method cleanups may be used to eliminate or minimize sample matrix effects. If still out, qualify.
Matrix Spike and Duplicate	1 per 20 samples per matrix	Standards Full target list for 8081A and a mix of 1016 & 1260 for 8082	Laboratory generated control limits	If MS/MSD results do not meet criteria, the reviewer should review the data in conjunction with other QC results to identify whether the problem is specific to
Target Analyte Confirmation	Every positive detection	RPD < 40%		Report the higher of the two concentrations unless a positive bias is apparent and qualify.

Table 8-16
Quality Control Method Criteria for Total Organic Carbon by Walkley-Black Method (Argonomy, Methods of Soil Analysis 29-3.5.2)
Radford Army Ammunition Plant
Radford, Virginia

Procedure	Frequency of QC Procedure	Acceptance Criteria	Corrective Action
Calibration (Titration Method)	Before Processing Samples a titration blank must be analyzed	0.5+/- 0.05N	If the titrant normality is not within the QC limit, clean the burette and remake the titrant solution and/or the 1N K2Cr2O7.
Laboratory Duplicate	1 per 20 samples or batch per matrix	RPD = 20%	If the RPD is out side the QC limit, it should be noted in the lab narrative.
Method Blank	1 per 20 samples or batch per matrix	No target analytes detected greater than the RL.	Document source of contamination. Re-extraction/re-analysis is required for positive results associated with blank contamination.
Laboratory Control Sample	1 per 20 samples per matrix	Laboratory generated control limits not to exceed recovery limits of 64-128%	Recoveries indicating a low bias require a re-extraction/reanalysis. Recoveries indicating a high bias require a re-extraction/re-analysis for associated positive field samples. Qualify associated data biased high or biased low as appropriate.
Matrix Spike and Duplicate	1 per 20 samples per batch, per matrix	Laboratory generated control limits not to exceed recovery limits of 68-142%	If MS/MSD results do not meet criteria, the reviewer should review the data in conjunction with other QC results to identify whether the problem is specific to the QC samples or systematic.

Table 8-17
Quality Control Method Criteria for General Chemistry Methods
Radford Army Ammunition Plant
Radford, Virginia

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 (linear) or r>0.99 (2^{o} order)	Sample analysis cannot begin until this criterion is met.
Initial Calibration Verification	Immediately following every initial calibration	Recovery ±10% of true value	Sample analysis cannot begin until this criterion is met. If criteria are not met, reanalyze the daily standards. If the ICV fails a second time, initial calibration must be repeated.
Continuing Calibration Check	Every 10 samples, end of analytical run	Recovery ±10% of true value	Sample analysis cannot proceed until this criterion is met. Reanalyze CCC. If the CCC 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	Every 10 samples, end of analytical run	No target analytes detected greater than the RL.	If not within criteria, terminate the analysis, correct the problem, re-calibrate, and reanalyze each sample analyzed since the last acceptable CCB.

Table 8-17
Quality Control Method Criteria for General Chemistry Methods
Radford Army Ammunition Plant
Radford, Virginia

Procedure	Frequency of QC Procedure	Acceptance Criteria	Corrective Action
Method Blank	1 per 20 samples or batch per matrix	No target analytes detected greater than the RL.	Document source of contamination. Re-extraction/re-analysis is required for positive results associated with blank contamination.
Laboratory Control Sample	1 per 20 samples per matrix	Laboratory generated control limits not to exceed recovery limits of 75-125% or RPD of 30%	Recoveries indicating a low bias require a re-extraction/reanalysis. Recoveries indicating a high bias require a re-extraction/re-analysis for associated positive field samples. Qualify associated data biased high or biased low as appropriate.
Matrix Spike and Duplicate	1 per 20 samples per batch, per matrix	Laboratory generated control limits not to exceed recovery limits of 60-140% or RPD of 30%	If MS/MSD results do not meet criteria, the reviewer should review the data in conjunction with other QC results to identify whether the problem is specific to the QC samples or systematic.

Figures

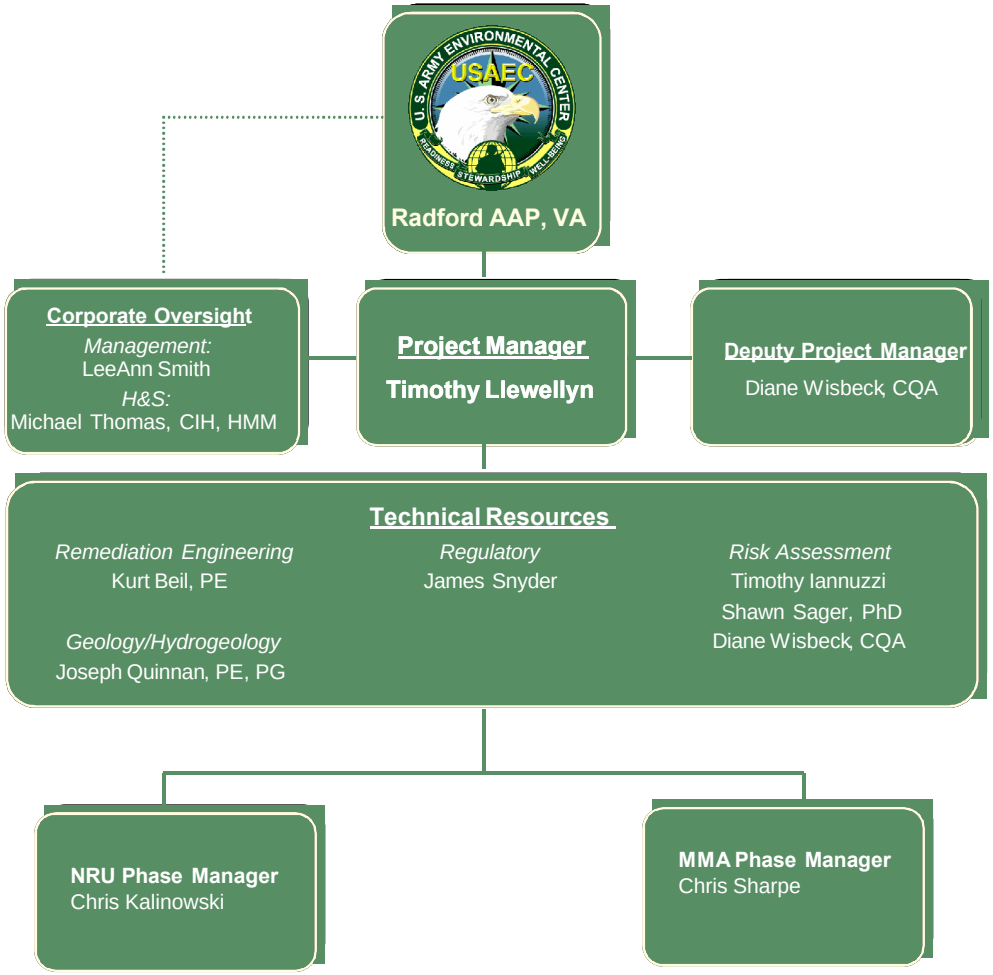

Figure 4-1
Project Organization Chart
Radford Army Ammunition Plant
Radford, Virginia

Appendix A

Quality Assurance Manual
Empirical Laboratory

(Provided on CD)

ANALYTICAL QUALITY ASSURANCE MANUAL

Empirical Laboratories, LLC
227 French Landing Drive
Nashville, Tennessee 37228

Revision 16.0

April 24, 2007

Authorized for Release by:

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AS A MATTER OF POLICY

Empirical Laboratories, LLC has established and will maintain a quality system consistent with elements contained in the *Quality Systems* chapter 5 of the *National Environmental Laboratory Accreditation Conference*, NELAC, 2003 Manual, and other State/Federal requlatory programs. All laboratory Standard Operating Procedures (SOP), Manuals, Documents and this Quality Assurance Plan are reviewed annually to insure that the most current information is available for laboratory use. Information is reviewed annually, updated if needed, and date stamped to indicate the time period that the document is in force.

It is the formal policy of Empirical Laboratories, LLC to maintain QA/QC procedures and practices which **meet or** exceed the overall goals and guidelines currently recommended by the **NELAC and other State/Federal regulatory programs**. State and Federal legislation has placed increased emphasis upon the accuracy of environmental analytical data. These programs require very stringent quality assurance and quality control procedures and documentation. Because of an increasing tendency to resolve discrepancies with litigation, most laboratories must be prepared to defend the accuracy of their reported data in court. This document outlines the elements of a good laboratory quality assurance program. More importantly, however, it emphasizes a systematic approach to both the acquisition and reporting of accurate data from all field and laboratory testing.

Empirical Laboratories, LLC intends to follow all of the procedures referenced within this manual and further, to be fully cognizant of **NELAC and other State/USEPA** guidelines for every project submitted. **Additionally, client specific Quality Assurance Project Plan ,QAPP, (when inplace) will be followed to meet all project requirements.** Any deviations from these established procedures will be submitted to the appropriate regulatory agency **and/or respective client** prior to project mobilization.

1.0 ORGANIZATION AND RESPONSIBILITY

This section presents specific laboratory personnel positions and the responsibilities which each provides in the implementation of the Quality Assurance Program and the execution of Quality Control activities. Quality Control begins at the lab bench with each analyst knowing the QC criteria for the analytical methods being performed and evaluating the analytical instrument calibrations and resulting data for compliance with these criteria. Each analyst has the responsibility and authority for halting an out-of-control analytical procedure, taking appropriate corrective action or seeking guidance from supervisory personnel. This process comprises the cornerstone of the Quality Assurance Program.

1.1 QUALITY-RELATED RESPONSIBILITIES

The Laboratory Director/Vice President of Operations, Quality Assurance Officer, Organic Laboratory Manager, Inorganic Laboratory Manager (listed on the cover page of this manual) and the Project managers listed below are the official signatories of our Laboratory. The staff positions outlined subsequently are fully implemented in the organization. The QA/QC responsibilities of each position are provided in the following.

D. Rick Davis	-	**Laboratory Director/Vice President of Operations**
Randy D. Ward	-	**Quality Assurance Officer**
Antonio D. Monteiro	-	**GC/MS Group Leader**
Betty L. DeVille	-	**Inorganic Laboratory Manager**
Marcia K. McGinnity	-	**Senior Project Manager**
Brian K. Richard	-	**Project Manager**

- **Laboratory Director/Vice President of Operations**

  - Implement the Quality Assurance Program.
  - Periodically determine effectiveness of the Quality Assurance Program.
  - Approve specific attachments to the Quality Manual and project-specific manuals and revisions.
  - Make recommendations to the appropriate laboratory section regarding necessary changes in the Quality Assurance Program.

- Maintain current distribution lists for specific attachments and project-specific manuals.
- Approve all reports.
- Serve as the "focal point" for the reporting and disposition of all nonconformances.
- Maintain current organization chart.

- **Laboratory Manager**

  - Supervision of group members, technical oversight and quality control.
  - Provides the lab supervisors with accurate and timely information on incoming projects.
  - Determines the priority of request for analyses to meet project requirements.
  - Coordinates the workload of each laboratory department.
  - Oversight for the laboratory quality control practices including coordinating the analyses of laboratory proficiency testing samples, reviewing laboratory QC data, approving daily laboratory results, and assists the QA officer in the various certification programs.

- **Quality Assurance Officer**

  - Supervise Quality Assurance Program.
  - Supervise the participation in inter-laboratory certification and proficiency testing programs.
  - Supervise performance of in-house Quality Assurance audits and Quality Control audits.
  - Prepare QC standards, insert QC samples into the sample inventory, and evaluate results.
  - Perform statistical evaluation of QC sample analytical results.
  - Report all nonconformance to the Director if the situation is not corrected.
  - Train analysts in QC procedures.

- **Section Managers**

  - Provide technical and personnel management for the section (organic or inorganic).
  - Organize and schedule the analytical testing program with consideration for sample-holding times.
  - Review draft and final data reports.
  - Implement data verification procedures.
  - Assign analysts for data processing and validation activities.
  - Evaluate instrument performance and supervise instrument calibration and preventive maintenance programs.
  - Report out-of-control (beyond control limits) or nonconforming situations to Quality Assurance Manager.
  - Implement, supervise and monitor adherence to good documentation, record keeping and filing practices.

- **Analysts**

  - Perform analytical procedures and record all data in accordance with accepted methods.
  - Immediately report out-of-control situations, instrument malfunction, calibration failure, or other nonconformances to the appropriate Section Manager (including documentation with Corrective Action Report).
  - Perform data processing and validation with regard to QC limits.
  - Prepare draft data reports for review.
  - Perform and document all instrument calibration and preventive maintenance procedures, as appropriate.

- **Project Manager**

  - Oversees sample receiving, including the review of Laboratory Information Management System log reports for correctness, and follow-up communications with laboratory technical staff and clients.
  - Coordinates the billing and reporting of all samples and services.

- Coordinates all incoming work including price quotes, scheduling and oversight of sample kit and materials preparation.
- Tracks laboratory turnaround time to ensure timeliness on analytical deliverables.

The organizational structure of the Analytical Testing & Aquatic Toxicology Sections of Empirical Laboratories, LLC is presented in Figure 1-1.

1.2 RELATIONSHIP BETWEEN MANAGEMENT, TECHNICAL OPERATIONS, SUPPORT SERVICES, AND THE QUALITY SYSTEM

The Lab Director has overall responsibility for the technical operation of the lab. The lab director is also responsible for arranging and overseeing all support services including instrument service contracts, subcontracting sample analyses, and physical maintenance of the laboratory.

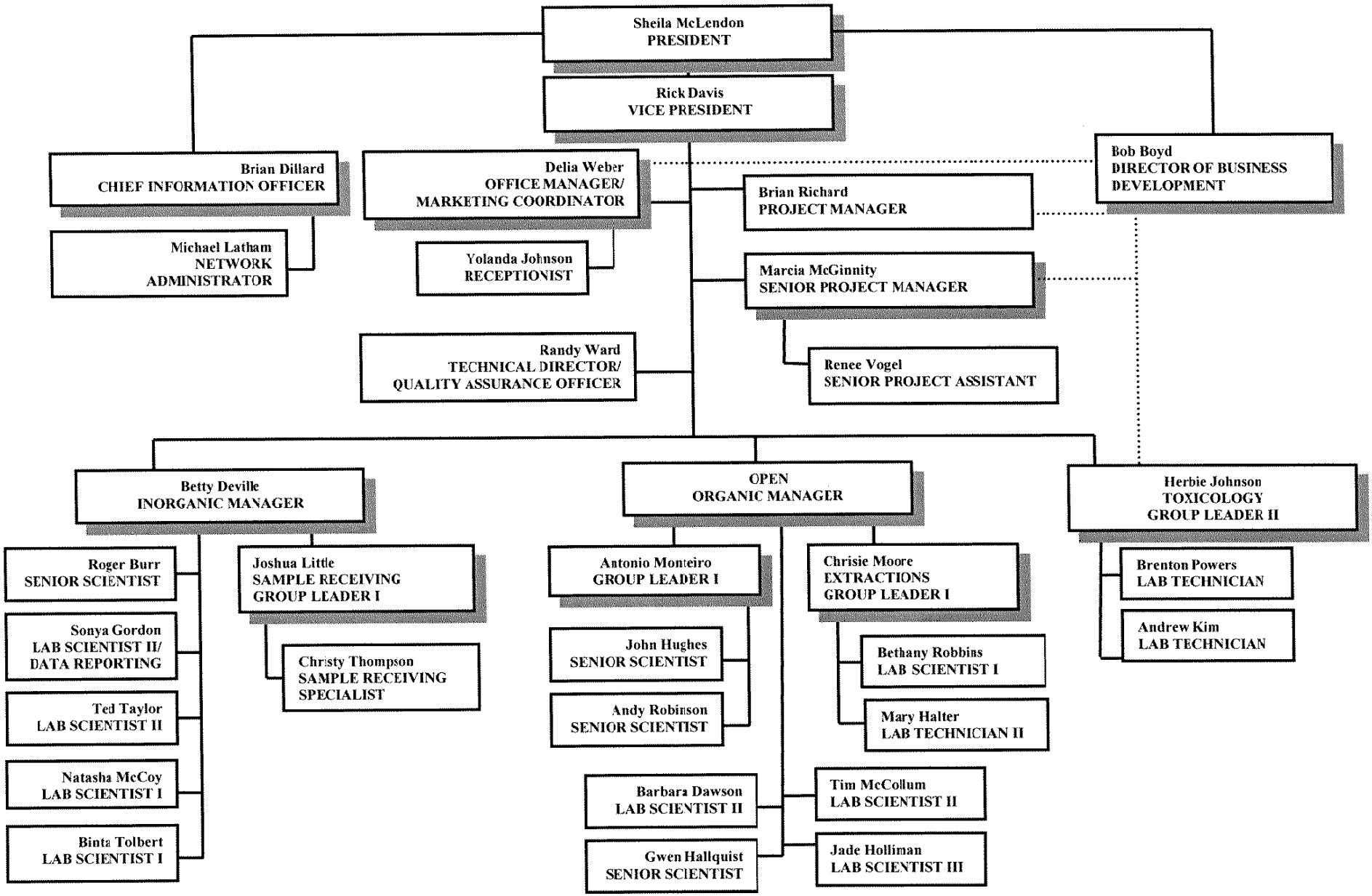
The Lab Director is responsible for providing supervision to all laboratory personnel to ensure adherence to lab documented procedures. When the director is not present in the lab, the lab manager who is familiar with the calibration and test procedures, the objective of the calibration or test and the assessment of results, will be appointed by the director to supervise.

The Lab Director shall certify that personnel with appropriate educational and/or technical background perform all tests for which the lab is accredited.

The Lab Director shall ensure that the lab's policies and objectives for quality of testing services are documented in the Quality Manual. The director shall assure that the Quality Manual is communicated to, understood, and implemented by all personnel concerned.

The Quality Assurance Officer has responsibility for the quality system and its implementation. The QA officer has direct access to the highest level of management at which decisions are taken on lab policy and /or resources, and to the lab director. When the QA officer is not present, an alternate shall be appointed.

EMPIRICAL LABORATORIES, LLC
ORGANIZATIONAL CHART
(Revised 02/14/07)



1.3 MANAGEMENT REVIEW OF PROJECTS/TESTING PROCEDURES

All new projects are initiated by the Laboratory Director or designee who delegates responsibilities for the new projects according to available resources. Staff meet prior to initiation of a new project in order to determine if appropriate facilities and resources are available. The plan for any new testing shall be reviewed and approved by the Laboratory Director or Laboratory Manager before commencing such work. After agreement is reached, facilities and resources are organized to efficiently perform the work. For any new testing requirements, the designated employee shall write a standard operating procedure and demonstrate capability to perform those tests prior to reporting results. The SOP(s) shall be under document control and a Demonstration of Capability Statement(s) must be on file.

1.4 LABORATORY ENVIRONMENT

Calibration and testing occur only within the laboratory, designed, built and maintained as laboratory space. The laboratory space is maintained and monitored to the specifications required for laboratory space. In general the specifications for temperature is 70°F(+/- 3°F); and for voltage 120V (+/- 2%). Electronic balances are located away from drafts and doorways and mounted on marble slabs in areas where their use is not affected by vibrations. Neighboring test areas of incompatible activities are effectively separated. Specific work areas are defined and access is controlled. (Only authorized laboratory personnel and escorted signed-in visitors may enter the work area.) Good housekeeping measures are employed to avoid the possibility of contamination. (Smoking is prohibited.)

All equipment and reference materials required for the accredited tests are available in the laboratory. Records are maintained for all equipment, reference measurement materials, and services used by the laboratory.

Reference materials traceable to national standards of measurement or to national standard reference materials are stored away from heavy use areas or major equipment that may affect the proper operation of the materials. Certificates of Traceability are available for the reference thermometer and the Class S weights. The reference materials are used only for calibrations to maintain the validity of performance.

1.5 EXCEPTIONALLY PERMITTED DEPARTURES FROM DOCUMENTED POLICIES AND PROCEDURES

The Lab Director has responsibility for ensuring the lab's policies and procedures are adhered to. Arrangements for known and controlled departures from documented policies and procedures are allowed. Planned departures do not require audits, however, the departure will be fully documented and include the reason for the departure, the affected SOP(s), the intended results of the departure and the actual results. If the data reported to the Authority is affected adversely, they will be notified in writing. The procedures used to document any specific departure will be the same as the corrective action procedure outlined in Section 11.

1.6 COMPLAINTS

All complaints about laboratory activities received from clients or other parties will be documented in a compliant file maintained in the laboratory. The file will contain the date and name of the person receiving the complaint, a description of the complaint, source of the complaint, the resolution, and any written material accompanying the complaint.

The QA Officer or designee investigates complaints and promptly audits all areas of activity and responsibility involved. The written results of the investigation including actions taken by the laboratory are reviewed by the Laboratory Director. The results of the investigation are signed and dated by the Laboratory Director and the QA Officer.

1.7 TRAINING AND REVIEW OF PERSONNEL QUALIFICATIONS

Laboratory management reviews an applicant's level of qualification, experience, and skills against the laboratory's job description requirements before assigning an employee to the laboratory. Each analyst has adequate experience and education to demonstrate specific knowledge of their function and a general knowledge of laboratory operations, test methods, QC procedures, and records management. Management will keep the following personnel records:

- The laboratory will maintain a training file which contains:

  - A statement from each employee that they have read, understood, and are using the latest version of the Laboratory Quality Manual and SOPs. The statement will be signed and dated.

  - A statement from each employee that they have read, acknowledged and understood their personal ethical and legal responsibilities including the potential punishments and penalties for improper, unethical or illegal actions. The statement will be signed and dated.

  - A Demonstration of Capability (DOC) for each employee or work group(work cell) for each accredited method.

  - Documentation of any training course, seminars, and/or workshops.

  - Documentation of each employee's continued proficiency to perform each test method by one of the following annually:

  - Acceptable performance of a blind sample (single blind to the analyst) for each accredited method;

    - At least four consecutive Laboratory Control Samples with acceptable levels of precision and accuracy.

    - If one of the above cannot be performed, analysis of authentic samples that have been analyzed by another trained analyst with statistically indistinguishable results.

      Demonstration of Capability (DOC) – A DOC must be performed prior to using any test method, and any time there is a change in instrument type, personnel, or method. Each analyst must have a DOC on file as well as analysts in a work group(work cell). A work cell is considered to be all those individuals who see a sample through the complete process such as sample prep, extraction and analysis. Each analyst must

demonstrate their capability in their area of the process. The procedure will follow NELAC guidance. See Laboratory SOP 413.

1.8 EDUCATION AND TRAINING IN ETHICAL AND LEGAL RESPONSIBILITIES

Laboratory management will require a formal statement that each employee has acknowledged and understood their personal ethical and legal responsibilities including the possible punishments and penalties for improper, unethical or illegal actions. **Further, this document will include an acknowledgement statement for protecting confidentiality and proprietary rights of client information generated within our laboratory. (See Empirical Laboratories, LLC ethics and data integrity form at the end of this section.) Laboratory management assures their employees that any information of illegal activties conveyed will be kept confidential.**

Education and training will be two-fold. First, during orientation, all new employees will be educated with regard to the above ramifications and how they will apply to the day to day operations within the laboratory. Secondly, all employees will meet annually to receive refresher training for a number of subjects, " legal and ethical" responsibilities will be a part of the annual refresher training agenda.

The Quality Assurance Officer shall conduct an annual internal laboratory audit. Checks for data integrity is included in this audit.

Laboratory management shall not put any pressure on personnel which might influence their technical judgment.

EMPIRICAL LABORATORIES, LLC

ETHICS AND DATA INTEGRITY

I. I, (print name)_____, state that I understand the high standards of integrity required of me with regard to the duties I perform and the data I report in connection with my employment at Empirical Laboratories, LLC.

II. I agree that in the performance of my duties at Empirical Laboratories, LLC:

a) I shall not intentionally report data values that are not the actual values obtained;
b) I shall not intentionally report the dates and times of data analyses that are not the actual dates and times of data analyses; and
c) I shall not intentionally represent another individual's work as my own.

III. I agree to inform Empirical Laboratories, LLC of any accidental reporting of non-authentic data by myself in a timely manner.

IV. I agree to inform Empirical Laboratories, LLC of any accidental or intentional reporting of non-authentic data by other employees.

V. I acknowledge that it is a crime to knowingly provide false, incomplete or misleading information. I understand that if I violate any of the obligations herein, I will be prosecuted to the fullest extent of the law and I will be subject to such penalties as may be prescribed by Federal, State or local laws.

_____

(Signature)

_____

(Date)

HR952e

DEMONSTRATION OF CAPABILITY
CERTIFICATION STATEMENT

Date:

Laboratory Name: Empirical Laboratories, LLC

Laboratory Address: 227 French Landing Drive, Suite 550, Nashville, TN 37228

Analyst(s) Name(s):

Matrix/Methods: SOP#: REV#:

We, the undersigned, CERTIFY that:

1. The analysts identified above, with signature below, using the cited test method(s), which is in use at this facility for the analyses of samples under the National Environmental Laboratory Accreditation Program and other regulatory programs, have met the Demonstration of Capability.
2. The test method was performed by the analyst(s) identified on this certification.
3. A copy of the test method and the laboratory-specific SOPs are available for all personnel on-site.
4. The data associated with the demonstration capability are true, accurate, complete and self-explanatory (1).
5. All raw data (including a copy of this certification form) necessary to reconstruct and validate these analyses have been retained at the facility, and that the associated information is well organized and available for review by authorized assessors.

Technical Director's Name and Title	**Signature**	**Date**
Quality Assurance Officer's Name	**Signature**	**Date**

This certification form must be completed each time a demonstration of capability is completed.

(1) Definitions

True:	Consistent with supporting data.
Accurate:	Based on good laboratory practices consistent with sound scientific principles/practices.
Complete:	Includes the results of all supporting performance testing.

Self-explanatory: Data properly labeled and stored so that the results are clear and require no additional explanation.

2.0 QUALITY ASSURANCE OBJECTIVES

This section addresses the QA objectives for the analytical data which are generated to support various projects tasks or various specific customer needs. The overall analytical QA objective is to provide chemical data of known precision and accuracy obtained with standard methods acceptable to the appropriate regulatory agencies. To accomplish this objective, analytical work is performed using widely accepted analytical procedures, mostly those from the USEPA "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods (SW-846)", Third Edition, Final Update III (promulgated 6/13/97). The precision and accuracy of the analyses are maintained at the highest levels consistent with these methods using well defined QA programs described in this manual. As mentioned below, the precision and accuracy of the analytical processes are monitored using various data quality indicators.

2.1 QUANTITATIVE QA OBJECTIVES

2.1.1 Precision

Precision is the agreement between a set of replicate measurements without assumption or knowledge of the true value. Precision is assessed by means of duplicate/replicate sample analysis.

Precision for the various analytical laboratory processes is estimated using the relative percent difference in the recoveries between duplicate samples. Matrix spike (MS) and matrix spike duplicate (MSD) samples are analyzed where appropriate. In most cases, the samples used as MS/MSD samples and duplicates, are laboratory duplicates. Precision for some of the analytical methods may also be assessed from the percent recoveries of surrogate spike compounds.

The spiking procedures are performed as recommended by the appropriate USEPA methods. The equation for calculating Relative Percent Difference is given in Section 12 of this manual. The precision limits to be achieved are those shown in the Tables 2-1, 2-2, and 2-3. The frequency for analysis of spiked duplicate (or replicate) samples is approximately 1 replicate pair per 20 samples (excluding QC samples), spaced as evenly through the sequential analysis of samples as practical.

TABLE 2-1

QUALITY ASSURANCE OBJECTIVES
WATER QUALITY PARAMETERS

	Precision[a] (RPD)	Accuracy[a] (%Recovery)
FIELD PARAMETERS		
pH	±0.1[b]	±0.05[c]
Specific Conductance	±20	75-130
Dissolved Oxygen	±20	NA
Temperature	±10	NA
LABORATORY PARAMETERS		
pH	±0.1[b]	±0.05[c]
Calcium	±20	75-125
Magnesium	±20	75-125
Sodium	±20	75-125
Potassium	±20	75-125
Iron	±20	75-125
Sulfate	±20	75-125
Chloride	±20	75-125
HCO_3^-/CO_3^{-2}	±20	75-125
Total Suspended Solids	±20	75-125
Specific Conductance	±20	75-125

[a]Sample concentrations must meet specific criteria for the data to be subjected to the specified control limits.

- For precision, sample concentrations must be at least 5 times the method detection limit.
- For accuracy the spike concentrations should be less than or equal to four times the sample concentration.

[b]pH units

[c]Accuracy as absolute variation from true value of continuing calibration check standard.

NA= Not Applicable

RPD = Relative Percent Difference

TABLE 2-2

QUALITY ASSURANCE OBJECTIVES

(Metals, Cyanide, Phenolics)

Parameter	Accuracy[a] (% Recovery)		Precision[a] (RPD)	
	Water	Soil/Sediment	Water	Soil/Sediment
Cyanide	75-125	75-125	±20	±20
Phenolics	75-125	75-125	±20	±20
Aluminum	75-125	75-125	±20	±20
Antimony	75-125	75-125	±20	±20
Arsenic	75-125	75-125	±20	±20
Barium	75-125	75-125	±20	±20
Beryllium	75-125	75-125	±20	±20
Cadmium	75-125	75-125	±20	±20
Chromium	75-125	75-125	±20	±20
Cobalt	75-125	75-125	±20	±20
Copper	75-125	75-125	±20	±20
Lead	75-125	75-125	±20	±20
Mercury	75-125	75-125	±20	±20
Molybdenum	75-125	75-125	±20	±20
Potassium	75-125	75-125	±20	±20
Nickel	75-125	75-125	±20	±20
Selenium	75-125	75-125	±20	±20
Silver	75-125	75-125	±20	±20
Thallium	75-125	75-125	±20	±20
Tin	75-125	75-125	±20	±20
Vanadium	75-125	75-125	±20	±20
Zinc	75-125	75-125	±20	±20
	75-125	75-125		

[a]Sample concentrations must meet specific criteria for the data to be subjected to the specified control limits.

- For precision, sample concentrations must be at least 3 times the method detection limit.
- For accuracy the spike concentrations should be less than or equal to four times the sample concentration.

NA= Not Applicable

RPD= Relative Percent Difference

TABLE 2-3

QUALITY ASSURANCE OBJECTIVES
ORGANIC ANALYTES

RECOMMENDED MATRIX SPIKE RECOVERY LIMITS[a]

Fraction	Matrix Spike Compound	Water		Soil/Sediment	
		(% Rec.)	(RPD)	(% Rec.)	(RPD)
VOA	1,1-Dichloroethene	61-145	14	59-172	22
VOA	Trichlorethene	71-120	14	62-137	24
VOA	Chlorobenzene	75-130	13	60-133	21
VOA	Toluene	76-125	13	59-139	21
VOA	Benzene	76-127	11	66-142	21
BN	1,2,4-Trichlorobenzene	39-98	28	38-107	23
BN	Acenaphthene	46-118	31	31-137	19
BN	2,4-Dinitrotoluene	24-96	38	28-89	47
BN	Pyrene	26-127	31	35-142	36
BN	N-Nitroso-di-n-propylamine	41-116	38	41-126	38
BN	1,4-Dichlorobenzene	36-97	28	28-104	27
Acid	Pentachlorophenol	9-103	50	17-109	47
Acid	Phenol	12-110	42	26-90	35
Acid	2-Chlorophenol	27-123	40	25-102	50
Acid	4-Chloro-3-Methylphenol	23-97	42	26-103	33
Acid	4-Nitrophenol	10-80	50	11-114	50
Pesticide	Lindane	56-123	15	46-127	50
Pesticide	Heptachlor	40-131	20	35-130	31
Pesticide	Aldrin	40-120	22	34-132	43
Pesticide	Dieldrin	52-126	18	31-134	38
Pesticide	Endrin	56-121	21	42-139	45
Pesticide	4,4'-DDT	38-127	27	23-134	50

[a]Limits from USEPA Contract Laboratory Program SOW OLM03.2/OLM04.2/OLM04.3

TABLE 2-3(Continued)

QUALITY ASSURANCE OBJECTIVES
ORGANIC ANALYTES

RECOMMENDED SURROGATE SPIKE RECOVERY LIMITS[a]

Fraction	Surrogate Compound	Low/Medium Water (% Rec.)	Low/Medium Soil/Sediment (% Rec.)
VOC	Toluene-d_8	88-110	84-138
VOC	4-Bromofluorobenzene	86-115	59 113
VOC	1,2-Dichloroethane-d_4	76-114	70-121
VOC	Dibromofluoromethane	86-118[b]	80-120[b]
SVOC	Nitrobenzene-d_5	35-114	23-120
SVOC	2-Fluorobiphenyl	43-116	30-115
SVOC	p-Terphenyl-d_{14}	33-141	18-137
SVOC	Phenol-d_6	10-110	24-113
SVOC	2-Fluorophenol	21-110	25-121
SVOC	2,4,6-Tribromophenol	10-123	19-122
Pesticide/PCB	Decachlorobiphenyl (DCB)	30-150	30-150
Pesticide	Tetrachloro-meta-xylene (TCMX)	30-150	30-150

[a]Limits from USEPA Contract Laboratory Program SOW OLM03.2/OLM04.2/OLM04.3
[b]Limits from USEPA SW-846, Third Edition, Final Update III Method 8260B

2.1.2 Accuracy

Accuracy is the nearness of a measurement or the mean ($\bar{x}$) of a set of measurements to the true value. Accuracy is assessed by means of reference samples and percent recoveries.

Accuracy for the various analytical processes is estimated using the recovery of the matrix spiking analytes from the MS/MSD samples mentioned above, other sample spikes as required by the methods, and/or by the analysis of Laboratory Control Samples (LCSs), standard reference materials of known composition. The methods for calculating accuracy based upon these data are presented in Section 10 of this manual. Tables 2-1, 2-2, and 2-3 show the accuracy limits to be achieved by the analytical laboratory data.

2.1.3 Method Detection Limit/Reporting Limit

The method detection limit (MDL) is defined as the minimum concentration of a substance that can be measured and reported with 99 percent confidence that the analyte concentration is greater than zero and is determined from analysis of a sample in a given matrix containing the analyte. Generally, the reporting limit (RL) is established as the lowest standard used in the calibration curve. At a minimum, the RL should not be less than three times the MDL.

MDLs for the various analytical methods are estimated from the analysis of seven replicates of a spiked blank matrix (40 CFR 136, Appendix B). The replicate data used to estimate the MDLs (where appropriate) are calculated as described in Section 10 of this manual. The analytical tests performed within the laboratory and the associated MDLs are shown in Appendix A to this manual. RLs are adjusted based on sample matrix and any sample dilutions/concentrations necessary. In addition, compounds which are identified by recognizable patterns (example: PCBs, toxaphene, technical-chlordane), the RL is not only based upon the detection limit of individual components, but on the concentration of the mixture at which the pattern becomes recognizable. When defining appropriate requirements for the RL verses action levels, consideration must be given to use of the data, uncertainty of low-level data that are acceptable by the data user, and the sensitivity capability of the method and instrument. MDL check standards are also used to verify if calculated MDLs are achievable.

2.1.4 Completeness

Completeness is defined as the number of analyses considered to be valid compared to the number of analyses that were considered necessary for accomplishing the task. Typically, studies are designed with extra sampling so that the loss of a few samples (perhaps 10 percent) would still leave enough data to achieve the desired objectives. For the purpose of estimating completeness, the total number of analyses required for accomplishing the objectives requiring analytical laboratory data is 90 percent of the non-QC samples submitted for analysis. With a project designed to tolerate some loss of analytical data, one might expect completeness of 100 percent or greater.

A typical project quality assurance goal is that over 90 percent of the analyses should meet the QA objectives for precision and accuracy based upon the surrogate and spike results and should be within control with respect to all of the other quality control guidelines. Samples which demonstrate QC problems which can be shown to be due to the sample matrix are excluded in the QC goal calculations. Sample matrix QC problems are not under laboratory control. It is Empirical Laboratories, LLC's policy to "flag" all data on its submitted data reports which do not meet the method QA/QC guidelines .

2.1.5 Timeliness

The normal analytical turnaround time for the laboratory is completion of the final analytical report ten (10) to fifteen (15) business days from the time of sample receipt at the laboratory, and completion of data deliverables packages twenty five business days from sample receipt. Turnaround times are routinely adjusted to meet specific project requirements.

2.2 QUALITATIVE QA OBJECTIVES: COMPARABILITY AND REPRESENTATIVENESS

2.2.1 Comparability

Comparability of the analytical data can be achieved by the use of the same analytical procedures for the samples throughout the projects and through consistency of reporting

units. In addition, the use of USEPA methods provides data of known precision and accuracy.

2.2.2 Representativeness

Representativeness refers to how well measured results reflect the actual concentrations of chemical compounds in samples at the moment of sampling. Sample handling protocols (e.g., collection, preservation, transportation, and storage) have been developed to preserve the representativeness of the collected samples. Proper documentation establishes that protocols have been followed and that sample identification and integrity have been assured.

Data representativeness reflects the degree to which the data accurately and precisely represent a characteristic of a population or parameter variation at a sampling point, or an environmental condition. Data representativeness is a qualitative criteria that is associated with the proper design of the sampling and analysis program. Data that are highly representative of the geographical areas and matrices being sampled can be achieved by performing field sampling and measurements and laboratory analyses in a standardized manner strictly adhering to procedures specified in this manual and in the individual Quality Assurance Project Plans, and following, where applicable, USEPA guidance.

3.0 SAMPLING PROCEDURES

When Empirical Laboratories, LLC is commissioned to conduct field sampling, a trained field sampling crew is sent to the site for sample collection and delivery of samples to the laboratory. Each crew is supervised by a qualified crew chief, trained in accordance with USEPA protocol for groundwater sampling and other types of environmental sampling.

3.1 SAMPLING PROCEDURES FOR GROUNDWATER AND SURFACE WATER

Samples from groundwater monitoring wells are collected with pre-cleaned teflon bailers except in cases where the client supplies a dedicated bailer. PVC bailers may be used in cases where only inorganic or metal analyses are required. Bailers are pre-cleaned by first rinsing with detergent then with tap water, followed by a final rinse with distilled water. Prior to sampling, the water level in the well is determined with an electronic water level meter or a fiberglass tape and recorded on the Custody Form. Date, time, location, client name and field notes are also recorded on the Custody Form. The volume of water in the casing is calculated and three to five times that volume is purged from the well. In some cases, the well is purged until the conductivity has stabilized. This is accomplished by checking the conductivity of every fifth bailer volume removed from the well. The conductivity is considered representative if two consecutive readings are constant.

For surface water sampling, the actual sample bottle can be used to collect a grab sample. Care is taken to avoid hand contact with the bottle lip. A clean dipper may be used to collect samples from shallow streams.

Table 3-1 lists the sample containers, preservatives, holding times and conditions for groundwater and surface water sampling. Only new pre-cleaned sample containers are used. Glass containers used for organic analyses are purchased pre-cleaned. These containers are cleaned in accordance with USEPA protocol. Plastic containers used for metals analyses are purchased pre-cleaned and cleaned in house by the following procedure:

All sample containers are stored in an area isolated from the solvent extraction laboratory. Trip blanks for volatiles are prepared and stored in the VOA lab. Storage time is kept to a minimum.

TABLE 3-1

ANALYTICAL METHODS AND COLLECTION REQUIREMENTS
AQUEOUS SAMPLES

PARAMETER	ANALYTICAL METHOD INFORMATION [a]				COLLECTION REQUIREMENTS		
	EPA No. [b] SM No. g	SW846 No.	Holding Time [c]	Detection Limit (mg/L) [d]	Sample Volume Required [e]	Container Type	Preservation Technique [f]
GENERAL CHEMISTRY							
Alkalinity	310.1, 2320B	NA	14 days	1.0	150 mL	Plastic	Cool to ≤6° C
Ammonia-Nitrogen	350.1, 4500-NH3 G	NA	28 days	1.0	100 mL (direct) 400 mL (distilled)	Plastic	H_2SO_4 to pH<2 Cool to ≤6° C
Bicarbonate/Carbonate	4500-CO2D g	NA	14 days	1.0	150 mL	Plastic	Cool to ≤4° C
BOD	405.1, 5210B	NA	48 hours	2.0	500 mL	Plastic	Cool to ≤6° C
Chloride	325.2, 300.0	9251	28 days	1.0, 0.5	200 mL	Plastic	None
Chlorine, Residual	330.4, 4500 Cl F	NA	Immediate [i]	0.10	200 mL	Plastic	None
COD	410.4	NA	28 days	20	50 mL	Plastic	H_2SO_4 to pH<2 Cool to ≤6° C
Coliform Total Fecal	 9222 g 9222 g	 9132 NA	 6 hours 6 hours	 1 colony/ per 100 mL	 200 mL 200 mL	 Plastic Plastic	Cool to ≤4° C $Na_2S_2O_3$
Color	2120B g	NA	48 hours	5 c. u.	1000 mL	Plastic	Cool to ≤6° C

TABLE 3-1 (Continued)

ANALYTICAL METHODS AND COLLECTION REQUIREMENTS
AQUEOUS SAMPLES

PARAMETER	ANALYTICAL METHOD INFORMATION [a]				COLLECTION REQUIREMENTS		
	EPA No. [b] SM No. [g]	SW846 No.	Holding Time [c]	Detection Limit (mg/L) [d]	Sample Volume Required [e]	Container Type	Preservation Technique [f]
GENERAL CHEMISTRY (continued)							
Conductivity	120.1	9050	28 days	1.0 µmhos/cm	100 mL	Plastic	Cool to ≤6° C
Cyanide							NaOH to pH >12
Total	335.4	9012	14 days	0.005	500 mL	Plastic	Cool to ≤6° C
Amenable	4500-CN G	9012	14 days	0.005	500 mL	Plastic	For all CN tests
Dissociable	335.4	9012	14 days	0.005	500 mL	Plastic	
Reactivity	NA	Chapter 7	14 days	0.13	500 mL	Plastic	
Fluoride (Non-distilled)	300.0	NA	28 days	0.10(both)	100 mL	Plastic	None
Hardness (as $CaCO_3$)	200.7	6010	6 months	2.5	100 mL	Plastic	HNO_3 to pH<2 Cool to ≤6° C
Nitrate-Nitrite, as N	353.2	NA	28 days	0.05	100 mL	Plastic	H_2SO_4 to pH<2 Cool to ≤4° C
Nitrate, as N	353.2, 300.0	NA	48 hours	0.05(both)	100 mL	Plastic	Cool to ≤6° C
Nitrite, as N	354.1	NA	48 hours	0.01	100 mL	Plastic	Cool to ≤6° C
Nitrogen, Total Kjeldahl (TKN)	351.2	NA	28 days	1.0	100 mL	Plastic	H_2SO_4 to pH<2 Cool to ≤6° C

TABLE 3-1 (Continued)

ANALYTICAL METHODS AND COLLECTION REQUIREMENTS
AQUEOUS SAMPLES

PARAMETER	ANALYTICAL METHOD INFORMATION [a]				COLLECTION REQUIREMENTS		
	EPA No. [b] SM No. g	SW846 No.	Holding Time [c]	Detection Limit (mg/L) [d]	Sample Volume Required [e]	Container Type	Preservation Technique [f]
			3-3				
GENERAL CHEMISTRY (continued)							
Odor	140.1	NA	24 hours	1.0 T.O.N	1000 mL	Glass , No Headspace	Cool to ≤4° C
Oil and Grease (Gravimetric)	1664	9070	28 days	2.0	1000 mL	Glass, Teflon Line Cap	H_2SO_4 to pH<2 Cool to ≤6° C
pH	4500-H B	9040	Immediate [h]	NA	50 mL	Plastic	None
Petroleum Hydrocarbons, Total (TPH)	1664	NA	28 days	2.0	1000 mL	Glass Amber	HCL to pH<2 Cool to ≤6° C
Phenolics, Total	420.2	9066	28 days	0.01	1000 mL	Glass	H_2SO_4 to pH<2 Cool to ≤6° C
Phosphorus							
Ortho	365.2,4500-P E	NA	48 hours	0.01	100 mL	Plastic	Cool to ≤6° C
Total	365.2,4500-P B5+E	NA	28 days	0.02	100 mL	Plastic	H_2SO_4 to pH<2 Cool to ≤6° C
Paint Filter	NA	9095	NA	NA	500 mL	Plastic/Glass	None
Perchlorate	314.0	9058	28 days	0.004	500 mL	Plastic/Glass	Cool to ≤4° C

TABLE 3-1 (Continued)

ANALYTICAL METHODS AND COLLECTION REQUIREMENTS
AQUEOUS SAMPLES

PARAMETER	ANALYTICAL METHOD INFORMATION [a]				COLLECTION REQUIREMENTS		
	EPA No. [b] SM No. [g]	SW846 No.	Holding Time [c]	Detection Limit (mg/L) [d]	Sample Volume Required [e]	Container Type	Preservation Technique [f]
			3-4				
GENERAL CHEMISTRY (continued)							
Solids							
Dissolved	160.1,2540C	NA	7 days	20	200 mL	Plastic	Cool to ≤6° C
Suspended	160.2,2540D	NA	7 days	2.0	500 mL	Plastic	Cool to ≤6° C
Total	160.3,2540B	NA	7 days	50	200 mL	Plastic	Cool to ≤6° C
Volatile	160.2,2540D	NA	7 days	50	200 mL	Plastic	Cool to ≤6° C
Settleable	160.5,2540F	NA	48 hours	0.10 mL/L	1000 mL	Plastic	Cool to ≤6° C
Sulfate	375.4, 300.0	9038	28 days	1.0, 0.5	100 mL	Plastic	Cool to ≤6° C
Sulfide							
Total	376.1,4500SF	9030	7 days	1.0	500 mL	Glass, No	$Zn(Ac)_2$ +NaOH to pH>9
Reactivity	NA	Chapter 7	7 days	25	500 mL	Headspace	Cool to ≤6° C
Sulfite	377.1	NA	Immediate [i]	2.0	100 mL	Plastic	None
Surfactants, MBAS	425.1,5540C	NA	48 hours	0.05	200 mL	Plastic	Cool to ≤6° C
Turbidity	180.1	NA	48 hours	1.0 NTU	100 mL	Plastic	Cool to ≤6° C

TABLE 3-1 (Continued)

ANALYTICAL METHODS AND COLLECTION REQUIREMENTS
AQUEOUS SAMPLES

PARAMETER	ANALYTICAL METHOD INFORMATION [a]				COLLECTION REQUIREMENTS		
	EPA No. [b] SM No. g	SW846 No.	Holding Time [c]	Detection Limit (mg/L) [d]	Sample Volume Required [e]	Container Type	Preservation Technique [f]
ORGANICS							
Total Organic Carbon (TOC)	415.1,5310C	9060	28 days	1.0	100 mL	Plastic	H_2SO_4 to pH<2 Cool to ≤6° C
Total Organic Halogen (TOX)	NA	9020	28 days	5 µg/L	500 mL	Glass Amber, Teflon Lid	H_2SO_4 to pH<2 Cool to ≤4° C
Chlorinated Pesticides	608/608.2 [h]	8081	7 days/ 40 days	0.005-2.0 µg/L	1000 mL	Glass Amber, Teflon Lid	Cool to ≤4° C $Na_2S_2O_3$ for chlorinated sample
PCBs	608 [h]	8082	7 days/ 40 days	0.25 µg/L	1000 mL	Glass Amber, Teflon Lid	Cool to ≤4° C $Na_2S_2O_3$ for chlorinated sample
Chlorinated Herbicides	615 SM18 6640B	8151 modified	7 days/ 40 days	.025-25 µg/L	1000 mL	Glass Amber, Teflon Lid	Cool to ≤4° C $Na_2S_2O_3$ for chlorinated sample
Semi-Volatiles (BNA)	625 [h]	8270	7 days/ 40 days	1.0-10 µg/L	1000 mL	Glass Amber, Teflon Lid	Cool to ≤4° C $Na_2S_2O_3$ for chlorinated sample
Explosives	NA	8330	7 days/ 40 days	0.1 ug/L	1000 mL	Glass Amber, Teflon Lid	Cool to ≤4° C $Na_2S_2O_3$ for chlorinated sample

TABLE 3-1 (Continued)

ANALYTICAL METHODS AND COLLECTION REQUIREMENTS
AQUEOUS SAMPLES

PARAMETER	ANALYTICAL METHOD INFORMATION [a]				COLLECTION REQUIREMENTS		
	EPA No. [b] SM No. [g]	SW846 No.	Holding Time [c]	Detection Limit (mg/L) [d]	Sample Volume Required [e]	Container Type	Preservation Technique [f]
ORGANICS (continued)							
Volatiles	624 [h]	8260	14 days	1.0-10 µg/L	3 40-oz. vials, No Headspace	Glass Vials, Teflon Lined Septum Cap	HCL to pH<2 Cool to ≤4° C Ascorbic Acid for chlorinated sample
FLPRO	NA	NA	7 days	0.1 mg/L	1000 mL	Glass Amber, Teflon Lid	H_2SO_4 to pH<2 Cool to ≤4° C
TPH-Gasoline/VPH	NA	8015	14 days	.020 mg/L	3-40 oz. vials, No Headspace	Glass Vials, Teflon Lined Septum Cap	HCL to PH<2 Cool to ≤4° C
TPH-Diesel/EPH	NA	8015	14 days	.10 mg/L	1000 mL	Glass Amber, Teflon Lid	HCL to PH<2 Cool to ≤4° C

TABLE 3-1 (Continued)

ANALYTICAL METHODS AND COLLECTION REQUIREMENTS
AQUEOUS SAMPLES

PARAMETER	ANALYTICAL METHOD INFORMATION [a]				COLLECTION REQUIREMENTS		
	EPA No. [b] SM No. [g]	SW846 No.	Holding Time [c]	Detection Limit (mg/L) [d]	Sample Volume Required [e]	Container Type	Preservation Technique [f]
METALS							
Dissolved	200.7	6010	6 months	0.001 - 2.0	200 mL	High Density Polyethylene	Filtered on site HNO_3 to pH <2
Total	200.7	6010	6 months	0.001 - 2.0	200 mL	High Density Polyethylene	HNO_3 to pH <2
Chromium, Hexavalent	3500 CrD	7196	24 hours, 28 days	0.025	200 mL	High Density Polyethylene	Cool to 6° C, pH 9.3-9.7
Mercury	245.1	7470	28 days	0.0002	300 mL	High Density Polyethylene	HNO_3 to pH <2

NA = Not Applicable

[a] If specific methods, detection limits, QC and/or reporting requirements, etc. are not specified, the Empirical Laboratories, LLC will utilize its best professional judgment in processing the samples.

[b] EPA Methods for Chemical Analysis of Water and Wastes

[c] The times listed are the maximum times that samples may be held before analysis begins.

[d] Detection limits listed are typical laboratory method detection limits. These are subject to change and may vary based on sample volume, matrix interferences, high concentration of analytes, etc. Units are mg/L unless specified otherwise.

[e] These are typical volumes. In some cases may be able to perform analyses with less sample volume however detection limits are subject to increase. Laboratory will always request extra volume (if available) in case of breakage, reanalysis, dilutions, QC requirements etc. Certain analytes with the same collection requirements may be combined upon collection and analyzed from the same container.

[f] Sample preservation should be performed immediately upon sample collection.

[g] Standard Methods 20th Edition

[h] 40 CFR 136 Methods

i Analyzed immediately means that analysis must take place immediately at the point of collection or within 15 minutes of collection

For safety reasons and in order to minimize contamination, preservatives are, in general, added to the sample bottles prior to transporting to the field. The pH of these samples is then checked when the samples are received to ensure that they are adequately preserved.

3.2 SAMPLING PROCEDURES FOR SOILS AND SEDIMENTS

Soil and sediments are collected according to procedures in Test Methods for Evaluating Solid Waste USEPA-SW-846.

Metal sampling devices are used for collection of samples requiring organics analyses. Plastic sampling devices are used when metals are to be analyzed. Prior to use, corers and other sampling tools are washed with soapy water and rinsed with deionized water. Nanograde isopropanol or acetone may be used to remove organic contamination. For near surface samples (3 feet or less), disposable lengths of pipe can be used for taking cores.

Table 3-2 lists the containers for collection of soil and sediment samples and holding times. Containers for solid samples are purchased pre-cleaned when project requirements dictate.

Soil and sediment samples for volatile analysis should be quickly added to the sampling vials. Special precautions are taken to minimize head or void space.

Soil and sediment samples for organics and nutrients analyses are stored at 4°C prior to testing.

TABLE 3-2
ANALYTICAL METHODS AND COLLECTION REQUIREMENTS
NON-AQUEOUS SAMPLES

PARAMETER	ANALYTICAL METHOD INFORMATION [a]				COLLECTION REQUIREMENTS		
	EPA No. [b]	SW846 No.	Holding Time [c]	Detection Limit [d] (mg/kg)	Sample Volume Required [e]	Container Type	Preservation Technique [f]
GENERAL CHEMISTRY							
% solids determination [g]	2540 [i]	NA	Not Specified	1.0 %	10 grams	Plastic/Glass	Cool 4°C
Cyanide						Plastic/Glass	Cool 4°C
Total	335.3	9012	14 days	0.25	10 grams		
Amenable	335.1	9012	14 days	0.25	10 grams		
Dissociable	335.3	9012	14 days		10 grams		
Reactivity	NA	Chapter 8	14 days	0.13	10 grams		
Nitrogen, Total Kjeldahl (TKN)	351.2	NA	28 days	20	10 grams	Plastic/Glass	Cool 4°C
Oil and Grease	1664	9071	28 days	5.0	20 grams	Plastic/Glass	Cool 4°C
Petroleum Hydrocarbons, Total (TPH)	1664	NA	28 days	100	20 grams	Plastic/Glass	Cool 4°C
Phenolics, Total	420.2	9066	28 days	0.5	10 grams	Plastic/Glass	Cool 4°C
Paint Filter	NA	9095	Not Specified	NA	500 grams	Plastic/Glass	None
TCLP	NA	1311	14 days	NA	500 grams	Plastic/Glass	Cool 4°C
SPLP	NA	1312	14 days	NA	500 grams	Plastic/Glass	Cool 4°C

TABLE 3-2 (Continued)

ANALYTICAL METHODS AND COLLECTION REQUIREMENTS
NON-AQUEOUS SAMPLES

PARAMETER	ANALYTICAL METHOD INFORMATION [a]				COLLECTION REQUIREMENTS		
	EPA No. [b]	SW846 No.	Holding Time [c]	Detection Limit [d] (mg/kg)	Sample Volume Required [e]	Container Type	Preservation Technique [f]
METALS							
Total	200.7	6010	6 months	0.05-50	5 grams	High Density Polyethylene(CLP only) /Glass	Cool to ≤4° C
Chromium, Hexavalent	NA	3060/7196	Project Specific	1.0	10 grams	High Density Polyethylene(CLP only) /Glass	Cool to ≤4° C
Mercury	245.5	7471	28 days	0.033	5 grams	High Density Polyethylene(CLP only) /Glass	Cool to ≤4° C
TOC	NA	Modified 9060	28 days	800-900	5 grams	Glass	Cool to ≤4° C

TABLE 3-2 (Continued)

ANALYTICAL METHODS AND COLLECTION REQUIREMENTS
NON-AQUEOUS SAMPLES

PARAMETER	ANALYTICAL METHOD INFORMATION [a]				COLLECTION REQUIREMENTS		
	EPA No. [b]	SW846 No.	Holding Time [c]	Detection Limit [d] (mg/kg)	Sample Volume Required [e]	Container Type	Preservation Technique [f]
ORGANICS							
Pesticides	608/608.2 [h]	8081	14 days/ 40 days			Glass, Teflon Lid	Cool to 4° C
Low Level				0.17-67 µg/kg	100 grams		
Medium Level				2.5-1000 µg/kg	10 grams		
PCB	608 [h]	8082	14 days/ 40 days			Glass, Teflon Lid	Cool to 4° C
Low Level (30 grams)				17 µg/kg	100 grams		
Medium Level (2 grams)				200 µg/kg	10 grams		
Soxhlet (10 grams)				2.5 µg			
Wipe							
Herbicides	615/SM18 6640B	8151	14 days/ 40 days	1-800 µg/kg	100 grams	Glass, Teflon Lid	Cool to 4° C
Semi-Volatiles (BNA)	625 h	8270	14 days/ 40 days			Glass, Teflon Lid	Cool to 4° C
Low Level				33-330 µg/kg	100 grams		
Medium Level				1-10	10 grams		
Explosives	NA	8330	14 days 40 days	50-140 µg/kg	100 grams	Glass, Teflon Lid	Cool to 4° C

TABLE 3-2 (Continued)

ANALYTICAL METHODS AND COLLECTION REQUIREMENTS
NON-AQUEOUS SAMPLES

PARAMETER	ANALYTICAL METHOD INFORMATION [a]				COLLECTION REQUIREMENTS		
	EPA No. [b]	SW846 No.	Holding Time [c]	Detection Limit [d] (mg/kg)	Sample Volume Required [e]	Container Type	Preservation Technique [f]
ORGANICS (Continued)							
Volatiles	624 [h]	8260	14 days		2-2 oz. jars[j]	Glass, Teflon Lined Septum Cap No Headspace	Cool to 4° C
Low Level				1.0-200 µg/kg			
Medium Level				130-1300 µg/kg			
TPH-Diesel Range/EPH	NA	8015	14 days	4.0	100 grams	Glass,Teflon Lid[j]	Cool to 4° C
TPH-Gasoline Range/VPH	NA	8015	14 days	1.0	2-2oz. Jars[j]	Glass, Teflon Lid No headspace[j]	Cool to 4° C
FLPRO	NA	NA	14 days	1.0	2-2oz. Jars[j]	Glass, Teflon Lid No headspace[j]	Cool to 4° C

NA = Not Applicable

[a] If specific methods, detection limits, QC and/or reporting requirements, etc. are not specified, the analytical laboratory will utilize its best professional judgment in processing the samples.

[b] EPA Methods for Chemical Analysis of Water and Wastes

[c] The times listed are the maximum times that samples may be held before analysis.

[d] Detection limits listed are typical laboratory method detection limits. These are subject to change and may vary based on sample volume, matrix interferences, high concentration of analytes, etc. Units are mg/kg unless otherwise specified.

[e] These are typical volumes. In some cases may be able to perform analyses with less sample volume however detection limits are subject to increase. Laboratory will request extra volume (if available) in case of breakage, reanalysis, QC requirements etc. Certain analytes with the same collection requirements may be combined upon collection and analyzed from the same container.

[f] Sample preservation should be performed immediately upon sample collection.

[g] All results will be reported on a dry weight basis unless requested otherwiseStandard Methods 19th Edition

[h] 40 CFR 136 Methods

[i] Standard Methods 19th Edition

EnCore sampling technique may be required, check with regulatory agency.

4.0 SAMPLE CUSTODY, TRANSPORT, AND RECEIVING

To facilitate sample identification and analytical procedures required for each sample, proper chain-of-custody documentation will be prepared for each sample that is sent to the analytical laboratory. The operational details regarding sample tracking within the laboratory is presented in Figure 4-1.

4.1 SAMPLE KIT PREPARATION

The necessary sample information is organized by the Project Manager and passed on to the appropriate staff. The Project Manager prepares a sample kit work order which details the type and number of samples, type and number of required containers, type of preservation required, etc. Tables 3-1 and 3-2 list the required volumes, sample containers, preservations, and holding times for collection of groundwater and surface water, and soil and sediment samples.

All sample containers and chemical preservatives are stored in an area isolated from any areas where solvents are used or stored. Trip blanks for volatiles are also prepared away from these areas and as close to the time of shipment as possible in order to keep storage time to a minimum. If projects require containers that have been certified as contaminant-free, the certification papers are maintained on file.

The sample kits are prepared in such a manner to ensure the following:

- That samples are collected with adequate sample volume. The volume will be limited to the quantity needed for analysis but will include enough volume for retesting if necessary.

- That samples are collected in proper containers. Plastic containers and screw lids will be used whenever possible. If corks and stoppers are used, they will be taped to help assure that they remain in place during shipment. It is recommended as a precaution that all sample container lids be taped.

- That samples are properly preserved. For safety reasons and in order to minimize contamination, chemical preservations are, in general, added to the sample bottles prior to transporting to the field. The pH of these samples is then checked

FIGURE 4-1

LABORATORY SAMPLE TRACKING SYSTEM
SAMPLE RECEIVING

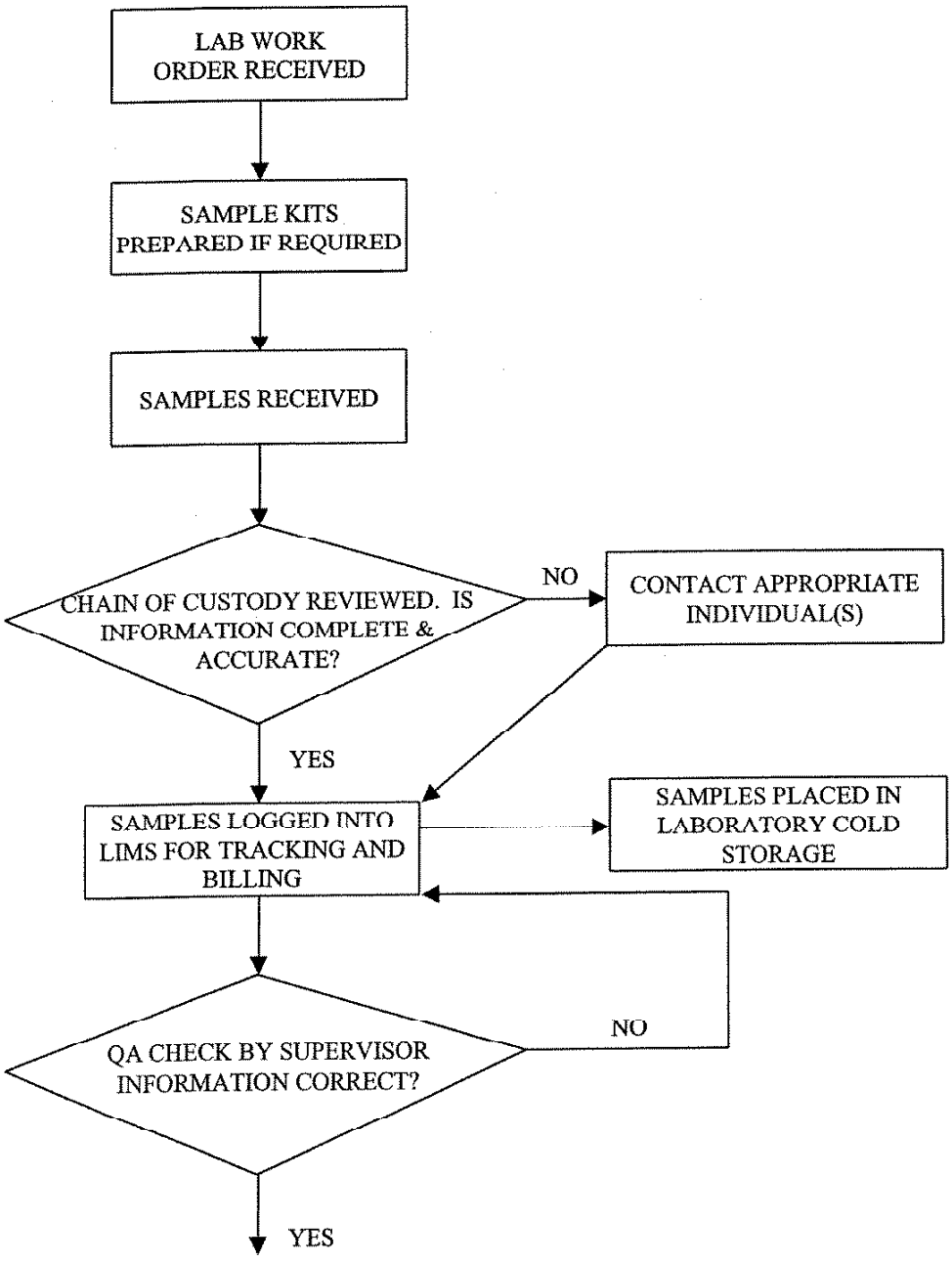


FIGURE 4-1 (Continued)

LABORATORY SAMPLE TRACKING SYSTEM
SAMPLE RECEIVING

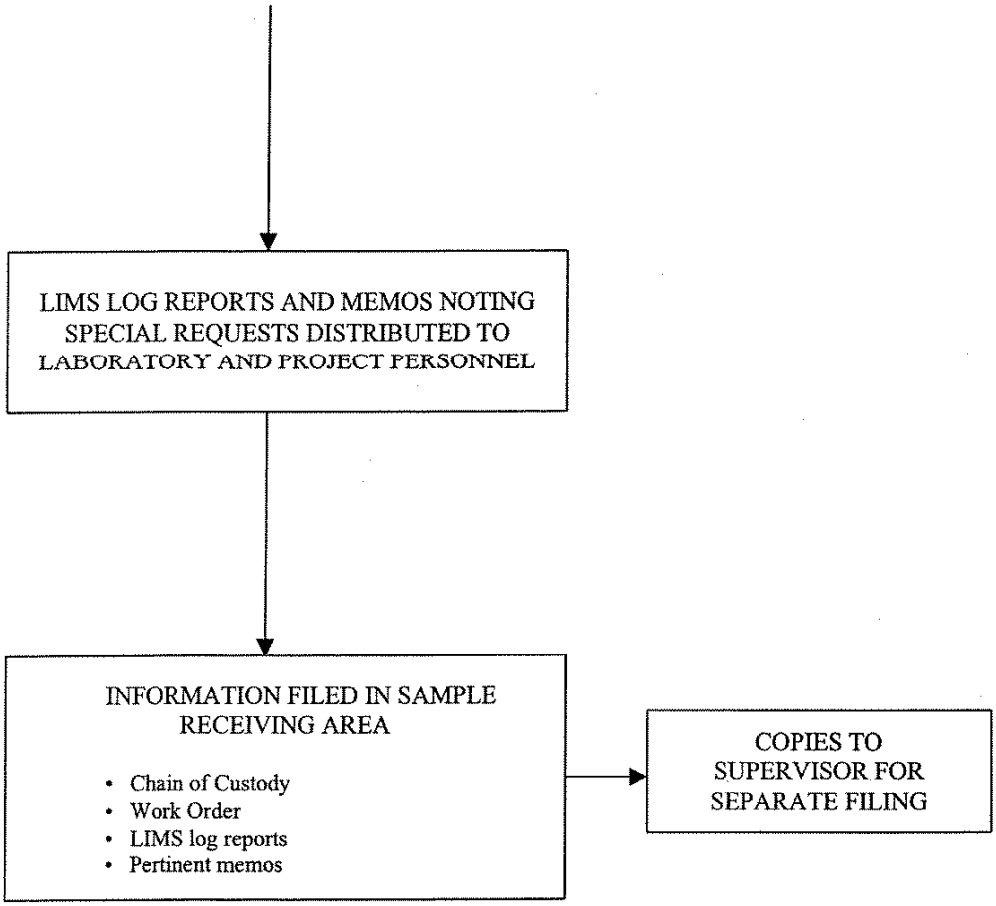
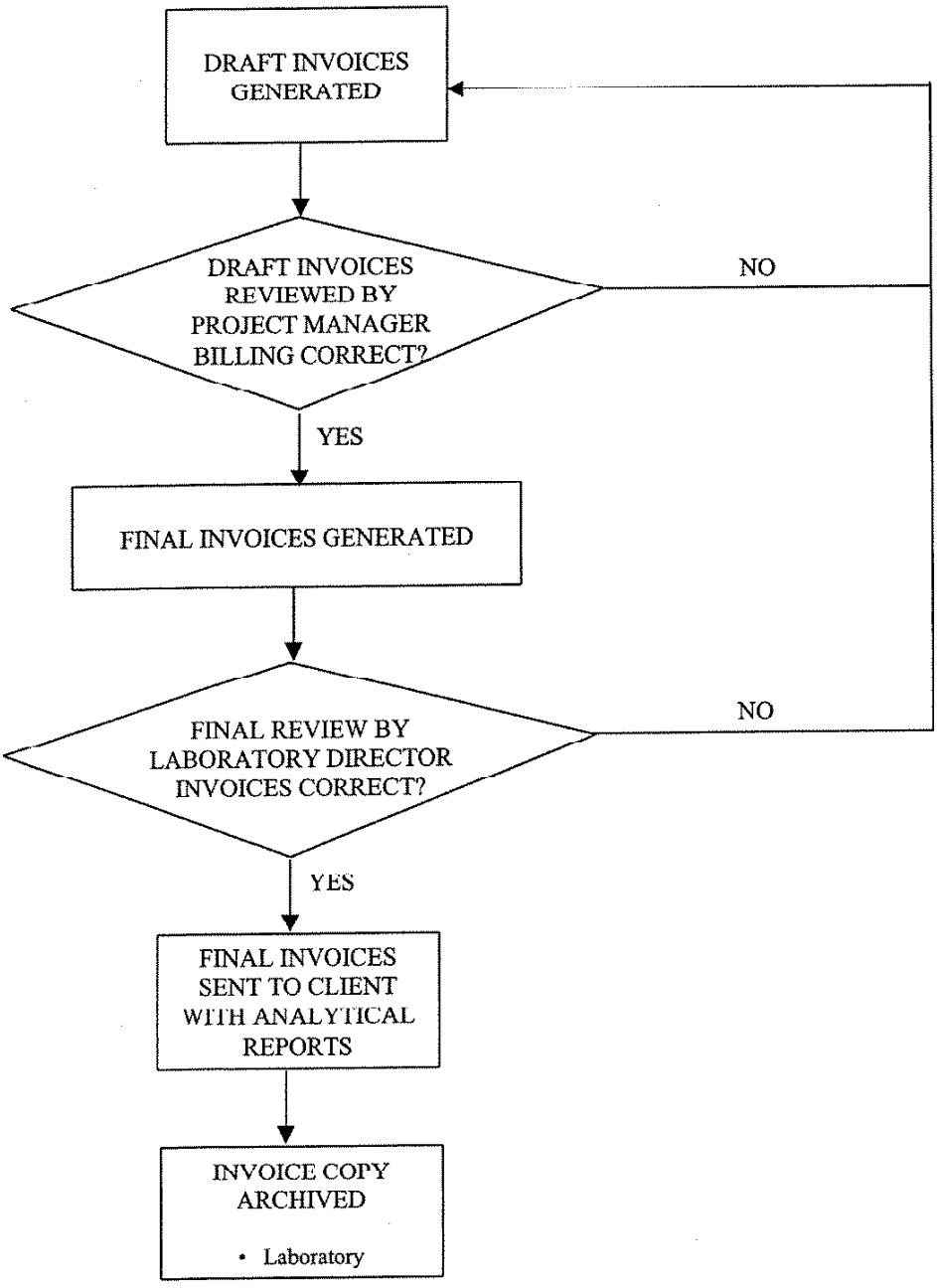


FIGURE 4-1 (Continued)

LABORATORY SAMPLE TRACKING SYSTEM
INVOICING



when they are received to ensure that they are adequately preserved. In some instances when nitric acid cannot be used as a preservative (US DOT regulations), the USEPA permits the preservation of metals samples with nitric acid immediately following receipt at the laboratory.

- That samples can be monitored to ensure that they are properly chilled. A temperature blank filled with tap water is placed in every cooler. The temperature of this bottle is checked upon receipt as a representation of the other containers in the cooler.

- That any problems associated with the shipment and log-in of the samples are minimized. This goal is achieved by: organizing sample containers by sample locations, providing pre-labeled containers with standard or custom labels, providing a copy of the sample kit work order, and providing special sampling instructions (e.g., for VOA sampling).

The sample kit technicians sign off on a chain-of-custody form certifying that they prepared the kit and that the containers are suitably clean. This chain-of-custody record is shipped with the containers to the site and tracks the containers from person to person and place to place. From this record, the movement in time and space of the trip blanks and reagent free water used for field/equipment blanks (which originate in the laboratory) can also be traced.

In some instances, it may be necessary to have sample containers shipped directly from the supply vendor to the sampling site.

4.2 FIELD COLLECTION AND SHIPMENT

When the sample kits are received in the field, the person receiving the kits signs and dates the chain-of-custody form to document receipt of the sample kits. When the sample kits are used for samples, the field sampler signs and dates the form again to complete the sample kit chain of custody and to begin the sample chain of custody. When transferred or shipped from the field, samples are accompanied by the chain-of-custody records. The records include the signatures of the relinquisher and the receiver, the date and time of the exchange, and any pertinent remarks. For the samples shipped to Empirical Laboratories, LLC the commercial shipper will appear in the chain-of-custody record only to the extent

that the bill of lading records will be stapled to the chain-of-custody form by the person receiving the shipment.

Figure 4-2 illustrates the sample chain-of-custody form which is used for both sample kit and sample tracking.

During sample collection, the following procedures are observed:

- To assure the validity of the sample, on site sampling procedures are reviewed prior to arrival in the field and confirmed for accuracy.

- Sample handling is minimized in order to reduce the chance of error, confusion, and damage.

- Sample labels are marked in the field with water-proof ink to prevent misidentification due to label illegibility. The shipping container is either padlocked or provided with a tamper-proof custody seal.

- Samples and/or coolers can be provided with a tamperproof seal so that sample integrity can be documented upon receipt.

4.3 SHIPPING AND PACKAGING

Sample packaging for shipment is done such that under normal handling, there is no significant release of materials and the effectiveness of the packing is not reduced; and such that there is no cross-contamination of samples. Care is taken to maintain the integrity of the samples and satisfy the preservation requirements. These guidelines should be followed in order to achieve these objectives:

- Select a sturdy cooler in good repair. Secure and tape the drain plug with fiber or duct tape. Line the cooler with a large, heavy-duty plastic bag.

- Allow sufficient space (ullage) in all bottles (except VOCs) to compensate for any pressure and temperature changes (approximately 10 percent of the volume of the container).

Figure 4-2
EMPIRICAL LABORATORIES, LLC CHAIN OF CUSTODY RECORD

Ship to:
EMPIRICAL LABORATORIES, LLC
227 French Landing Drive
Suite 550
Nashville, TN 37228
Attn: Analytical Laboratory
(615) 345-1115 (phone)
(615) 846-5426 (fax)

Send Results to:

Name _____
Company _____
Address _____
City,State,Zip _____
Phone _____
Fax _____
E-mail _____

Send Invoice To:

Name _____
Company _____
Address _____
City,State,Zip _____
Phone _____
Purchase Order _____
E-mail _____

Details:

Page _____ of _____
Cooler No. _____ of _____
Date Shipped _____
Shipped By _____

Turnaround _____
(Std. Turn unless noted otherwise / There may be a surcharge for RUSH-contact lab)

Project No./Name

Samplers (Signature)*

Lab Use Only Lab #	Date Sampled	Time	Comp./ Grab	Sample Location/Description	Sample Matrix	Field pH/Temp	Field Cond.	ANALYSIS REQUIRED	No. of Bottles	*Lab Use Only* Containers/Pres.

Sample Kit Prep'd by: (Signature)	Date/Time	Received By: (Signature)
Relinquished by: (Signature)	Date/Time	Received By: (Signature)
Relinquished by: (Signature)	Date/Time	Received By: (Signature)
Received for Laboratory by: (Signature)	Date/Time	*Temperature*

REMARKS
*Signature recuired to ensure validity

Lab Use Only

VOA Headspace	Y	N	NA
Field Filtered	Y	N	NA
Correct Containers	Y	N	NA
Discrepancies	Y	N	NA
Cust. Seals intact	Y	N	NA
Containers Intact	Y	N	NA

Airbill # _____

CAR # _____

Distribution: Original and yellow copies accompany sample shipment to laboratory; Pink retained by samplers

- Be sure the lids on all bottles are tight (will not leak). In some instances, leakage will be minimized by the use of internal bagging.

- Place 2 to 4 inches of vermiculite in the bottom of the cooler and then place the sample containers in the cooler with sufficient space to allow for the addition of more vermiculite between the containers. Vermiculite will absorb any spillage that could occur, as well as provide cushioning and insulation for cooling.

- Put "blue ice" (or ice that has been properly sealed in heavy-duty polyethylene bags) on top of or between the samples. Fill all remaining space between the sample containers with vermiculite. Securely fasten the top of the garbage bag with tape (preferably plastic electrical tape).

- Place the chain-of-custody record into a plastic bag, tape the bag to the inner side of the cooler lid, close the cooler and securely tape the top shut (preferably with fiber tape). Chain-of-custody seals should be affixed to the top and sides of the cooler within the securing tape so that the cooler cannot be opened without breaking the seals.

- Place a label containing the name and address of the shipper on the outside of the cooler. The coolers must be marked "THIS END UP," and arrow labels which indicate the proper upward position of the cooler affixed to the sides. Labels used in the shipment of hazardous materials (such as Cargo Only Aircraft, Flammable Solids, etc.) are not permitted to be on the outside of containers used to transport environmental samples and shall not be used.

All samples determined to be hazardous, according to the US Department of Transportation regulations (US DOT 49 CFR Section 172.1 or 49 CFR 173.3), will be labeled and shipped in strict accordance with the US DOT regulations.

4.4 SAMPLE RECEIPT

The first step in the receipt of samples is obtaining the necessary project specific sample information. In general, this information is organized by the Project Manager and passed on to the appropriate staff. The Project Manager who is expecting the shipment, notifies

the Sample Receiving Department and appropriate Department Managers of the incoming samples.

Upon sample receipt, the Sample Receiving Department follows the procedure described below:

- Visually inspect the shipping containers for any signs of tampering, intact custody seals, and to make sure there is no damage or leakage to the outside of the shipping container.

- Check to make sure that proper temperature has been maintained during shipment. The temperature is recorded directly on the chain-of-custody sheets.

- Unpack and remove all samples. Sort and inventory the samples against the chain of custody. Any samples suspected to be hazardous and evolving gas will be inspected under a hood. Personal protective equipment is also available for any hazardous samples.

- Visually inspect the individual containers for signs of tampering and to make sure the containers are intact with no damage or leakage. If samples have been damaged during shipment, the remaining samples are carefully examined to determine whether they were affected.

- Verify that sample holding times have not been exceeded.

- Check samples to verify that they were collected in the correct containers and that there is adequate volume for all the parameters requested.

- Check samples to verify preservation techniques. Check pH of preserved samples.

- Sign and date the chain-of-custody forms attaching shipping documents (if appropriate). Certain projects also require that a cooler receipt form be completed.

- Assign laboratory identification numbers to the samples; write these numbers on the sample containers and on the chain-of-custody sheets. Color coded tape is placed on each container to designate a particular group of testing.

- Place the samples in appropriate storage.

- Place the completed chain-of-custody sheets in the project file.

- Enter the following information for the samples into the computer-based laboratory information management system:

  - Billing information (quotations, purchase order numbers, etc.)
  - Project identification number
  - Date and time received
  - Name of person receiving
  - Method of shipment
  - Date and time collected
  - Name of sampler(s)
  - Sample identification
  - Temperature upon receipt
  - Number and types of containers and preservative
  - Matrix of samples
  - Note if VOA headspace is present, if applicable
  - Note if correct containers were used
  - Note if any breakage or spillage occurred
  - Note any information concerning hazards (known or suspected), project specific requirements, rush turnaround, etc.

4.5 CORRECTIVE ACTION

Any problems with the samples (e.g., damaged or improper containers, improper cooling or preservation, etc.),or discrepancies between the chain of custody and the samples, will be documented and brought to the attention of the Project Manager. If necessary, the Project Manager will contact the customer and/or field personnel. The samples may be temporarily placed on hold until all discrepancies are resolved. If significant changes are required, the customer and/or field personnel should submit written confirmation of these

changes or make the corrections directly on the chain-of-custody records. Any errors on the chain of custody should be deleted with a one line strike on the chain of custody and the changes must be initialed and dated. If no chain-of-custody record is received, the samples will be temporarily placed on hold and will not undergo processing until a chain of custody has been received. All attempts to resolve any discrepancies should be made as quickly as possible to avoid possible holding time conflicts.

A corrective action report (CAR) form will be completed in order to keep a written record of any deficiencies associated with sample receiving. The problem(s) will be outlined as well as the action taken to resolve the problem. If any of the project team is contacted, the person's name, time of contact, date, and resolution must be recorded. Each sample receiving CAR will have a unique number and will be attached directly to the chain of custody. Copies of the CAR will be distributed to all appropriate personnel.

4.6 LABORATORY SAMPLE CUSTODY

Empirical Laboratories, LLC is located on the fifth floor of a building which is locked and monitored by a guard after normal working hours. During working hours, the only access (without building keys) to the fifth floor is via elevators which discharge within view of a reception desk which is occupied continuously. No unauthorized personnel are permitted within the facility without a proper escort and a visitor's badge.

Samples are maintained in the sample log-in or sample storage room. All samples (excluding the following exceptions) are stored in a walk-in refrigerator in the sample storage room.

- Soils quarantined by the US Department of Agriculture must be segregated from other soil samples. These are stored in a side by side refrigerator in the sample storage room. Quarantined soils are defined as:

    1. Soil taken from much of the southeastern U.S. and parts of New York and Maryland at an area of three feet or less. Soils from three feet or more are not regulated provided they are stored separately. A map of the regulated areas is posted in the sample receiving room.

    2. All soils taken from foreign sources, U.S. territories and Hawaii.

- Highly contaminated or product samples which could jeopardize the integrity of other samples in the walk in cooler will be stored under a hood at room temperature.

Any person removing samples for processing from the walk in refrigerator or quarantined storage areas must sign them out on a laboratory custody sheet. The individual performing the processing becomes responsible for the samples at this point. The samples are maintained in the secure possession of the individual processing the samples. When the processing is completed, the samples are returned and signed back into the appropriate storage area. It must be noted if the entire sample volume was used and the container discarded. The generation of any sample extracts and/or digests and their movement through the laboratory will also be tracked on a laboratory custody sheet.

After the analytical results have been reported, the samples, sample extracts, and digests will remain in secure storage until they are disposed of in accordance with the Empirical Laboratories, LLC's Waste Disposal Standard Operating Procedure.

4.7 SUBCONTRACTING LABORATORY SAMPLES

The Project Manager will advise the customer (if regulatory compliance is involved) in writing of its intention to subcontract any portion of the sample to another lab. The subcontracting laboratory must be certified to perform that work under the appropriate accrediting authority (state, federal, local or third party). The laboratory must have records to document that the above requirement was followed when required.

TABLE 4-1

LIST OF SUBCONTRACTORS

1. Beaver Engineering, Nashville, TN.
2. ELAB, Inc., Ormond Beach, FL.
3. Environmental Science Corp., Mt. Juliet, TN.
4. Florida Radiochemistry, Orlando, FL.
5. Kemron, Marietta, OH.
6. Microseeps, Pittsburg, PA.
7. SGS, Wilmington, N.C.
8. PDR Environmental Labs, Nashville,TN.
9. PEL Laboratories, Inc., Tampa, FL.
10. STL, Denver, CO.
11. STL, West Sacramento, CA.
12. Terracon, Nashville, TN.
13. TestAmerica, Nashville, TN.

5.0 PROCEDURES AND CALIBRATION

Most of the analytical procedures performed by Empirical Laboratories, LLC are directed by the regulatory sector. Hence, most of the methodologies used begin with state and federal agencies. The laboratory will generally utilize only those methods that USEPA has recognized as "approved" analytical procedures. The following is a list of analytical references that the laboratory uses routinely. This list is not intended to be all inclusive.

1. Test Methods for Evaluating Solid Waste, Physical/Chemical Methods (SW-846), Third Edition, Update III (promulgated 6/13/97).

2. Methods for Chemical Analysis of Water and Wastes (MCAWW), EPA 600/4-79-020.

3. Other available USEPA methods, e.g., methods described in the Statement of Work (SOW) for EPA's Contract Laboratory Program (CLP).

4. Standard Methods for the Examination of Water and Wastewater (SM), 20th Edition (APHA, AWWA, and WPCF 1992).

5. "Guidelines Establishing Test Procedures for the Analysis of Pollutants," Code of Federal Regulations Vol. 40, Part 136.

6. SW846 - Method 1311: Toxicity Characteristic Leaching Procedure (TCLP), included in reference 1.

7. Manual of Analytical Methods for the Analysis of Pesticides in Humans and Environmental Samples, EPA 600/8-80-038, June 1980.

8. "Methods for the Determination of Organic Compounds in Finished Drinking Water and Raw Source Water," USEPA, Environmental Monitoring and Support Laboratory - Cincinnati, Ohio, September 1986.

9. Analytical Procedures for Determining Organic Priority Pollutants in Municipal Sludges, EPA 600/2-80-030, MERL, March 1980.

10. Annual Book of ASTM Standards, American Society for Testing and Materials, Philadelphia, Pennsylvania.

11. Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air, EPA 600\4-89-017, EPA Atomospheric Research and Exposure Assessment Laboratory, RTP, North Carolina, June 1988.

12. NIOSH Manual of Analytical Methods, Third Edition, U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control, National Institute for Occupational Safety and Health, Division of Physical Science and Engineering, Cincinnati, Ohio, February 1984.

13. "Determination of Metals in Fish Tissue by Inductively Coupled Plasma - Atomic Emission Spectrometry," Theodore P. Martin, Eleanor R. Martin, and Larry B. Lobring; Inorganic Chemistry Branch, Chemistry Research Division, USEPA Office of Research and Development, EMSL, Cincinnati, Ohio, December 1989.

14. "Extraction and Analysis of Priority Pollutants in Biological Tissue," USEPA, S&A Division, Region IV, Laboratory Services Branch, Athens, Georgia.

5.1 LABORATORY INSTRUMENTS

The laboratory calibrates its analytical instrumentation at a frequency consistent with the methodologies referenced above. Calibration criteria for laboratory instrumentation for the methodologies most commonly used are summarized in Table 5-1. Calibration standards are obtained from several commercial suppliers. The formulations of calibration standards are documented in logbooks including information for traceability such as the supplier, lot number, and expiration date where traceability to national standards of measurement is not applicable, the laboratory has evidence of correlation of data, for example the participation in interlaboratory comparisons, proficiency testing or independent evaluations.

TABLE 5-1

CALIBRATION FREQUENCY AND CRITERIA

Method	Instrument	Calibration Frequency	Calibration Points	Criteria for Passing
Volatile Organics 8260 (SW-846)	HP 5971 GC/MS HP 5972 GC/MS HP 5972 GC/MS Agilent 5973 GC/MS	BFB tune and calibration check every 12 hours	A minimum of 5 initial calibration standards Continuing calibration standard (method specific)	Initial: CCC RF's Method specified SPCC RRF Method specified Continuing: CCC Method specified SPCC RRF Method specified
Semivolatile Organics 8270 (SW-846)	HP 5971 GC/MS Agilent 5973 GC/MS	DFTPP tune and calibration check every 12 hours	A minimum of 5 initial calibration standards Continuing calibration 50 ppb standard	Initial: CCC RF's Method specified SPCC RRF Method specified Continuing: CCC Method specified SPCC RRF Method specified
Chlorinated Herbicides 8151 (SW-846)	Hewlett Packard 5890 capillary GC-ECD	Calibration check every 10 samples	5 calibration standards at concentration of interest	Initial: <20% RSD Check: <15%D
Pesticides and PCB's 8081 & 8082 (SW-846)	Hewlett Packard 5890 Agilent 6890 capillary GC-ECDs	Calibration check every 20 samples or 12 hours	5 calibration standards at concentration of interest	Initial: <20% RSD Check: <15% D
Explosives (HPLC) 8330 (SW-846)	2- HP 1050/UV	Calibration check every 20 samples	5 calibration standards at concentration of interest	Initial: <20% RSD Check: <15%D
TPH(DRO) Project specified method MOD-8015 (SW-846)	HP 5890 GC/FID	Calibration check every 20 samples	5 initial calibration standards	Initial: Method specified Check: Method specified
FLPRO	HP 5890 GC/FID	Calibration check every 10 samples	5 calibration standards at concentration of interest	Initial: <25% RSD Check: <25% D
GRO TNGRO, 8015 (SW-846)	HP 5890 GC/FID	TNGRO-Calibration check at the beginning and end. 8015-Calibration check every 12 hrs	5 calibration standards at concentration of interest	Initial: Method specified Check: Method specified
Volatile/Semivolatile Organics (Screening)	Hewlett Packard 5890 capillary GC-FID	Calibration daily	1 calibration standard and blank	None

TABLE 5-1(Continued)

CALIBRATION FREQUENCY AND CRITERIA

Method	Instrument	Calibration Frequency	Calibration Points	Criteria for Passing
Metals by ICP 6010 (SW-846)	Thermal Jarrell-Ash ICP (TRACE)	Calibration at the beginning of each analytical series	Blank and one standard	Check standard within 10% of true value
Mercury by Cold Vapor 7470 (SW-846)	Perkin Elmer FIMS	Calibration check every 10 samples Calibration check at the end of the analytical sequence	5 initial calibration standards + blank	Check standard within 20% of true value
7000 Series (SW-846)				Check standard within 10% of true value
Cyanide 335.4/9012	Lachat Quikchem AE	Calibrate every 3 months for all except IC Method 300.0 calibrate every 6 months. Calibration check at beginning and every 10 samples Calibration check at the end of the analytical sequence	5 initial calibration standards	Check standard within 10% of true value
Total Phenolics (4AAP) Method 420.2/9065	Lachat Quickchem AE		3 calibration standards + blank	
TOC (Aqueous) Method 415.1/SM5310C/9060	OI Model 1500 OIC Model 1010		3 calibration standards + blank	
Chloride 325.2/9251 300.0	Lachat Quikchem AE Dionex Model DX 500		9 calibration standards + blank; 8 Calibration standards	
Fluoride(Non-distilled) 300.0	Orion-407A- ISE Dionex Model DX 500		8 Calibration standards	
Perchlorate 314.0	Dionex Model DX 500		8 Calibration standards	
Sulfates 375.4/9038 300.0	Hach Turbidimeter Model 2100A Dionex Model DX 500		3 calibration standards + blank 8 Calibration standards	
Hexavalent Chromium 7196 (SW-846)	Bausch and Lomb UV/VIS Spec. 2000		5 calibration standards + blank	
pH Measurement 9040 (SW-846)	Orion pH Meter Model 420A	With each analytical series	At least 2 buffers bracketing sample pH	Buffer reading within 0.05 pH units of true value
TVS in Soil	Balance Muffle Furnace	Balance calibration daily	None	None

5.2 VARIANCE FROM STATED ANALYTICAL METHODS

Analyses will be performed in accordance with the methods cited herein unless specific project requirements or needs dictate adoption of an alternative method or modification of the cited methods. If an alternate method or modification is required the customer will be required to give written approval for such action. Standard operating procedures(SOP) are detailed in the laboratory's SOP Manual. The table of contents to our laboratory SOP Manual is listed in Table 5-2.

5.3 PROCEDURES FOR CALIBRATION, VERIFICATION, AND MAINTENANCE OF EQUIPMENT

Equipment is maintained, inspected, and cleaned according to the manufactures specifications. Any defective equipment is taken out of service until it has been shown to perform satisfactorily.
Equipment and reference material records include the following:

- Name of item
- Manufacturer, identification, serial number
- Date received and placed in service
- Copy of manufacture's instructions or manuals
- Details of maintenance carried out to date
- History of any damage, malfunction, modification, or repair

Service of equipment is performed by quality service organizations. All records and certificates from service calls are retained. Instruments are tagged when they are out of service.

General laboratory support equipment are calibrated/verified at least annually using NIST traceable references over the range of use. Balances, ovens, refrigerators, freezers, incubators, and water baths are checked with NIST traceable references (where possible) and recorded. Additional monitoring as prescribed by the test method SOP is recorded. Mechanical volumetric dispensing devices are checked for accuracy at least quarterly and recorded. Mercury thermometers are calibrated annually. Digital thermometers are calibrated quarterly. Both are calibrated at their range of use.

Table 5-2
EMPIRICAL LABORATORIES, LLC
STANDARD OPERATING PROCEDURES

SOP NUMBER	SECTION 1
	METALS/CONVENTIONAL CHEMISTRY
SOP-100	Metals Digestion/Preparation Methods 3005A, 3010A, 3020A, 3030, 3040A, 3050B USEPA CLPILMO 04.1 AQUEOUS & Soil/Sediment USEPA CLPILMO 05.2 Aqueous & Soil/Sediment, USEPA Method 200.7 (Standard Methods) 3030C **Rev. 19 Effective Date 07/25/06; Date of Last Review 07/25/06**
SOP-101	N-Hexane Extractable Material (HEM) and Silica Gel Treated N-Hexane Extractable Material (SGT-HEM) by Extraction and Gravimetry (Oil and Grease and total Petroleum Hydrocarbons), Methods (SW846) 1664, **Rev. 5 Effective Date 11/29/06; Date of Last Review 11/29/06**
SOP-102	Color (ADMI) Method 110.1, **Rev. 1, Effective Date 07/31/01; Date of Last Review 02/03/06**
SOP-103	Mercury Analysis in Water by Manual Cold Vapor Technique Methods USEPA SW846 7470S & 245.1 CLP-M 4.1, **Rev. 13, Effective Date 07/20/06; Date of Last Review 07/20/06**
SOP-104	Mercury Analysis in Soil/Sediment by Manual Cold Vapor Technique Methods SW846 7471A , 245.5 & CLPILM 04.1, **Rev. 14, Effective Date 07/21/06; Date of Last Review 07/21/06**
SOP-105	Metals Analysis by ICP Technique Methods 200.7, (SW846) 6010B (SM 19th Edition 2340B) USEPA CLP ILMO 4.1, **Rev. 12, Effective Date 07/24/06; Date of Last Review 07/24/06**
SOP-106	ICP Instrument Operation, **Rev. 5, Effective Date 03/08/04; Date of Last Review 03/17/05**
ATSD-107	**Deleted** 03/20/95 per Rick Davis
ATSD-108	**Deleted** 08/10/00 per Betty DeVille
ATSD-109	**Deleted** 08/10/00 per Betty DeVille
ATSD-110	**Deleted** 08/10/00 per Betty DeVille
ATSD-111	**Deleted** 08/10/00 per Betty DeVille
ATSD-112	**Deleted** 08/10/00 per Betty DeVille
ATSD-113	**Deleted** 08/10/00 per Betty DeVille
ATSD-114	**Deleted** 08/10/00 per Betty DeVille
ATSD-115	**Deleted** 01/20/00 per Betty DeVille
SOP-116	Metals Digestion/Preparation Biological Tissue USEPA Region IV, **Rev. 0, Effective Date 10/25/01; Date of Last Review 03/21/05**
SOP-117	Mercury Analysis in Biological Tissue by Manual Cold Vapor Techniques USEPA Region IV Method, **Rev. 0, Effective Date 10/26/01; Date of Last Review 03/23/05**
SOP-118	Inorganic Raw Data and Report Check, **Rev. 1, Effective Date 12/05/03; Date of Last Review 01/17/06**
	CONVENTIONAL CHEMISTRY/GENERAL
SOP-143	Determination of Ferrous Iron by Standard Methods 3500-Fe D Phenanthroline Method Using HACH AccuVac Ampuls from Method 8146, **Rev.0, Effective Date 02/08/07, Date of Last Review 02/08/07**
SOP-144	Acid Soluble Sulfide Method SW846 9030B for distillation & Method SW846 9034 for the titration. **Rev 0, Effective Date 10/13/03; Date of Last Review 10/13/03**
SOP-145	Determination of Inorganic Anions in water by ION Chromatography using Dionex DX-500 Ion Chromatograph with Hydroxide Eluent And Dionex Column AS18, Method 300.0 Guidance, **Rev. 4, Effective Date 11/28/06; Date of Last Review 11/28/06**
SOP-146	Easily Oxidisable Carbon/Total Oxidisable Carbon Walkley Black TOC, **Rev. 0, Effective Date 05/13/03; Date of Last Review 03/21/05**
SOP-147	Synthetic Precipitation Leaching Procedure Method 1312, **Rev. 0, Effective Date 10/22/02; Date of Last Review 01/09/04**
SOP-148	Determination of Perchlorate using the Dionex DX-500 ION Chromatograph Method 314.0, **Rev. 1, Effective Date 08/22/02; Date of Last Review 11/04/05**

Table 5-2
EMPIRICAL LABORATORIES, LLC
STANDARD OPERATING PROCEDURES
SECTION 1 (Continued)

SOP-149	Flashpoint Ignitability Method SW846-1010, **Rev. 1, Effective Date 02/25/02; Date of Last Review 01/28/06**
ATSD-150	**Deleted** 8/24/01 per Betty DeVille
ATSD-151	**Deleted** 2/18/02 per Betty DeVille
ATSD-152	**Deleted** 8/24/01 by Betty DeVille
SOP-153	Sulfide Method 376.1 (Titrimetric, Iodine) with Sample Pretreatment to Remove Interfering Substances or to Concentrate the Sulfide, **Rev. 2, Effective Date 08/14/01; Date of Last Review 01/28/06**
SOP-154	Alkalinity by EPA Method 310.1, SM2320B, **Rev. 2, Effective Date 11/28/06; Date of Last Review 11/28/06**
SOP-155	**Deleted** 04/13/07 per Betty DeVille
SOP-156	Reactive Sulfide Method SW-846, Chapter 7, Section 7.3.4, **Rev. 3, Effective Date 03/07/02; Date of Last Review 01/28/06**
ATSD-157	**Deleted** 2/18/02 per Betty DeVille
SOP-158	Turbidity Method 180.1 (Nephelometric), **Rev. 2, Effective Date 01/08/03; Date of Last Review 01/28/06**
SOP-159	Acidity by EPA Method 305.1 and SW846 Method 2310, **Rev. 1, Effective Date 01/09/04; Date of Last Review 03/22/05**
SOP-160	**Deleted** 04/13/07 per Betty DeVille
SOP-161	Methylene Blue Active Substances (MBAS) by EPA Method 425.1 (Colorimetric) **Rev. 4, Effective Date 11/28/06; Date of Last Review 11/28/06**
SOP-162	Sulfate Methods SW846 9038 (USEPA) 375.4 (Turbidimetric), **Rev. 4, Effective Date 04/11/05; Date of Last Review 04/11/05**
SOP-163	Chemical Oxygen Demand (High & Low) (USEPA) Method 410.4 (Colormetric, Manual), **Rev. 5, Effective Date 11/28/06; Date of Last Review 11/28/06**
SOP-164	Distillation of Aqueous/Solid Samples for Total and Non-Amenable Cyanide Analysis Methods 335.1/335.4 (SW846) 9012A/USEPA CLP ILMO 4.1, **Rev. 12, Effective Date 11/29/06; Date of Last Review 11/29/06**
SOP-165	Phosphorous, Total and Ortho (USEPA) Method 365.2 (Colorimetric, Ascorbic Acid, Single Reagent), **Rev. 4, Effective Date 01/09/07; Date of Last Review 01/09/07**
SOP-166	Hexavalent Chromium (Cr^{+6}) Manual Method by SW846-7196A/Standard Methods 3500 CrD, **Rev. 6, Effective Date 11/28/06; Date of Last Review 11/28/06**
SOP-167	Nitrogen, Ammonia (USEPA) Method 350.2 (Potentiometric,Titrimetirc- Distillation Procedure), **Rev. , Effective Date 09/08/06; Date of Last Review 09/08/06**
SOP-168	Phenolics, Total Recoverable (USEPA) Method 420.1 and 420.2 (Spectrophotometric, Manual and Automated 4-AAP with Distillation), **Rev. 5, Effective Date 11/28/06; Date of Last Review 11/28/06**
SOP-169	Biochemical Oxygen Demand (BOD) Method 405.1 (5 days, 20°C), **Rev. 6, Effective Date 11/28/06; Date of Last Review 11/28/06**
SOP-170	Threshold Odor Test Method 2150B, **Rev. 1, Effective Date 01/12/04; Date of Last Review 03/22/05**
SOP-171	Color – Standards, Methods 19th Edition 2120B, **Rev. 2, Effective Date 11/27/06; Date of Last Review 11/27/06**
SOP-172	Solids - Total and Volatile in Bottom Sediments % Volatile Solids Method by USEPA Methods 160.3 and 160.4, **Rev. 1, Effective Date 01/12/04; Date of Last Review 02/08/06**
SOP-173	Total Residue Total Solids (TS) Total Volatile Solids (TVS) also known as Percent Solids USEPA Method 160.1 (Gravimetric, Dried at 103 to 105°C), **Rev. 4, Effective Date 07/19/06; Date of Last Review 07/19/06**
SOP-174	Residue, Non-Filterable Total Suspended Solids and Volatile Suspended Solids by EPA Method 160.2 (Gravimetric, Dried at 103 to 105°C), **Rev. 2, Effective Date 01/04/02; Date of Last Review 02/08/06**

Table 5-2
EMPIRICAL LABORATORIES, LLC
STANDARD OPERATING PROCEDURES

SECTION 1 (Continued)

SOP-175	Post-Distillation Analysis for Cyanide By the LACHAT Methods 335.4;SW846 9012A;USEPA-CLP 4.1;Addendum for USEPA CLP ILM 05.2 Aqueous & Soil/Sediment , **Rev. 9, Effective Date 07/18/06; Date of Last Review 07/18/06**
SOP-176	Ammonia (Phenolate) Potable and Surface Waters Method 10-107-06-1-A 0.1 to 20 mg N/L as NH_3 USEPA Method 350.1, **Rev. 3, Effective Date 11/26/06; Date of Last Review 11/26/06**
SOP-177	Chloride in Waters QuikChem Method 10-117-07-1-B 1 to 100 mg Cl^-/L by USEPA Method 325.2/9251, **Rev. 3, Effective Date 11/30/06; Date of Last Review 11/30/06**
SOP-178	**Deleted** 04/13/07 per Betty DeVille
SOP-179	Nitrate/Nitrite, Nitrite in Surface Water, Wastewater 0.02 to 2.0 mg N/L and NO_3- or NO_2- USEPA Method 353.2, **Rev. 4, Effective Date 11/29/06; Date of Last Review 11/29/06**
ATSD-180	**Deleted** 2/18/02 per Betty DeVille
SOP-181	Phenol and Phenolic Materials Distilled Water Samples Method SW846 9066 Lachat 10-210-00-1-A, **Rev. 5, Effective Date 11/28/06; Date of Last Review 11/28/06**
SOP-182	Total Kjeldahl Nitrogen in Waters Method 10-107-06-2-D 0.02 to 20.0 mg N/L by USEPA Method 351.2, **Rev. 5, Effective Date 01/24/07; Date of Last Review 01/24/07**
ATSD-183	**Deleted** per Betty DeVille on 1/13/00
SOP-184	Specific Conductance Methods SW846 9050A USEPA 120.1, **Rev. 7, Effective Date 11/29/06; Date of Last Review 11/29/06**
SOP-185	Nitrogen, Nitrite Method 354.1 (Spectrophotometric), **Rev. 3, Effective Date 11/28/06; Date of Last Review 11/28/06**
SOP-186	Filterable Residue Total Dissolved Solids and Total Dissolved Volatile Solids by Method 160.1 (Gravimetric, Dried at 180°C), **Rev. 2, Effective Date 01/04/02; Date of Last Review 02/08/06**
SOP-187	Electrometric Determination of pH, Methods 150.1 and 9040B for Waters, Liquids and Liquid Wastes, 9045C for Soils and Solid Wastes, **Rev. 6, Effective Date 09/05/06; Date of Last Review 09/05/06**
SOP-191	Paint Filter Liquids Test Standard Operational Procedure (SOP) by SW846 Method 9095, **Rev. 1, Effective Date 01/09/04; Date of Last Review 01/28/06**
SOP-193	Verification of Eppendorf Calibration (Methods: Not Applicable), **Rev. 3, Effective Date 01/12/04; Date of Last Review 01/17/06**
SOP-194	Inorganic Glassware Cleaning (Methods: Not Applicable), **Rev. 2, Effective Date 03/14/03; Date of Last Review 03/23/05**
SOP-195	Inorganic Electronic Data Archival (Methods: Not Applicable), **Rev. 1, Effective Date 01/12/00; Date of Last Review 01/12/04**
SOP-196	Verification of Balance Calibration (Methods: Not Applicable), **Rev. 3, Effective Date 09/03/03; Date of Last Review 01/17/06**
SOP-197	Alkaline Digestion for Hexavalent Chromium in Soil and Sediment (Method 3060A) **Rev. 6, Effective Date 01/09/04; Date of Last Review 02/03/06**
SOP-198	Toxicity Characteristic Leaching Procedure (Method 1311), **Rev. 5, Effective Date 02/09/06; Date of Last Review 02/09/06**
SOP-199	Inorganic Data Entry and Reporting, **Rev. 1, Effective Date 03/10/03; Date of Last Review 03/10/03**

Table 5-2
EMPIRICAL LABORATORIES, LLC
STANDARD OPERATING PROCEDURES

SOP NUMBER	SECTION 2 ORGANICS – QUANTITATION
SOP-200	GC/MS Data and Report Check, **Rev. 9, Effective Date 08/03/05; Date of Last Review 08/03/05**
SOP-201	GC/MS Semivolatiles by EPA Method 625 and SW846 Method 8270C, **Rev. 16, Effective Date 07/05/06; Date of Last Review 07/05/06**
SOP-202	GC/MS Volatiles by EPA Method 624 and SW846 Method 8260B, **Rev. 19, Effective Date 09/29/06; Date of Last Review 09/29/06**
ATSD-203	**Deleted** on 11/13/97 per MKM
SOP-204	Standard Operating Procedures for Assembly of Organic Deliverable Packages and Preliminary Validation of Organic and Inorganic Deliverable Packages, **Rev. 4, Effective Date 02/15/01; Date of Last Review 01/09/04**
SOP-205	**Deleted** 04/13/07 by RDW
SOP-206	**Deleted** 04/13/07 by RDW
SOP-207	**Deleted** 01/12/04 by RDW
SOP-208	GC/ECD Chlorinated Acid Herbicides by SW-846, Method 8150B/8151A, **Rev. 12, Effective Date 08/23/06; Date of Last Review 08/23/06**
SOP-209	**Deleted** 04/13/07 by RDW
SOP-210	**Deleted** 04/13/07 by RDW
SOP-211	GC/ECD Organochlorine Pesticides/PCBs by EPA Method 608 and SW846 Method 8081A/8082, **Rev. 17, Effective Date 10/04/06; Date of Last Review 10/04/06**
ATSD-212	**Deleted** 01/23/97 per MKM
SOP-213	Organic Raw Data Filing, **Rev. 1, Effective Date 05/02/02; Date of Last Review 01/09/04**
ATSD-214	**Deleted** per Marcia McGinnity 1/21/00
ATSD-215	**Deleted** per Marcia McGinnity 2/2/99
SOP-216	GC Data and Report Check, **Rev. 8, Effective Date 08/03/05; Date of Last Review 08/03/05**
SOP-217	**Deleted** 04/13/07 by RDW
SOP-218	GC/ECD 1,2-Dibromoethane and 1,2-Dibromo-3-Chloropropane by Method 8011 **Rev. 4, Effective Date 1/09/07; Date of Last Review 01/09/07**
SOP-219	GC/FID Nonhalogenated Volatile Organics And TPH by Method 8015B, **Rev. 9, Effective Date 08/22/06; Date of Last Review 08/22/06**
ATSD-220	**Deleted** per MKM 2/9/99
SOP-221	Total Organic Carbon SM5310C, USEPA Method 415.1 and SW846 Method 9060 and Lloyd Kahn Method, **Rev. 5, Effective Date 11/29/06; Date of Last Review 11/29/06**
SOP -222	GC/ECD Routine Maintenance, **Rev. 3, Effective Date 04/10/04; Date of Last Review 01/16/06**
SOP-223	**Deleted** 04/13/07 by RDW
SOP-224	Manual Integration of a Chromatographic Peak, **Rev. 4, Effective Date 07/07/06; Date of Last Review 07/07/06**
SOP-225	GC/MS Volatile Non-Aqueous Matrix Extraction Using SW-846 Method 5035 for 8260B Analysis, **Rev. 6, Effective Date 11/20/03; Date of Last Review 03/16/05**
SOP-226	Method for the Determination of Extractable Hydrocarbons (EPH) MADEP– EPH-98-1, **Rev. 2, Effective Date 05/02/02; Date of Last Review 01/09/04**
SOP-227	Method for the Determination of Volatile Petroleum Hydrocarbons (VPH) MADEP– VPH-98-1, **Rev. 1, Effective Date 05/02/02; Date of Last Review 01/09/04**

Table 5-2
EMPIRICAL LABORATORIES, LLC
STANDARD OPERATING PROCEDURES

SECTION 2 (Continued)

SOP-228	**Deleted** 04/13/07 by RDW
SOP-229	GC/MS Volatiles in Drinking Water by EPA Method 524.2, **Rev. 3, Effective Date 03/22/05; Date of Last Review 03/22/05**
SOP-230	GC/MS Volatiles Extraction from Biological Tissue Using USEPA Region IV Method for 8260B Analysis, **Rev. 0, Effective Date 10/29/01; Date of Last Review 01/09/04**
SOP-231	GC/MS Low Level PAH'S By EPA Method 625 and SW-846 Method 8270C, **Rev. 0, Effective Date 07/24/03; Date of Last Review 01/09/04**
SOP-232	TNRCC, Total Pertroleum Hydrocarbons Method 1005, **Rev. 0, Effective Date 09/23/03; Date of Last Review 01/09/04**
SOP-233	Nitroguanidine in Soil and Water By High Performance Liquid Chromatography, **Rev.0, Effective Date 12/30/04; Date of Last Review 12/30/04**
SOP-234	Analysis of Nitrocellulose in Aqueous and Non-aqueous Samples By Basic Hydrolysis and Measurement of Nitrate and Nitrite(Modified 353.2), **Rev.0, Effective Date 1/7/05, Date of Last Review 1/7/05**
SOP-235	Total Organic Halides(TOX) Method 9020B, **Rev 1, Effective Date 05/05/06 ,Date of Last Review 05/05/06**
SOP-236	Methane, Ethane, Ethene in Aqueos Samples by Modified RSK-175 (Automated Headspace), **Rev.0, Effective Date 02/08/07, Date of Last Review 02/08/07**
OLM01.3	Organic CLP Ammendments, **Rev. 0, Effective Date 07/09/98; Date of Last Review 01/09/04**
OLM03.2	Organic CLP Ammendments, **Rev. 1, Effective Date 06/07/02; Date of Last Review 01/09/04**
OLM04.1	Organic CLP Ammendments, **Rev. 1, Effective Date 06/07/02; Date of Last Review, 01/09/04**

Table 5-2
EMPIRICAL LABORATORIES, LLC
STANDARD OPERATING PROCEDURES

SECTION 3

SOP NUMBER	ORGANICS - EXTRACTION/ SAMPLE PREPARATION
SOP-300	GC/MS-Semi-Volatile BNA-Aqueous Matrix Extraction Using SW-846 Method 3510C for 8270C/625 Analysis, **Rev 14, Effective Date 03/17/05; Date of Last Review 03/17/05**
SOP-301	**Deleted** by RDW 01/12/04
SOP-302	Pesticide/PCBs – Aqueous Matrix Extraction for EPA Method 608 and SW846 Method 8081A/8082 Using SW846 Method 3510C, **Rev. 13, Effective Date 03/17/05; Date of Last Review 03/17/05**
ATSD-303	**Deleted** 01/98 per MKM
SOP-304	Herbicides Aqueous Matrix by Methods EPA SW-846 Method 8151A, **Rev. 9, Effective Date 08/22/06; Date of Last Review 08/22/06**
ATSD-305	**Deleted** 08/06/98 per MKM
SOP-306	Glassware Cleanup SW-846 Chapter 4 Organic Analytes 4.1.4 Cleaning of Glassware, **Rev. 3, Effective Date 05/23/00; Date of Last Review 04/15/05**
SOP-307	Sulfur Cleanup Method SW-846 3660B, **Rev. 5, Effective Date 09/09/03; Date of Last Review 02/07/06**
SOP -308	Acid Cleanup SW-846 Method 3665A, **Rev 5, Effective Date 08/22/06; Date of Last Review 08/22/06**
SOP -309	Florisil Cartridge Cleanup CLP Statement of Work (OLM01.0) and SW-846 Method3620B, **Rev 5, Effective Date 02/15/05; Date of Last Review 02/07/06**
SOP-310	Herbicides – Non-Aqueous Matrix by SW-846 Method 8150B/8151A, **Rev. 9, Effective Date 08/23/06; Date of Last Review 08/23/06**
SOP-311	Waste Dilution for BNA and Pest/PCB by SW-846 Method 3580A, **Rev. 5, Effective Date 05/23/00; Date of Last Review 01/18/06**
ATSD-312	**Deleted** - Combined with ATSD-311 per MKM 2/9/99
SOP -313	Biological Tissue Extractions for Pest/PCB EPA Method OB 10/90, **Rev. 5, Effective Date 04/15/05; Date of Last Review 04/15/05**
SOP-314	Biological Tissue Extractions for BNA, **Rev. 4, Effective Date 04/15/05; Date of Last Review 04/15/05**
SOP -315	PCB (Puffs) Method SW-846 8081A/8082 Method 3540C and TO4, **Rev. 4, Effective Date 05/29/02; Date of Last Review 01/09/04**
SOP-316	Medium Level Non-Aqueous Matrix BNA and Pesticide/PCB using SW846 Method 3550B, **Rev. 9, Effective Date 4/10/04; Date of Last Review 1/18/06**
ATSD-317	**Deleted** - Combined with ATSD-316 per MKM 2/9/99
SOP-318	Low Level Non-Aqueous Matrix BNA and Pesticide/PCB Extraction using SW846 Method 3550B, **Rev 16, Effective Date 08/21/06; Date of Last Review 08/21/06**
ATSD-319	**Deleted** - Combined with ATSD-318 per MKM 2/9/99
SOP-320	TPH (Total Petroleum Hydrocarbons) Non-Aqueous Matrix (Low Level) by USEPA SW-846 Method 8015B, **Rev. 6, Effective Date 04/15/05; Date of Last Review 04/15/05**
SOP -321	TPH (Total Petroleum Hydrocarbon), **Rev. 4, Effective Date 04/15/05; Date of Last Review 04/15/05**
SOP-322	TPH (Total Petroleum Hydrocarbons) Aqueous Matrix by USEPA SW846 Method 8015A, **Rev. 5, Effective Date 04/15/05; Date of Last Review 04/15/05**
SOP -323	Wipes (PCB), **Rev. 6, Effective Date 05/29/02; Date of Last Review 04/15/05**
ATSD -324	**Deleted** 04/25/95 by DFC
SOP 327	Nitroaromatics and Nitramines by High Performance Liquid Chromatography (HPLC) Method 8330A, **Rev. 10, Effective Date 02/27/07; Date of Last Review 02/27/07**
SOP -328	Generation of Diazomethane for Herbicide Esterification, **Rev. 3, Effective Date 11/11/02; Date of Last Review 04/15/05**

Table 5-2
EMPIRICAL LABORATORIES, LLC
STANDARD OPERATING PROCEDURES
SECTION 3 (Continued)

SOP NUMBER	ORGANICS – EXTRACTION/ SAMPLE PREPARATION
SOP-329	Soxhlet Extraction - BNA and Pest/PCB Using SW846 Method 3541, **Rev. 14, Effective Date 10/04/06; Date of Last Review 10/04/06**
SOP-330	GPC Cleanup SW-846 Method 3640A, **Rev. 3, Effective Date 05/23/03; Date of Last Review 04/15/05**
SOP-331	Silica Cartridge Cleanup SW-846 Method 3630C, **Rev. 3, Effective Date 08/21/06; Date of Last Review 08/21/06**
SOP-332	**Deleted** 04/13/07 by RDW
SOP-333	Acid-Base Partitioning Cleanup SW-846 Method 3650B, **Rev. 4, Effective Date 08/21/06; Date of Last Review 08/21/06**
SOP-334	**Deleted** 04/13/07 by RDW
SOP-335	Massachusetts EPH (Extractable Petroleum Hydrocarbons) MADEP-EPH-98-1 Aqueous Matrix, **Rev. 1, Effective Date 05/23/00; Date of Last Review 01/12/04**
SOP-336	Process for Handling Methylene Chloride, **Rev. 0, Effective Date 05/18/00; Date of Last Review 04/15/05**
SOP-337	Modified Low-Level Non-Aqueous Matrix PCB Extraction Using SW-846 Method 3550B, **Rev. 1, Effective Date 04/15/05; Date of Last Review 04/15/05**
SOP-338	FLPRO (Extractable Petroleum Hydrocarbons) Aqueous and Solid Matrix, **Rev. 4, Effective Date 04/11/05; Date of Last Review 02/07/06**
SOP-339	PCB Continuous Liq-Liq Extraction Using EPA Method 608 and SW846 Method 3520C, **Rev.1, Effective Date 08/22/06; Date of Last Review 08/22/06**
SOP 340	Nitroaromatics and Nitramines by High Performance Liquid Chromatography (HPLC) Method 8330B, **Rev. 0, Effective Date 02/13/07; Date of Last Review 02/13/07**

Table 5-2
EMPIRICAL LABORATORIES, LLC
STANDARD OPERATING PROCEDURES

SOP NUMBER	SECTION 4 QA/SAMPLE LOG-IN/ADMINISTRATIVE/VARIOUS
SOP-400	Laboratory Administrative Assistant SOP for the Purchasing, **Rev. 3, Effective Date 01/27/05; Date of Last Review 01/27/05**
SOP-401	Laboratory Administrative Assistant SOP for the Generation of Analytical Reports **Rev. 3, Effective Date 06/28/01; Date of Last Review 01/09/04**
SOP-402	Laboratory Administrative Assistant SOP for Filing Laboratory Documents, **Rev. 3, Effective Date 06/28/01; Date of Last Review 01/09/04**
SOP-403	Correcting Analytical Reports for Erroneously Reported Data, **Rev. 2, Effective Date 02/01/06; Date of Last Review 02/01/06**
SOP-404	Laboratory Sample Receiving Log-In and Storage Standard Operating Procedures **Rev. 10, Effective Date 07/20/06; Date of Last Review 07/20/06**
SOP-405	Analytical Laboratory Waste Disposal, **Rev. 4, Effective Date 09/26/03; Date of Last Review 04/13/05**
SOP-406	Standard Operation Procedure (SOP) for Sub Contracting Laboratory Samples, **Rev. 3, Effective Date 02/16/05; Date of Last Review 07/05/06**
SOP-407	Standard Operating Procedure for Sample Kit Preparation, **Rev. 6, Effective Date 02/10/06; Date of Last Review 02/10/06**
ATSD 408	**Deleted** per Rick Davis 2/6/00
SOP-410	Standard Operating Procedures for Laboratory Sample Storage, Secure Areas and Sample Custody, **Rev. 4, Effective Date 02/10/06; Date of Last Review 02/10/06**
SOP-411	Sample Tracking/Work Performed, **Rev. 4, Effective Date 02/01/06; Date of Last Review 02/01/06**
SOP-413	Training of Laboratory Personnel, **Rev. 5, Effective Date 05/01/02; Date of Last Review 01/17/06**
SOP-414	MDL/IDL Determinations (FR Part 136, Appendix B), **Rev. 6, Effective Date 07/05/06; Date of Last Review 07/05/06**
SOP-415	The Laboratory Sample Custodian's Duties and Responsibilities, **Rev. 3, Effective Date 02/13/06; Date of Last Review 02/13/06**
SOP-416	Determination of Statistical Outliers, **Rev. 2, Effective Date 01/09/04; Date of Last Review 03/21/05**
SOP-417	Traceability and Expiration Dates of Test-Related Chemicals for Inorganic/Wet Chemistry Methods, **Rev. 2, Effective Date 03/29/02; Date of Last Review 01/12/04**
SOP-418	North Carolina Samples SOP, **Rev. 3, Effective Date 08/14/03; Date of Last Review 08/14/03**
SOP-419	Standard Operating Procedures for Controlling and Changing Laboratory Standard Operating Procedures, **Rev. 3, Effective Date 01/14/04; Date of Last Review 01/30/06**
SOP-420	Laboratory Invoicing Standard Operating Procedures, **Rev. 0, Effective Date 05/04/00; Date of Last Review 01/09/04**
SOP-421	Deleted 02/01/06 per MKM
SOP-422	ELAB Laboratory Servers/Data Integrity, **Rev. 2, Effective Date 09/18/03; Date of Last Review 03/17/05**
SOP-423	Respirator Program, **Rev. 0, Effective Date 01/02/03; Date of Last Review 01/17/06**
SOP-424	Laboratory Administrative Assistant/Project Assistant SOP for Data Storage Boxes, **Rev. 1, Effective Date 03/14/03; Date of Last Review 01/09/04**
SOP-425	Control Charts and Limits, **Rev. 1, Effective Date 01/16/06; Date of Last Review 01/16/06**
SOP-426	Internal Audits, **Rev. 0, Effective Date 01/08/04; Date of Last Review 01/16/06**
SOP-427	Customer Complaint Resolution Procedure, **Rev. 0, Effective Date 01/13/04; Date of Last Review 01/16/06**
SOP-428	Preparation of Trip Blanks Procedure and Storage Blanks Procedure, **Rev.1, Effective Date 4/05/05; Date of Last Review 4/05/05**
SOP-429	Standard Process for Submitting Requests for IT Assistance, **Rev.0, Effective Date 02/04/05; Date of Last Review 02/04/05**

Table 5-2

EMPIRICAL LABORATORIES, LLC

STANDARD OPERATING PROCEDURES

SOP-430	Procedure for Handling PT Samples, **Rev. 0, Effective Date 02/08/06; Date of Last Review 02/08/06**
SOP-431	Environmental Laboratory Definitions, **Rev. 0, Effective Date 07/18/06; Date of Last Review 07/18/06**

6.0 DATA REDUCTION, VALIDATION, AND REPORTING

6.1 DATA REDUCTION

In general, data will be reduced by an analyst in one of the following ways:

- Manual computation of results directly on the laboratory bench sheet or on calculation pages attached to the data sheets.
- Input of raw data for computer processing.
- Electronic acquisition and processing of data.

If data are manually processed by an analyst, all steps in the computation are provided including the equations used and the source of input parameters such as response factors, dilution factors, and calibration constants. If calculations are not performed directly on the data sheet, calculations are done on standard calculation paper and attached to the data sheets. Table 6-1 summarizes the equations used for calculations of results and reporting units.

If data are input and processed using a computer, a copy of the input is kept and uniquely identified with the project number and other information as needed. The samples analyzed shall be evident and the input signed and dated by the analyst.

If data are directly acquired from instrumentation and processed, the analyst verifies that the following are correct: project and sample numbers, calibration constants and response factors, output parameters such as units,sample volumes/weights/%solids and numerical values used for detection limits (if a value is reported as less than). The analyst signs and dates the resulting output.

The data reduction/validation flow chart is shown as Figure 6-1.

TABLE 6 -1

SUMMARY OF EQUATIONS USED IN CALCULATIONS

Parameter	Equations	Reporting Units	
		Water	Soil/Sediment
BN/A Extractables and Volatile Organics (GC/MS)		ug/L	ug/kg

$$\text{Response Factor (RF)} = \frac{A_x\, C_{is}}{A_{is}\, C_x}$$

A_X = area of the characteristic ion for the compound from the calibration standard
A_{is} = area of the characteristic ion for the internal standard
C_X = concentration of standard (ng/µL)
C_{is} = concentration of the internal standard (ng/µL)

$$\text{Water Concentration (ug/L)} = \frac{(A_x)\ (I_s)\ (V_t)\ (D)}{(A_{is})\ (\overline{RF})\ (V_o)\ (V_i)}$$

A_X = area of the characteristic ion for compound from the sample
I_S = amount of the internal standard (ng)
A_{is} = area of characteristic ion of the internal standard
$\overline{RF}$ = average response factor for compound
V_o = volume extracted or purged (Mls)
V_i = Volume of extract injected (µL). For purge and trap analysis, V_i is not applicable and therefore = 1.
V_t = Volume of total extract. For purge and trap analysis, V_t is not applicable and therefore = 1.
D = dilution factor

TABLE 6-1 (Continued)

SUMMARY OF EQUATIONS USED IN CALCULATIONS

Parameter	Equations	Reporting Units: Water	Reporting Units: Soil/Sediment
BN/A Extractables, Volatile Organics, Soil/Sediment (GC/MS)	Sediment Concentration (ug/kg) $= \frac{(A_x)\ (I_s)\ (V_t)\ (D)}{(A_{is})\ (\overline{RF})\ (V_i)\ (W_s)}$ A_x = area of the characteristic ion for compound from the sample I_s = amount of the internal standard (ng) V_t = Volume of total extract. For purge and trap analysis, V_t is not applicable and therefore = 1 A_{is} = area of characteristic ion of the internal standard $\overline{RF}$ = average response factor for compound V_i = Volume of extract injected (µL). For purge and trap analysis, V_i is not applicable and therefore = 1. W_s = weight of sample extracted or purged in grams. The wet weight or dry weight may be used, depending upon the specific application of the data. D = dilution factor		
Nutrients and other colorimetric procedures	Water Concentration (mg/L) = mg/L (from calibration curve) x dilution factor	mg/L	mg/kg
	Sediment Concentration (mg/kg) dry = mg/L (from calibration curve) x $\frac{\text{liters of leachate (or digestate)}}{(\text{kg of sample})\,(\%\ \text{solids} \times 0.01)}$		

TABLE 6-1 (Continued)

SUMMARY OF EQUATIONS USED IN CALCULATIONS

Parameter	Equations	Reporting Units: Water	Reporting Units: Soil/Sediment
Volatile Organics/ Pesticides - PCBs (Gas Chromatography)		µg/L	µg/kg

Calibration Factor (CF) = $\frac{A}{A_s}$

A = amount of standard injected or purged, ng
A_s = Response for external standard, units may be in area counts or peak height

Water Concentration (µg/L) = $\frac{(A_x)(V_T)(D)}{(\overline{CF})(V_i)(V_s)}$

A_x = response for the analyte in the sample, units may be in area counts or peak height
V_i = Volume extract injected, µL. For purge-and-trap analysis, V_i is not applicable and therefore = 1
D = dilution factor
V_t = volume of total extract, µL. For purge-and-trap analysis, V_t is not applicable and therefore = 1
V_s = Volume of sample extracted or purged, mL

Soil/Sediment concentration (ng/g) = $\frac{(A_x)(V_T)(D)}{(\overline{CF})(V_i)(W_s)}$

A_x = response for the analyte in the sample, units may be in area counts or peak height.
V_t = Volume of total extract, µL. For purge-and-trap analysis V_t is not applicable and therefore = 1
D = dilution factor
V_i = Volume extract injected, µL. For purge-and-trap analysis, V_i is not applicable and therefore = 1
W_s = Weight of sample extracted or purged, grams. The wet weight or dry weight may be used, depending upon the specific application of the data.

TABLE 6-1 (Continued)

SUMMARY OF EQUATIONS USED IN CALCULATIONS

Parameter	Equations	Reporting Units	
		Water	Soil/Sediment
Metals	Water concentration (mg/L or µg/L)	µg/L (or mg/L)	mg/kg

Read the metal concentration value in µg/L or mg/L directly from the calibration curve.

If dilution of the sample was required:

$$\text{mg/L or µg/L} = \frac{A\,(C + B)}{C}$$

A = mg/L or µg/L in diluted aliquot from calibration curve
B = acid blank matrix used for dilution, mL
C = sample aliquot, mL

For soil and sediments (mg/kg) dry weight

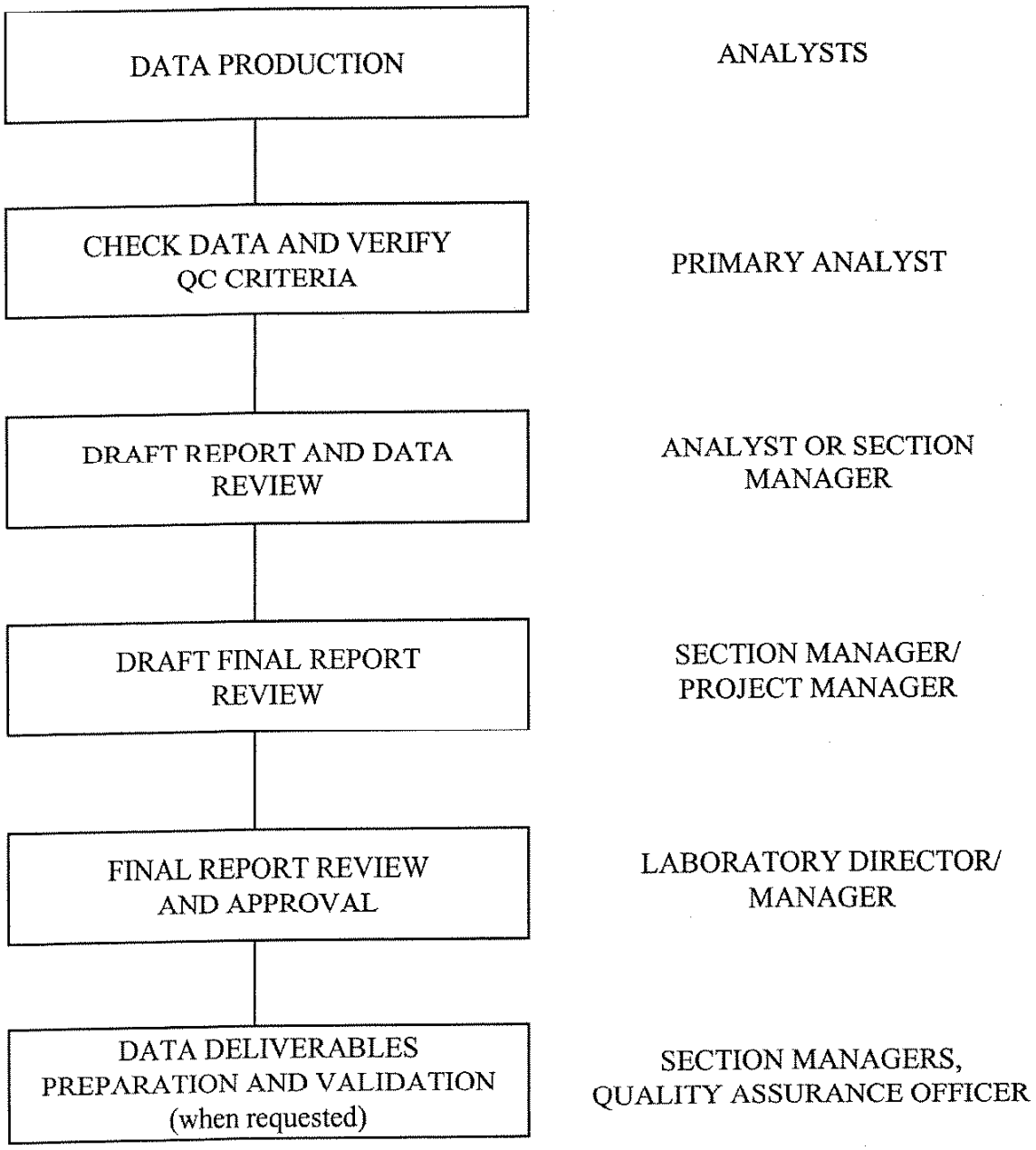
$$= \frac{A_x V}{W_x P}$$

A_X = mg/L in sample from calibration curve
V = final volume of sample, mL
W = weight of sample, grams
P = % solids x 0.01

FIGURE 6-1

DATA REDUCTION AND VALIDATION FLOW

SCHEMATIC AT EMPIRICAL LABORATORIES, LLC



K:\qaqc\qam\NELAP2001\fig7-1.ppt

6.2 DATA VALIDATION

Data validation involves a series of steps taken within an analytical laboratory to ensure that reported results correctly represent the analyses performed, that all instrument systems are in control, and that QA objectives for precision, accuracy, and method detection limits are being met. All analytical data produced at the Empirical Laboratories laboratory are validated against the criteria set forth in this manual or project specific criteria where applicable.

Typically, data validation begins with the primary analyst and continues through several levels of review until the data are reported. The primary analyst verifies that all of the QA objectives are met by comparing the information provided by the various internal quality control checks to the required QC limits, and prepares a draft report. A second analyst experienced with the method then performs a complete check of all steps of data reduction beginning with the raw data. This analyst also signs and dates the time of this data validation check.

The draft reports and supporting data are reviewed and evaluated by the appropriate analytical Section Manager. At this level, the data validation process is reviewed and any necessary additional data qualifiers attached to the report after consultation with the laboratory Quality Assurance Officer, if necessary. The final reports are reviewed for completeness and compliance with overall project goals by the Laboratory Director.

The flow of this data validation process is shown in Figure 6-1. As shown, when projects require a full, CLP-style data validation, data deliverables packages are assembled and data validation performed by the Department Managers or designee. This process is detailed in the SOP included in Appendix B of this manual.

6.3 DATA REPORTING

The flow of information from the initial production of the data to the final report is shown in the flow chart depicted in Figure 6-1. The final, fully reviewed and validated data will be displayed in report form in summary tables separated according to analysis type. After samples have been analyzed and the data reviewed and second checked by the analysts, and the Department Manager, inorganic data are entered into the LIMS and a draft report is printed from the LIMS.

Organic draft reports are created by the use of HP Chemstation in conjunction with Target/Envision computer software. The draft reports are then reviewed and sent forward for the creation of the final summary report. Table 6-2 presents an example of the Empirical Laboratories, LLC standard report for the VOC analysis of a water sample by USEPA Method 8260. As can be seen in the example, the final summary report is in Report Writer. The standard report includes client name, date sampled, date received, date analyzed, date reported, laboratory sample number, field id, method detection limits, dilution factors, constituents being reported, analytical results, concentration units, and QC qualifier flags. A separate page for definition of terms and qualifiers is attached to the summary report when required. If there were any problems with the sample matrix, data or analytical methods a separate narrative will accompany the report.

The laboratory maintains a complete set of the raw analytical data on site for approximately one year after the completion of sample analysis, followed by off site storage for at least six years.

6.4 REPORTING REQUIREMENTS

Each analytical summary report may include the following information:

- Title, e.g. "Certificate of Results", or laboratory results
- Name and address of laboratory
- Unique identification of the report and of each page, and the total number of pages
- Clear identification of sample (customer code)
- Date/time of report, sample preparation and/or analysis if the required holding time for either activity is <48 hours
- Clear identification of test method
- Clear statement if lab performed sampling
- Clear statement of any QA/QC qualifiers that may have an impact on the data user
- A signature and title of person(s) accepting responsibility for the control of the report

Table 6-2

(SAMPLE OF A SUMMARY REPORT)

Client:
Date Reported:

ELAB SAMPLE NUMBER			V3BLK0310	V3BLK0310	V2BLK0311	0103119-01D	0103119-02
DATE SAMPLED			NA	NA	NA	03/02/04	03/02/04
DATE RECEIVED			NA	NA	NA	03/08/04	03/08/04
DATE ANALYZED			03/10/04	03/10/04	03/11/04	03/10/04	03/11/04
CLIENT SAMPLE DESCRIPTION			M.BLANK	M.BLANK	M.BLANK	MW-16DR	FB-031504
VOLATILE ORGANICS BY USEPA METHOD 8260	MDL	EQL	CONC	CONC	CONC	40 X(1) CONC	CONC
Acetone	5.0	50	< 5.0	< 5.0	< 5.0	< 200 D	< 5.0
Benzene	1.0	10	< 1.0	< 1.0	< 1.0	420 D	< 1.0
Bromodichloromethane	1.0	10	< 1.0	< 1.0	< 1.0	< 40 D	< 1.0
Bromoform	1.0	10	< 1.0	< 1.0	< 1.0	< 40 D	< 1.0
Bromomethane	3.0	30	< 3.0	< 3.0	< 3.0	< 120 D	< 3.0
2-Butanone	10	100	< 10	< 10	< 10	< 400 D	< 10
Carbon disulfide	1.0	10	< 1.0	< 1.0	< 1.0	< 40 D	< 1.0
Carbon tetrachloride	1.0	10	< 1.0	< 1.0	< 1.0	< 40 D	< 1.0
Chlorobenzene	1.0	10	< 1.0	< 1.0	< 1.0	7500 D	< 1.0
Chloroethane	2.0	20	< 2.0	< 2.0	< 2.0	< 80 D	< 2.0
Chloroform	1.0	10	< 1.0	< 1.0	< 1.0	< 40 D	2.0 J
Chloromethane	2.0	20	< 2.0	< 2.0	< 2.0	< 80 D	< 2.0
Dibromochloromethane	1.0	10	< 1.0	< 1.0	< 1.0	< 40 D	< 1.0
1,2-Dichlorobenzene	1.0	10	< 1.0	< 1.0	< 1.0	540 D	< 1.0
1,3-Dichlorobenzene	1.0	10	< 1.0	< 1.0	< 1.0	< 40 D	< 1.0
1,4-Dichlorobenzene	1.0	10	< 1.0	< 1.0	< 1.0	1200 D	< 1.0
1,1-Dichloroethane	1.0	10	< 1.0	< 1.0	< 1.0	< 40 D	< 1.0
1,2-Dichloroethane	1.0	10	< 1.0	< 1.0	< 1.0	< 40 D	< 1.0
1,1-Dichloroethene	1.0	10	< 1.0	< 1.0	< 1.0	< 40 D	< 1.0
cis-1,2-Dichloroethene	1.0	10	< 1.0	< 1.0	< 1.0	< 40 D	< 1.0
trans-1,2-Dichloroethene	1.0	10	< 1.0	< 1.0	< 1.0	< 40 D	< 1.0
1,2-Dichloropropane	1.0	10	< 1.0	< 1.0	< 1.0	< 40 D	< 1.0

ALL COMPOUNDS EXPRESSED IN MICROGRAMS/LITER UNLESS OTHERWISE NOTED.

ALL NON-DETECT VALUES ARE REPORTED AS <MDL (MODIFIED TO REFLECT DILUTIONS/SAMPLE VOLUME).

SEE ATTACHED PAGE FOR DEFINITIONS OF TERMS AND QUALIFIERS.

(1) = SAMPLES WERE DILUTED BY THE NUMERICAL VALUE DISPLAYED.
DETECTION LIMITS HAVE BEEN INCREASED BY THE SAME FACTOR.

Empirical Laboratories, LLC, 227 French Landing Drive, Nashville, TN 37228 Phone (615) 345-1115

Table 6-2 (continued)

(SAMPLE OF A SUMMARY REPORT)

Client:
Date Reported:

ELAB SAMPLE NUMBER			V3BLK0310	V3BLK0310	V2BLK0311	0103119-01D	0103119-02
DATE SAMPLED			NA	NA	NA	03/02/04	03/02/04
DATE RECEIVED			NA	NA	NA	03/08/04	03/08/04
DATE ANALYZED			03/10/04	03/10/04	03/11/04	03/10/04	03/11/04
CLIENT SAMPLE DESCRIPTION			M.BLANK	M.BLANK	M.BLANK	MW-16DR	FB-030204
VOLATILE ORGANICS BY USEPA METHOD 8260	MDL	EQL	CONC	CONC	CONC	40 X(1) CONC	CONC
cis-1,3-Dichloropropene	1.0	10	< 1.0	< 1.0	< 1.0	< 40 D	< 1.0
trans-1,3-Dichloropropene	1.0	10	< 1.0	< 1.0	< 1.0	< 40 D	< 1.0
Ethylbenzene	1.0	10	< 1.0	< 1.0	< 1.0	< 40 D	< 1.0
2-Hexanone	2.0	20	< 2.0	< 2.0	< 2.0	< 80 D	< 2.0
Methylene chloride	1.0	10	< 1.0	< 1.0	< 1.0	< 40 D	< 1.0
4-Methyl-2-pentanone	2.0	20	< 2.0	< 2.0	< 2.0	< 80 D	< 2.0
Styrene	1.0	10	< 1.0	< 1.0	< 1.0	< 40 D	< 1.0
1,1,2,2-Tetrachloroethane	1.0	10	< 1.0	< 1.0	< 1.0	< 40 D	< 1.0
Tetrachloroethene	1.0	10	< 1.0	< 1.0	< 1.0	< 40 D	< 1.0
Toluene	1.0	10	< 1.0	< 1.0	< 1.0	< 40 D	< 1.0
1,2,4-Trichlorobenzene	1.0	10	< 1.0	< 1.0	< 1.0	130 JD	< 1.0
1,1,1-Trichloroethane	1.0	10	< 1.0	< 1.0	< 1.0	< 40 D	< 1.0
1,1,2-Trichloroethane	1.0	10	< 1.0	< 1.0	< 1.0	< 40 D	< 1.0
Trichloroethene	1.0	10	< 1.0	< 1.0	< 1.0	< 40 D	< 1.0
Vinyl acetate	5.0	50	< 5.0	< 5.0	< 5.0	< 200 D	< 5.0
Vinyl chloride	2.0	20	< 2.0	< 2.0	< 2.0	< 80 D	< 2.0
Xylene(total)	1.0	10	< 1.0	< 1.0	< 1.0	< 40 D	< 1.0

ALL COMPOUNDS EXPRESSED IN MICROGRAMS/LITER UNLESS OTHERWISE NOTED.

ALL NON-DETECT VALUES ARE REPORTED AS <MDL (MODIFIED TO REFLECT DILUTIONS/SAMPLE VOLUME).

SEE ATTACHED PAGE FOR DEFINITIONS OF TERMS AND QUALIFIERS.

(1) = SAMPLES WERE DILUTED BY THE NUMERICAL VALUE DISPLAYED.
DETECTION LIMITS HAVE BEEN INCREASED BY THE SAME FACTOR.

ELAB of Tennessee, LLC

D. Rick Davis
Vice President

Table 6-2 (Continue)
ANALYTICAL REPORT TERMS AND QUALIFIERS

EQL: The estimated quantitation limit (EQL) is defined as the estimated concentration above which quantitative results can be obtained with a specific degree of confidence. ELAB defines the EQL to be at or near the lowest calibration standard.

B: The presence of a "B" to the right of an analytical value indicates that this compound was also detected in the method blank and the data should be interpreted with caution. One should consider the possibility that the most accurate sample result might be less than the reported value and, perhaps, zero. The qualifier will be placed on the analyte according to "National Functional Guidelines." The 10x rule will be applied.

D: When a sample (or sample extract) is rerun diluted because one of the compound concentrations exceeded the highest concentration range for the standard curve, all of the values obtained in the dilution run will be flagged with a "D".

E: The concentration for any compound found which exceeds the highest concentration level on the standard curve for that compound will be flagged with an "E". Usually the sample will be rerun at a dilution to quantitate the flagged compound.

J: The presence of a "J" to the right of an analytical result indicates that the reported result is estimated. The chromatographic data pass the identification criteria showing that the compound is present, but the calculated result is less than the EQL.

P: The associated numerical value is an estimated quantity. There is greater than a 40% difference between the two GC columns for the detected concentrations. The higher of the two values is reported.

- Foot note any subcontracted work
- After the initial issuance of the laboratory report, the report shall remain unchanged. Changes or revisions can only be made in the form of another report form. The only exception to this would be for typographical errors in regard to things such as sample identification.
- The laboratory must notify customers promptly if a defective measuring system was found to be present causing erroneous results.
- Laboratory shall certify that the results reported meet NELAC standards.

7.0 INTERNAL QUALITY CONTROL CHECKS

The overall effectiveness of a quality control program depends upon operating in the field and the laboratory in accordance with a program that systematically controls the precision and accuracy of analyses by detecting errors and preventing their recurrence, or measuring the degree of error inherent in the methods applied.

Internal QC checks are accomplished through standard programs involving the analysis of various types of samples and standards, such as, replicate, spiked, and split samples; method and reagent blanks; internal, surrogate, and matrix spikes; QC check samples and calibration standards. Such QC programs are shown in Tables 7-1 through 7-6.

The blank, analytical replicate, and spiked quality control samples are analyzed in the same way as field samples and are interspersed with the field samples. The analytical results of these samples are used to document the validity and control the quality of data within predetermined tolerance limits.

7.1 OUTSIDE SUPPORT SERVICES AND SUPPLIES

- When the laboratory procures outside services and supplies, other than those referred to in this document in support of tests, the laboratory will use only those outside support services and supplies that are of adequate quality to sustain confidence in the laboratory's tests.

- Where there is no independent assurance of the quality of outside support services or supplies is available, the laboratory will ensure that purchased equipment, materials and services comply with specified requirements. The laboratory should, whenever possible, ensure that purchased equipment and consumable materials are not used until they have been inspected, calibrated or otherwise verified as complying with any standard specifications relevant to the calibrations or test concerned.

- The laboratory maintains records of all suppliers from whom it obtains support services or supplies required for tests. Table 7-7 and 7-8 are lists of suppliers and subcontractors that are used by the laboratory.

7.2 DOCUMENTATION AND LABELING OF STANDARDS AND REAGENTS

Procedures exist for the purchase, reception and storage of consumable materials used for the technical operations of the laboratory

- The laboratory retains records for all standards including the manufacturer/vendor, the manufacturer's Certificate of Analysis or purity (if supplied), the date of receipt, recommended storage conditions, and an expiration date after which the materials shall not be used unless it is verified by the laboratory.

- Original containers (such as provided by the manufacturer or vendor) are labeled with an expiration date.

- Records are maintained on reagent and standard preparation. These records indicate traceability to purchase stocks or neat compounds, reference to the method of preparation, date of preparation, expiration date and preparer's initials.

- All containers of prepared reagents and standards must bear a unique identifier and expiration date and be linked to the documentation requirements above.

7.3 COMPUTERS AND ELECTRONIC DATA RELATED REQUIREMENTS

Where computers or automated equipment are used for the capture, processing, recording, manipulation, reporting, storage or retrieval of test data, the laboratory ensures that:

- Sections 8.1 through 8.11 of the EPA Document "2185 - Good Automated Laboratory Practices" (1995), will be followed as the standard for employing microprocessors, computers as well as laboratories employing Laboratory Information Management Systems.

- Computer software is documented and adequate for use.

- Procedures are established and implemented for protecting the integrity of data; such procedures should include, but not be limited to, integrity of data entry or capture, data storage, data transmission and data processing.

- Computer and automated equipment are maintained to ensure proper functioning and provided with the environmental and operating conditions necessary to maintain the integrity of calibration and test data.

- The laboratory uses appropriate procedures for the maintenance of security of data including the prevention of unauthorized access to, and the unauthorized amendment of, computer records.

TABLE 7-1

QUALITY ASSURANCE PROGRAM OUTLINE
CONVENTIONAL CHEMISTRY

A) Initial calibration for each analytical parameter

B) Initial calibration for each new set of reagents

1) Four to five concentration levels (Method/Program dependent)
2) One standard may be required at the method reporting limit (Regulatory agency driven)
3) One reagent-water blank
4) One Laboratory Control Sample

C) Control procedures for each analytical batch, 20 sample maximum[a]

1) One method blank
2) Calibration verification standard[b]

a) Run initially, then every 10 samples (assumes more than 20 samples are processed in one day)

b) Concentration of check standard must agree with original curve within 10 percent

3) One Matrix Spike[b]

4) One Matrix Spike Duplicate[b] or One Duplicate

5) One Laboratory Control Sample (LCS) where applicable

D) Inter-laboratory quality control

1) Reference samples provided by NVLAP accredited providers and NIST.

2) Participation in performance evaluation and method studies available from NVLAP accredited providers.

3) Split samples between laboratories.

4) Blind field duplicates, blanks, and spikes.

[a]These procedures are to be used as guidelines in the absence of project-specific criteria.
[b]Does not apply to some parameters like BOD, TS, TSS, specific conductance, etc.

TABLE 7-2

QUALITY ASSURANCE PROGRAM OUTLINE
MERCURY - CVAA

A) Standard Curve for each run

B) Initial Calibration Curve

1) Four to five concentration levels (varies with each method/program)
2) One standard may be required at the method reporting limit (Regulatory agency driven)
3) One reagent-water blank
4) One Laboratory Control Sample (LCS)

C) Control procedures for each analytical batch, 20 sample maximum[a]

1) One method blank

2) Calibration verification standard

a) After every tenth sample and/or at the end of each run

b) Concentration of check standard must agree with original curve within 15 percent (Method/Program dependent)

3) One Matrix Spike

4) One Matrix Spike Duplicate or One Duplicate

5) One Laboratory Control Sample (LCS)

D) Inter-laboratory quality control

1) Reference samples provided by NVLAP accredited providers and NIST.

2) Participation in performance evaluation and method studies available from NVLAP accredited providers.

3) Split samples between laboratories.

4) Blind field duplicates, blanks, and spikes.

[a]These procedures are to be used as guidelines in the absence of project-specific criteria.

TABLE 7-3

QUALITY ASSURANCE PROGRAM OUTLINE
METALS - ICAP (Trace)

A) Standard Curve for each analytical parameter

B) New Standard Curve for each analytical run

1) Three concentration levels/one concentration level (Program dependent)

(Some agencies require a standard to be analyzed at the reporting limit)

2) One Initial Calibration Verification standard (ICV)

3) Initial calibration blank

4) One interference check standard at the beginning and end of the run or at least every eight hours.

5) One standard at two times the USEPA contract required detection limit (CRDL) at the beginning and end of the run. (Program Dependent)

6) Quarterly, a Linear Range Standard is run for each metal. This standard must agree within 5 percent of original concentration.

7) Annually, Interference element corrections are analyzed and correction factors calculated; sensitive IEC's are checked daily.

C) Control procedures for each analytical batch, 20 sample maximum[a]

1) One method blank

2) Calibration verification standard

a) After every tenth sample and/or at the end of each run

b) Concentration of check standard must agree with original curve within 5 to 10 percent (depending on method)

3) Continuing Calibration Blank

a) After every 10th sample and/or at the end of each run.

b) Concentrations must be below the specific method tolerance limits.

4) One Laboratory Control Sample (LCS)

5) One Matrix Spike (MS)

6) One Matrix Spike Duplicate (MSD) or One Duplicate

7) Serial Dilution on new or unusual matrix

8) Post Digestion Spike for out-of-control MS/MSD situations

9) Method of Standard Addition as required

TABLE 7-3 (Continued)

QUALITY ASSURANCE PROGRAM OUTLINE
METALS - ICAP (Trace)

D) Inter-laboratory quality control

1) Reference samples provided by NVLAP accredited providers and NIST.

2) Participation in performance evaluation and method studies available from NVLAP accredited providers.

3) Split samples between laboratories.

4) Blind field duplicates, blanks, and spikes.

[a]These procedures are to be used as guidelines in the absence of project-specific criteria.

TABLE 7-4

QUALITY ASSURANCE PROGRAM OUTLINE
ORGANIC ANALYSIS
GAS CHROMATOGRAPHY

A) Standard Curves for each analytical parameter

1) Evaluation check standard for DDT and Endrin breakdown. If degradation of either DDT of Endrin exceeds 15%, corrective action will be taken in the form of cleaning the injection port. (Pesticide only)

2) Five calibration standards (minimum) are prepared and analyzed at the concentration of interest.

3) A second source standard is analyzed for calibration verification.

4) A calibration curve or calibration factor is generated from the above data for each compound of interest.

B) Control procedures for each analytical batch, 20 sample maximum[a]

1) Evaluation check standard for DDT and Endrin at the beginning of each run. (Pesticides)

2) Continuing calibration verification (CCV) standard every 12 hours (and every 10- 20 samples based on method) with less than 15% difference back to the original calibration curve. Retention time windows are adjusted for each analyte to reflect "real time" stability of the system based on the first midpoint calibration verification for the sequence. If 15% difference criteria is not met, two options are available:

- Stop the sequence, perform maintenance, recalibrate and proceed with analysis; or
- Allow the sequence to proceed and evaluate the impact on the data. If the CCV recoveries are high and the analyte is not detected in a sample, the analysis would be acceptable. If CCV recoveries are low or the analyte is detected in a sample, that sample would have to be reanalyzed or flagged.

3) Method Blank

4) Matrix Spike/Matrix Spike Duplicate

5) Laboratory control samples are analyzed according to project requirements, or at a rate of 5% the total number of samples, or at a minimum of one per month.

C) Inter-laboratory quality control

1) Reference samples provided by NVLAP accredited providers and NIST.

2) Participation in performance evaluation and method studies available from NVLAP accredited providers.

3) Split samples between laboratories.

4) Blind field duplicates, blanks and spikes.

[a] These procedures are to be used as guidelines in the absence of project specific criteria.

TABLE 7-5

QUALITY ASSURANCE PROGRAM OUTLINE
ORGANIC ANALYSIS
GAS CHROMATOGRAPHY/MASS SPECTROMETRY

A) Standard Curves for each analytical parameter

1) Each GC/MS system is tuned to meet USEPA criteria.

2) Five calibration standards (minimum) are prepared and analyzed at the concentration of interest.

3) A second source standard is analyzed for calibration verification.

4) A calibration curve or average response factor is generated from the above data for each compound of interest. The percent RSD for each CCC (calibration check compound) must be less than 30%.

5) The SPCCs (system performance check compounds) for BNA's must have an average response factor greater than 0.050. The SPCCs for VOA's must have an average response factor greater than 0.10 or 0.30, depending on the compound, as specified in the method. SPCCs typically have low response factors and tend to decrease in response as the system begins to deteriorate. They are normally the first compounds to show poor performance.

6) The relative retention times of each compound in each calibration run should agree within 0.06 relative retention time units.

B) Control procedures for each analytical batch, 20 sample maximum[a]

1) GC/MS system is tuned to meet USEPA requirements, these criteria must be met before each analytical run.

2) A continuing calibration standard is analyzed. The SPCCs must meet the same criteria as the initial calibration and the CCCs must have a percent difference of less than 20% back to the initial calibration curve. If any of these criteria are not met, corrective action must be taken in the form of maintenance or a new calibration curve.

3) The internal standard responses and retention times in the calibration check standard must be evaluated during or immediately after data acquisition. Retention times should not vary more than 30 seconds from the midpoint standard of the most recent initial calibration. The EICP (extracted ion current profile) area for any of the internal standards should not change by more than a factor of two (- 50% to +100%) from the midpoint standard of the most recent initial calibration. If either criteria is not met, the system must be inspected for malfunctions and corrections made.

4) Method Blank

5) Matrix Spike/Matrix Spike Duplicate

6) Laboratory control samples are analyzed according to project requirements, or at a rate of 5% the total number of samples, or at a minimum of one per month.

TABLE 7-5 (Continued)

QUALITY ASSURANCE PROGRAM OUTLINE
ORGANIC ANALYSIS
GAS CHROMATOGRAPHY/MASS SPECTROMETRY

C) Inter-laboratory quality control

1) Reference samples provided by NVLAP accredited providers and NIST.
2) Participation in performance evaluation and method studies available from NVLAP accredited providers.
3) Split samples between laboratories.
4) Blind field duplicates, blanks and spikes.

[a] These procedures are to be used as guidelines in the absence of project specific criteria.

TABLE 7-6

QUALITY ASSURANCE PROGRAM OUTLINE
ORGANIC ANALYSIS
LIQUID CHROMATOGRAPHY (EXPLOSIVES)

A) Standard Curves for each analytical parameter

1) Five calibration standards (minimum) are prepared and analyzed at the concentration of interest.

2) A second source standard is analyzed for calibration verification.

3) A calibration curve or calibration factor is generated from the above data for each compound of interest.

B) Control procedures for each analytical batch, 20 sample maximum[a]

1) Midpoint calibration verification standard analyzed singly after every 10 samples(or client specified) with less than 15% difference back to the first midpoint calibration verification standard for the sequence. Retention time windows are adjusted for each analyte to reflect "real time" stability of the system based on the latest midpoint calibration verification. If 15% difference criteria is not met, the sequence is stopped and maintenance performed before recalibrating and proceeding with sample analysis.

2) Method Blank

3) Matrix Spike/Matrix Spike Duplicate (Spike concentration is generally at the mid range of the calibration curve.)

4) Laboratory control samples are analyzed according to project requirements, or at a rate of 5% the total number of samples, or at a minimum of one per month.

C) Inter-laboratory quality control

1) Reference samples provided by NVLAP accredited providers and NIST.

2) Participation in performance evaluation and method studies available from NVLAP accredited providers.

3) Split samples between laboratories.

4) Blind field duplicates, blanks and spikes.

[a] These procedures are to be used as guidelines in the absence of project specific criteria.

TABLE 7-7

CONSUMABLES SUPPLIER LIST

1. AbsoluteStandards, Inc
2. AccuStandard, Inc.
3. Agilent Technologies
4. ANL Compressed Gases
5. APG (Analytical Products Group)
6. Chem Service Inc
7. ERA (Environmental Resource Associates)
8. Fisher Scientific Company
9. High- Purity Standards
10. Innovative
11. NSI Environmental Solutions, Inc
12. Perkin Elmer
13. Phenomenex
14. Plastic Supply
15. QEC (Quality Environmental Containers)
16. Restek Corporation
17. RTC (Resource Technology Corporation)
18. SPEX CertiPrep Inc
19. Supelco (Sigma-Aldrich family of companies)
20. TJA (Thermo Jarrell Ash)
21. Ultra Scientific, Inc
22. VWR Scientific

8.0 LABORATORY AUDITS

Performance and systems audits are essential elements of every quality assurance program. These audits are usually conducted at the beginning of a program to ascertain that the groups involved have the capability and understanding to perform the sampling and analysis according to the requirements and procedures set forth in the project work plans and SAP. In addition, for large projects, one or more audits are usually performed during a project to document that established procedures and the associated laboratory Standard Operating Procedures are being implemented.

The personnel listed below are responsible for all performance and system audits:

- Laboratory Director
- Quality Assurance Officer

The laboratory participates in the following certification programs which require performance evaluation samples to be analyzed bi-annually and annually and on site internal audits to be performed at specified intervals.

- NELAP/New Jersey Department of Environmental Protection
- NELAP/Florida Department of Health
- U.S. Army Corps of Engineers – Missouri River Region, MRR, HTRW-CX
- Department of the Navy – Naval Facility Engineering Service Center, NFESC
- Arkansas Department of Environmental Quality
- California Department of Health Services
- North Carolina Department of Environment and Natural Resources
- Commonwealth of Massachusetts Department of Environmental Protection
- Commonwealth of Kentucky Department of Environmental Protection
- Tennessee Department of Health and Environment

8.1 PERFORMANCE AUDITS

A performance audit independently collects measurement data using performance evaluation samples. The data which a multi-state certified laboratory generates by analyzing blind performance evaluation samples provided by the certifying agency serve as an ongoing performance audit of the laboratory analytical process. The blind QC

samples (duplicates and blanks) submitted to the laboratory from the field also form an important element of the performance audit process. In addition, all analytical processes are tested through the analysis of commercially available (or in-house generated) performance audit samples.

The laboratory will make available to any appropriate persons, upon request, information on any certification performance samples analyzed for the past two years.

8.2 INTERNAL AUDITS

A systems audit consists of a review of the total data production process, including on-site reviews of field and laboratory operational systems and physical facilities for sampling, calibration, and measurement protocols. To the extent possible, these audits should not be conducted by persons who are directly involved in the measurement process. These audits must be conducted at least annually.

Systems audits are conducted on sampling/analysis under the direction of the Quality Assurance Officer.

As appropriate, the audits will consist of all or any of the following items:

- Review of the organization and responsibilities to determine the functional operation of the quality assurance program.
- Check on whether or not standard operating procedures are available and implemented as written.
- Assessment of the traceability of samples and data.
- Validation that the appropriate QC checks are being made and that appropriate documentation is maintained.
- Determination of whether or not the specified equipment is available, calibrated, and in proper working condition for specific projects.

- Checking that record-keeping procedures, including notebooks, logsheets, bench sheets, and tracking forms are properly maintained.

- Verification that the appropriate chain of command is followed in responding to variances and implementing corrective action.

8.3 AUDIT REVIEW

All audit and review findings and any corrective actions will be documented. Laboratory management will ensure that all corrective actions are implemented within an agreed time schedule.

8.4 LABORATORY MANAGEMENT REVIEW

Annually, the management of the laboratory will review its quality systems to ensure the stability and effectiveness of the system. The review will be focused on reports from managerial and supervisory staff. The outcome of internal audits, external audits, the results from interlaboratory comparisons or proficiency tests, feedback from customers, corrective action reports, and any other revelent factors. This document will be reviewed by management and distributed to the appropriate managers and supervisory staff. This document will be kept in the laboratory files and available for review.

9.0 LABORATORY DOCUMENTS

9.1 LABORATORY RECORDS

The laboratory maintains a record system to meet its particular circumstances and comply with any applicable regulations. The system produces accurate records, which document all laboratory activities. The laboratory retains all original observations, calculations and derived data, calibration records and a copy of the test report for a minimum of seven years.

9.2 RECORD KEEPING SYSTEM

The system is designed to allow for historical reconstruction of all laboratory activities that produce the reported sample analytical data. The history of the sample will be readily understood through the documentation. This includes interlaboratory transfers of samples and/or extracts.

- The records include the identity of personnel involved in sampling, preparation, calibration or testing.

- Information relating to the laboratory facilities equipment, analytical test methods, and related laboratory activities, such as sample receipt, sample preparation, or data verification will be documented.

- The record keeping system facilitates the retrieval of all working files and archived records for inspection and verification purposes.

- Documentation entries will be signed or initialed by responsible staff.

- All generated data except those that are generated by automated data collection systems, will be recorded directly, promptly and legibly in permanent ink.

- Entries in records are not obliterated by methods such as erasures, overwritten files. All corrections to record-keeping errors shall be made by one line marked through the error. The individual making the correction shall sign (or initial) and date the correction. These criteria also will apply to electronically maintained records.

- Refer to Section 7.3 for Computer and Electronic Data.

9.3 RECORDS MANAGEMENT AND STORAGE

- All records, certificates and reports are safely stored, held secure and in confidence to the client.

- All records are to be retained for a minimum of seven years from last use. All information necessary for the historical reconstruction of data will be maintained by the laboratory. Records which are stored only on electronic media will be supported by the hardware and software necessary for their retrieval.

- Records that are stored or generated by computers will have a hard copy or write-protected backup copies.

- The laboratory has begun implementation of a record management system with a master list of logbooks for control of laboratory notebooks, instrument logbooks, standard logbooks, and records for data reduction. Old logbooks are kept in the QAO's office until boxed and sent off-site to Iron Mountain to be stored.

- Standard Operating Procedures (SOP's) issued to laboratory personnel are reviewed and approved for use by authorized personnel before issue. A master list of SOP's is kept showing effective date and last review date. SOP's are periodically reviewed and revised if needed. Obsolete SOP's are removed from use and archived.

- Access to archived information is documented with an access log of items sent to the Iron Mountain storage site. These records are protected against fire, theft, loss, environmental deterioration, vermin and in the case of electronic records, electronic or magnetic sources.

- The laboratory will have the responsibility to implement a plan to ensure that the records are maintained or transferred according to the client's instructions in the event that the laboratory transfers ownership or goes out of business.

9.4 LABORATORY SUPPORT ACTIVITIES

In addition to documenting all the above-mentioned activities, the following are retained.

- All original raw data, whether hard copy or electronic, for calibrations, samples and quality control measures, including analysts work sheets and data output records (chromatograms, strip charts, and other instrument response readout records).

- A written description, included in the appropriate SOP, or reference to the specific test method used which includes a description of the specific

computational steps used to translate the data into a reportable analytical value.

- Copies of final reports
- Archived standard operating procedures
- Correspondence relating to laboratory activities for a specific project
- Corrective action reports, audits and audit responses
- Proficiency test results
- Data review and cross checking

9.5 ANALYTICAL RECORDS

The essential information to be associated with analysis, such as strip charts, tabular printouts, computer data files, analytical notebooks, and run logs include:

- Laboratory sample ID
- Date and time of analysis
- Analysis type
- Manual calculations
- Analyst's or operator's initials/signature

9.6 ADMINISTRATIVE RECORDS

The following records are maintained within the laboratory.

- Personnel qualifications, experience and training records

- Records of demonstration of capability for each analyst

- A log of names, initials and signatures for all individuals who are responsible for signing or initialing any laboratory record

9.7 LEGAL/EVIDENTIARY CUSTODY

The use of legal chain of custody (COC) protocols may be required by some programs. In addition to the records and the performance standards outlined above, the following protocols will be incorporated if legal COC is implemented by the regulatory body.

9.7.1 Basis Requirements

The legal COC records establish an intact, continuous record of the physical possession, storage and disposal of sample containers, collected samples, samples aliquots, and sample extracts or digestates. For ease of discussion, the above-mentioned items shall be referred to as samples:

- It is in one's actual physical possession

- It is in one's view, after being in one's physical possession

- It is in one's physical possession and then locked up so that no one can tamper with it

- It is kept in a secure area, restricted to authorized personnel only

- The COC records shall account for all time periods associated with the samples

- The COC records shall identify individuals who physically handled individual samples

- The COC records are not limited to a single form or document

- Legal COC begins at the point established by the federal or state oversight program. This may begin at the point that cleaned sample containers are provided by the laboratory or the time sample collection occurs

- The COC forms shall remain with the samples during transport or shipment

- If shipping containers and/or individuals sample containers are submitted with sample custody seals, and any seals are not intact, the lab will note this on the chain of custody

- Mailed packages should be registered with return receipt requested. If packages are sent by common carrier, receipts should be retained as part of the permanent COC documentation

- Once received by the laboratory, laboratory personnel are responsible for the care and custody of the sample

9.8 INFORMATION IN CUSTODY RECORDS

In addition to the information specified above, tracking records shall include, by direct entry or linkage to other records:

- Time of day and calendar date of each transfer or handling procedure

- Signatures of all personnel who physically handle the sample(s)

- All information necessary to produce unequivocal, accurate records that document the laboratory activities associated with sample receipt, preparation, analysis and reporting

- Common carrier documents

10.0 CALCULATION OF DATA QUALITY INDICATORS

This section describes how common data quality indicators are calculated and reported.

10.1 PRECISION

If calculated from duplicate measurements, relative percent difference is the normal measure of precision:

$$RPD = \frac{(C_1 - C_2)x100}{\frac{(C_1 + C_2)}{2}} \quad (1)$$

where:

RPD	=	relative percent difference
C_1	=	larger of the two observed values
C_2	=	smaller of the two observed values

If calculated from three or more replicates, use relative standard deviation rather than RPD:

$$RSD = (s / \bar{y})\ x100 \quad (2)$$

where:

RSD	=	relative standard deviation
s	=	standard deviation
$\bar{y}$	=	mean of replicate analyses

Standard deviation is defined as follows:

$$S = \sqrt{\frac{\sum_{i=1}^{n}(y_i - \bar{y})^2}{n-1}} \quad (3)$$

where:

s	=	standard deviation
y_i	=	measured value of the *i*th replicate
$\bar{y}$	=	mean of replicate measurements
n	=	number of replicates

10.2 ACCURACY

For measurements where matrix spikes are used, calculate the percent recovery as follows:

$$\%R = 100 \times \left[\frac{S-U}{C_{sa}}\right] \quad (4)$$

where:

%R	=	percent recovery
S	=	measured concentration in spiked aliquot
U	=	measured concentration in unspiked aliquot
C_{sa}	=	actual concentration of spike added.

When a standard reference material (SRM) is used:

$$\%R = 100 \times \left[\frac{C_m}{C_{srm}}\right] \quad (5)$$

where:

%R	=	percent recovery
C_m	=	measured concentration of SRM
C_{srm}	=	actual concentration of SRM

10.3 COMPLETENESS

Completeness is defined as follows for all measurements:

$$\%C = 100 \times \left[\frac{v}{n}\right] \quad (6)$$

where:

%C	=	percent completeness
v	=	number of measurements judged valid
n	=	total number of measurements necessary to achieve a specified level of confidence in decision making

10.4 METHOD DETECTION LIMIT (MDL)

MDL is defined as follows for all measurements:

$$MDL = (n-1, 1-a = 0.99)\,(S)$$

where:

MDL	=	method detection limit
S	=	standard deviation of the replicate analyses
$t_{(n-1,\ 1-a = 0.99)}$	=	student's t-value for a one-sided 99 percent confidence level and a standard deviation estimate with n-1 degrees of freedom

11.0 ANALYTICAL CORRECTIVE ACTIONS

Corrective actions are undertaken at any time during the analytical process when deemed necessary based on the judgement of the analyst or when established QC data or documented protocols indicate a need for action. (Specific limits are addressed in Section 2.) Generally, corrective action is triggered by poor analysis replication, poor recovery, instrument calibration problems, blank contamination, etc. (Previous sections outline specifics.)

Nonconformances associated with the statistical analysis and review of data are, in general, easy to identify. The analyst is responsible for assessment of QC sample information. If data outlie accepted limits, the analyst immediately notifies the responsible Department Manager and/or Quality Assurance Officer. The Managers and/or Quality Assurance Officer are responsible for identifying the source of the nonconformance and initiating corrective action. Completion of corrective action should be evidenced by data returning to prescribed acceptable limits or by documented resolution that validates data being reported to the client. If the situation is not corrected so that an out-of-control condition may occur, or is expected to, the Laboratory Director is notified.

Corrective actions may include, but are not necessarily limited to: reanalysis, calculation checks, instrument recalibration, preparation of new standards/blanks, reextraction/digestion, dilution, application of another analysis method, additional training, etc. Many of these corrective actions are initiated by the analyst at the time of analysis. However, some corrective actions are initiated subsequently based on evaluations performed by management personnel.

Nonconformances which do not readily result in an observed impact on data quality are more difficult to identify. Such events can sometimes be tracked to samples stored at an incorrect temperature or held beyond prescribed holding times, or improper maintenance of records. The entire staff is responsible for reporting "system" nonconformances. Analysts report nonconformances to their Section Manager, the Section Managers in turn to the Quality Assurance Officer and/or Laboratory Director. Corrective action is again the responsibility of the Section Managers. They will, in most instances, review and approve the action(s) taken.

Empirical Laboratories, LLC has a corrective action system in place, which includes documentation of out-of-control situations with corrective action reports (CARs). Each functional area (such as, sample receiving, GC, GC/MS, Metals, wet chemistry) generates CARs to document any observed deviation from normal processes or expectations. These CARs must be generated, reviewed, and approved by the section manager, and copies distributed to the laboratory Quality Assurance Officer and Laboratory Director. Each CAR contains the following information: date the problem was observed; identity of person completing the CAR; lab number(s) of the sample(s) involved; analytical parameter(s) involved; statement of the problem; description of the corrective action taken; description of action taken to prevent reoccurrence of the problem; additional comments (if any) and a listing of those persons to whom copies were sent. The copies maintained in file by each Section Manager are considered the original "archivable" versions.

This system was started to document out of control situations, but, in years of use, has become a very effective means to identify and communicate any excursions from the norm in all phases of laboratory operation. The immediate review feature has allowed many opportunities for correcting analytical problems before expiration of sample holding times.

To the extent possible, sample data should only be reported if all QA/QC requirements have been met. If any QA/QC requirements are found to be out of control, all samples associated with the failed measurements will be re-analyzed or reported with the appropriate data qualifications.

12.0 QUALITY ASSURANCE REPORTS TO MANAGEMENT

Formal quality assurance reports from the Laboratory Quality Assurance Officer will be submitted to the appropriate management personnel (Project Quality Assurance Officer, Department Manager, or Laboratory Director) as needed if a change in the QA/QC Program occurs, or to document the results of a corrective action.

12.1 RESULTS OF CORRECTIVE ACTIONS

System performance that is deemed out-of-control in comparison with method expectations or unusual events worthy of notation require a Corrective Action Report (CAR). Detailed information concerning corrective action procedures and requirements for generating a CAR are presented in Section 11.

The CARs are promptly reviewed by laboratory management to assure proper decisions are made to resolve quality control issues. Each CAR is maintained in the laboratory and may be submitted with data as part of a deliverables package.

12.2 RESULTS OF INTERNAL AND PERFORMANCE EVALUATION AUDITS

An audit report will be submitted to the Laboratory Director as a result of either an internal or external laboratory audit. Detailed information concerning these audits is presented in Section 8.

There are several types of internal audits performed during the year. At least one complete system audit is scheduled each year along with a random number of method audits. Internal blind quality control samples are dispersed into various areas of the laboratory to evaluate specific analyses performance. Internal audit reports are submitted by the Quality Assurance Officer to the Laboratory Director for initial review. Audit reports are then forwarded to the appropriate Section Manager for their evaluation and to respond to any documented deficiencies. The response is submitted in the form of a CAR, by the Department Manager to the Quality Assurance Officer and Laboratory Director. The CAR is maintained in the laboratory and available for review by external auditors.

External on-site system audits and performance evaluation studies (WP and WS) are conducted routinely by city, state and federal agencies or major client representatives. The audit report is submitted to the Quality Assurance Officer/Laboratory Director by the external audit source. The audit report is forwarded to the Section Managers for evaluation and response to any deficiencies sited. The response to deficiencies discovered by external audits are dependent upon the auditors requirements. The response is submitted to the Quality Assurance Officer and Laboratory Director by the Department Manager for review before implementation of the corrective action plan is initiated. The information of the external audit is maintained by the laboratory.

12.3 LABORATORY MANAGEMENT REVIEW

The management of the laboratory will conduct an annual review of the overall quality systems and to ensure it's stability and effectiveness and to consider any operational changes that would improve quality. The review will include an assessment of all reports from management, internal and external audits, proficiency tests, blind sample results, any feedback from customers, correction action reports and any other relevant materials. Management will document and maintain records of the review and corrective action taken.

Initiation of a new QA/QC program or changes to an existing QA/QC program are submitted in written form to the Laboratory Director by laboratory management (Quality Assurance Officer or Department Manager). Notification in writing by city, state or federal agencies of change in QA/QC requirement or certification status will be forwarded in writing to all interested parties (affected clients, other state or federal regulatory authorities and laboratory personnel) as soon as possible.

Control charting evaluation reports are submitted by the Quality Assurance Officer to the Laboratory Director and upper management. The report details specific QC assessment throughout the laboratory. The control chart report evaluates laboratory performance based upon QA/QC samples. This information is discussed with specific Department Managers to evaluate system trends and potential problems.

12.4 DATA QUALITY ASSESSMENT

Many projects require some form of a data package. These packages differ in content depending on the specific clients request. They range in design from containing sample data results and portions of QC documentation to a full CLP style package. These packages will include a formal assessment of the quality of data. The data quality assessment report (General Discussion / Report Narrative) is submitted by the laboratory management in the laboratory data package (LDP) for management personnel (Project Manager, Project QC Coordinator, and Laboratory Director) to review.

The data quality assessment report is generated after the laboratory management completes evaluation and/or validation of the LDP. The Laboratory Director reviews case narrative reports submitted by Section Managers to assist in the determination of data quality. The report will assess the usability of the data in light of analytical performance and whether project data quality objectives have been met by the reported data.

APPENDIX A

SUMMARY OF MDLS AND ANALYTICAL METHOD REFERENCE

TABLE A-1

SUMMARY OF ANALYTICAL METHODS AND DETECTION LIMITS

Method Water: 5030/8260 Soil: 5035/8260 Volatiles	Method Detection Limits Water – 5mL (µg/L)	 Soil (µg/Kg)
Acetone	5	5
Benzene	1	1
Bromodichloromethane	1	1
Bromoform	2	1
Bromomethane	2	2
2-Butanone	10	10
Carbon disulfide	1	1
Carbon tetrachloride	1	1
Chlorobenzene	1	1
Chloroethane	2	3
Chloroform	1	1
Chloromethane	2	2
Dibromochloromethane	1	1
1,2-Dichlorobenzene	1	1
1,3-Dichlorobenzene	1	1
1,4-Dichlorobenzene	1	1
Dichlorodifluoromethane	2	2
1,1-Dichloroethane	1	1
1,2-Dichloroethane	1	1
1,1-Dichloroethene	1	1
cis-1,2-Dichloroethene	1	1
trans-1,2-Dichloroethene	1	1
1,2-Dichloropropane	1	1
cis-1,3-Dichloropropene	1	1
trans-1,3-Dichloropropene	1	1
Ethylbenzene	1	1
2-Hexanone	3	2
4-Methyl-2-pentanone	2	2
Methylene chloride	2	3
Styrene	1	1
1,1,2,2-Tetrachloroethane	1	1
Tetrachloroethene	1	1
Toluene	1	1
1,1,1-Trichloroethane	1	1
1,2,4-Trichlorobenzene	2	1
1,1,2-Trichloroethane	1	1
Trichloroethene	1	1
Trichlorofluoromethane	2	2
Vinyl acetate	1	1
Vinyl chloride	2	2
Xylene(total)	1	1

MDLs are in-house, Empirical Laboratories, LLC, generated limits except where otherwise stated. MDLs are updated frequently and the limits indicated here are generic but consistent with method performance in our laboratory.

TABLE A-1 (Continued)

SUMMARY OF ANALYTICAL METHODS AND DETECTION LIMITS

Method Water: 3510/8270 Soil: 3540/8270	Method Detection Limits	
Semi-Volatiles	Water (µg/L)	Soil (µg/Kg)
Acenaphthene	2	100
Acenaphthylene	2	100
Anthracene	2	100
Benzo(a)anthracene	2	100
Benzo(a)pyrene	2	100
Benzo(b)fluoranthene	2	100
Benzo(g,h,i)perylene	2	100
Benzo(k)fluoranthene	2	100
Benzyl alcohol	2	100
bis(2-Chloroethoxy)methane	1	100
bis(2-Chloroethyl)ether	2	100
bis(2-Chloroisopropyl)ether	1	100
bis(2-Ethylhexyl)phthalate	2	1300
4-Bromophenyl-phenylether	2	100
Butylbenzylphthalate	2	100
Carbazole	2	100
4-Chloroaniline	1	100
2-Chloronaphthalene	2	100
4-Chlorophenyl-phenylether	2	100
Chrysene	1	100
Dibenz(a,h)anthracene	2	100
Dibenzofuran	2	100
1,2-Dichlorobenzene	2	100
1,3-Dichlorobenzene	2	100
1,4-Dichlorobenzene	2	100
3,3'-Dichlorobenzidine	2	500
Diethylphthalate	1	100
Dimethylphthalate	2	100
Di-n-butylphthalate	2	100
2,4-Dinitrotoluene	2	100
2,6-Dinitrotoluene	1	100
Di-n-octylphthalate	2	100
1,2-Diphenylhydrazine	1	100
Fluoranthene	2	100
Fluorene	1	100
Hexachlorobenzene	2	100
Hexachlorobutadiene	2	100

MDLs are in-house, Empirical Laboratories, LLC, generated limits except where otherwise stated. MDLs are updated frequently and the limits indicated here are generic but consistent with method performance in our laboratory.

TABLE A-1 (Continued)

SUMMARY OF ANALYTICAL METHODS AND DETECTION LIMITS

Method Water: 3510/8270 Soil: 3540/8270 **Semi-Volatiles (continued)**	Method Detection Limits Water (µg/L)	 Soil (µg/Kg)
Hexachlorocyclopentadiene	1	100
Hexachloroethane	1	100
Indeno(1,2,3-cd)pyrene	2	100
Isophorone	2	100
2-Methylnaphthalene	2	100
Naphthalene	2	100
2-Nitroaniline	2	100
3-Nitroaniline	2	100
4-Nitroaniline	2	100
Nitrobenzene	1	100
N-Nitroso-di-methylamine	1	100
N-Nitroso-di-n-propylamine	2	100
N-Nitrosodiphenylamine	2	100
Phenanthrene	2	100
Pyrene	2	100
1,2,4-Trichlorobenzene	2	100
Benzoic acid	2	100
4-Chloro-3-methylphenol	2	100
2-Chlorophenol	2	100
2,4-Dichlorophenol	2	100
2,4-Dimethylphenol	2	100
4,6-Dinitro-2-methylphenol	4	100
2,4-Dinitrophenol	7	700
2-Methylphenol	2	100
4-Methylphenol	4	100
2-Nitrophenol	1	100
4-Nitrophenol	3	100
Pentachlorophenol	5	500
Phenol	1	100
2,4,5-Trichlorophenol	2	100
2,4,6-Trichlorophenol	2	100

MDLs are in-house, Empirical Laboratories, LLC, generated limits except where otherwise stated. MDLs are updated frequently and the limits indicated here are generic but consistent with method performance in our laboratory.

TABLE A-1 (Cont'd)

SUMMARY OF ANALYTICAL METHODS AND DETECTION LIMITS

Inorganics	Analytical Method		Method Detection Limits	
	Water	Soil	Water (µg/L)	Soil (mg/kg)
Aluminum	6010	6010	15	2.0
Antimony	6010	6010	2.0	0.50
Arsenic	6010	6010	1.5	0.45
Barium	6010	6010	1.0	0.04
Beryllium	6010	6010	1.0	0.02
Cadmium	6010	6010	0.2	0.050
Calcium	6010	6010	50	1.0
Chromium(total)	6010	6010	1.0	0.10
Chromium VI	7196	3060/7196	10	0.5
Cobalt	6010	6010	0.5	0.05
Copper	6010	6010	0.5	0.20
Iron	6010	6010	20	2.5
Lead	6010	6010	1.0	0.20
Magnesium	6010	6010	20	1.0
Manganese	6010	6010	0.5	0.10
Mercury	7470/245.1	7471/245.5	0.050	0.005
Molybdenum	6010	6010	1.0	0.15
Nickel	6010	6010	0.5	0.10
Potassium	6010	6010	50	10
Selenium	6010	6010	2.0	0.30
Silver	6010	6010	0.5	0.050
Sodium	6010	6010	150	20
Thallium	6010	6010	0.5	0.25
Vanadium	6010	6010	0.5	0.10
Zinc	6010	6010	2.0	0.10
Cyanide	335.3/9012	9012	2.0	0.10
Chloride	325.2/300.1	NA	0.5/0.02(mg/L)	NA
Fluoride	340.2/300.1	NA	0.02 (mg/L)	NA
Nitrate	353.2/300.1	NA	0.02 (mg/L)	NA
Perchlorate	314.0	314.0	1.0(mg/L)	0.010
Phenol	420.2/9066	9066	10	5.0
Sulfate	375.4/300.1	NA	1.0/0.05 (mg/L)	NA

MDLs are in-house, Empirical Laboratories, LLC, generated limits except where otherwise stated. MDLs are updated frequently and the limits indicated here are generic but consistent with method performance in our laboratory.

APPENDIX B

STANDARD OPERATING PROCEDURES FOR ASSEMBLY OF ORGANIC DELIVERABLE PACKAGES AND PRELIMINARY VALIDATION OF ORGANIC DELIVERABLE PACKAGES

STANDARD OPERATING PROCEDURES FOR ASSEMBLY OF ORGANIC DELIVERABLE PACKAGES AND PRELIMINARY VALIDATION OF ORGANIC DELIVERABLE PACKAGES

Before assembling a deliverables package you must first obtain a copy of the chain of custody record from the Empirical Laboratories, LLC log-in personnel. You will also need to generate a parameters requested list of the organic tests required for each work order withthe organic report generator macro located at L:\archive\archives\organic\parameters requested MDB\organic report generator.mdb. Lastly, you will need to obtain a copy of the summary report that was created from the data.

Once all of the samples are analyzed the forms will be generated and the raw data copied to be included in the deliverables package. The following sections will describe the items to be included in the deliverables package, the order in which the pieces are to be assembled, and preliminary validation procedures.

1.0 PACKAGE

The Organic parameters include volatiles, semivolatiles (base neutral/acids), pesticides, PCBs (often pest/PCB together), and herbicides. Two types of packages will be created - a data summary package which is a composite of all of the organic fractions analyzed and a raw data package for the organic fraction in the order 1) basic information, 2) volatiles, 3) semi-volatiles, 4) pest/PCBs and 5) herbicides.

1.1 Basic Information

Information that is common to all fractions and included at the beginning of both the summary package and main data package includes 1) Chain of Custody, 2) Cooler Receipt Form (if available), 3) Parameters Requested Listing and 4) Case Narrative (generated by Organic Supervisor – notes from preliminary package validation are helpful.

1.2 Volatiles

Once the analyst supplies all of the raw data and forms, the next step is to separate the information according to the form type. All of the chromatograms should remain with their appropriate report (e.g., the sample chromatogram should stay with the sample quant report and the BFB chromatogram should stay with the BFB listings). When the Form I's are separated, they must be arranged by sample number order. If there was a rerun arrange the forms for the same sample number according to the date analyzed; however, if a sample has several dilutions, place the lowest dilution in front of the others. Separate the Form I's that go to LCS/MS/MSD and Method Blanks from the sample Form I's. Arrange the Method Blank Form I's according to the date analyzed and arrange the other forms (Forms II-VIII, BFB) according to the dates analyzed. If there is an uncertainty to the date analyzed look at the name of the method blank that appears on the form and arrange the forms according to the number name of the method blank.

Table 1-1 describes the different forms to be included in a volatiles package and gives items to review in the preliminary validation process. Table 1-2 indicates which forms appear in each of the two packages and the order in which they appear. Notice that the Form V's, VI's, VII's, BFB, LCS/MS/MSD Form I's and Quant Reports only appear in the Raw Data Package. The remaining forms (Form I's for the samples and method blanks, and all Forms II, III, IV, and VIII) will require photocopying since they appear in both packages. After making a copy of these forms, bind the original copies with a paper clip and label the stack to be the volatile summary package. The summary package will not be assembled until all organic parameter deliverables are assembled and validated, since it is a composite of all organic fractions.

Prior to assembling the data package it helps to separate the stack of quant reports and arrange them according to samples number with the lowest number on top of the stack. Placing sequential quant reports perpendicular to the previous report will aide in quick assembly. Once all of the needed pages are photocopied, match the quant report with the corresponding Form I.

TABLE B-1

DELIVERABLE FORM DESCRIPTION AND VALIDATION CHECKS FOR ORGANICS

Form Type	Form Name/Description	When needed	Validation Checks
Form I	Analysis Data Sheet	one needed per sample analyzed including method blanks, duplicates, dilutions and LCS/MS/MSD	The numbers and flags on the Form I should correspond to the numbers on the Summary Report
Form II	Surrogate Recovery Sheet	each sample analyzed must be listed on a Form II including QC samples	verify that each sample is represented on a Form II
Form III	Laboratory Control Sample (LCS)	one needed per sample batch	verify that each LCS has a Form III
Form III	Matrix Spike/Matrix Spike Duplicate Recovery (MS/MSD)	one needed per sample that had a MS/MSD performed (at least one per batch)	verify that each MS/MSD has a Form III
Form IV	Method Blank Summary	each sample analyzed must be listed on a Form IV to show which method blank corresponds with the sample	verify that each sample is listed on a Form IV including LCS/MS/MSD, Dilutions, etc.
Form V	GC/MS Tuning & Mass Calibration- Bromofluorobenzene (BFB) for Volatiles Decafluorotriphenylphosphine (DFTPP) for Semivolatiles	there must be a Form V for each day the instrument was run for the batch including initial calibrations, continuing calibrations and samples	verify that each sample is listed on a Form V including LCS/MS/MSD, Dilutions, Calibrations, etc.
Form VI	Initial Calibration Data (ICAL)	to determine which Form VI's should appear in the batch, look at the Form VII's and see which ICAL it refers to for its calculations/comparison	verify that the Form VI that is referred to by a Form VII appears in the package
Form VII (pesticide Only)	Continuing Calibration Verification (performance evaluation mix)	One needed for each day a sample was analyzed	verify that every date a sample was run, a performance evaluation mix was also analyzed with acceptable breakdown.
Form VII	Continuing Calibration Verification	One needed for each day a sample was analyzed (Minimum of two needed for each GC analysis data)	verify that every date a sample was run, a Form VII was also produced and that every Form VI that is reference on a Form VII is included
Form VIII (GC/MS Only)	Internal Standard Area Summary	each sample analyzed must be listed on a Form VIII	verify that each sample is listed on a Form VIII including LCS/MS/MSD, Dilutions, etc.
Form VIII (GC Only)	Analytical Sequence Summary	each sample analyzed must be listed on a Form VIII	verify that each sample is listed on a Form VIII including LCS/MS/MSD, Dilutions, etc.
Form X (GC Only)	Dual Column Analyte Identification Form	each sample with a dual column reported analyte concentration must have a Form X	verify that each sample with reported concentrations has a Form X including LCS/MS/MSD, Dilutions, etc.

TABLE B-1 (CONTINUED)

DELIVERABLE FORM DESCRIPTION AND VALIDATION CHECKS FOR ORGANICS

Form Type	Form Name/Description	When needed	Validation Checks
Quant Report	Quant Report w/ Chromatogram (and detected analyte spectra for GC/MS)	one report for each sample analyzed	a quant report and a chromatogram should be printed for each sample, LCS/MS/MSD, method blank, calibration check, dilution, and replicate. GC/MS spectra must be printed for each analyte identified in a sample, dilution, replicate or method blank.
GC/MS Performance Standard – BFB/DFTPP	Acceptance criteria listing with graphic mass spectrum, tabular mass spectrum and chromatogram	one needed for each day the instrument was running (samples or calibration standards)	Verify that every date a sample was analyzed the GC/MS Performance Standard data is present
Library Searches (optional)	List of Hits for compounds not on the target analyte list	dependent on the analytical results of the sample	Library Search Form I will go with each form I even if there were no hits. There are no Library Searches for LCS/MS/MSDs. The samples that have compounds listed must have spectra to confirm the hit. Samples with two dilutions require library search only on the most concentrated analysis.

TABLE B-2

ORGANIZATION OF THE VOLATILE/SEMIVOLATILE ORGANIC PACKAGE

Data Package	Summary Package
Written Case Narrative (basic) Chain of Custody (basic) Parameters Requested Listing (basic) Data Summary Report Form II Form III (LCS/MS/MSD) Form IV Form V Form VIII Form I with corresponding: - Library Search Form I (if requested) - Quant Report with Chromatogram - Library Search Quant Report - Spectra for target compounds - Spectra for the library search compounds (if requested) Form VI with corresponding Quant Reports, Chromatograms and Manual Integrations Form VII with corresponding Quant Report, Chromatogram and Manual Integrations BFB (for volatiles) or DFTPP (for semi-volatiles) Raw Data with the corresponding Mass Listing and Chromatogram Form I for Method Blank with corresponding: - Library Search Form I (if requested) – Quant Report with Chromatogram - Library Search Quant Report – Spectra for target compounds – Spectra for library search compounds (if requested) Laboratory Control Sample Form I's with corresponding Quant Report, Chromatogram and Manual Integrations Matrix Spike Form I with corresponding Quant Report, Chromatogram and Manual Integrations Matrix Spike Duplicate Form I with corresponding Quant Report, Chromatogram and Manual Integrations Internal Chain of Custody Logs including: Sample Storage Refrigerator Extract Storage Refrigerator Extraction Log Analytical Run Log % Solid Sheet (Only for Soil/Sediment Samples)	Written Case Narrative (basic) Chain of Custody (basic) Parameters Requested Listing (basic) Data Summary Reports Form I (not including Method Blank or LCS/MS/MSD) followed by the corresponding Library Search Form I (if requested). Form II. Form III (LCS/MS/MSD) Form IV followed by the corresponding Method Blank Form I Form VIII NOTE: When more than one Organic Fraction has been requested all of the Similar Forms go together in the order of Volatile, Semivolatile, Pesticide, and Herbicide. Example: Volatile Form I's will be followed by the Form I's of Semivolatiles, Pesticides, and Herbicides. The Form II's will follow in the same fraction order, etc.

TABLE B-2 (Continued)

ORGANIZATION OF THE PESTICIDE/PCB/HERBICIDE ORGANIC PACKAGE

Data Package	Summary Package
Written Case Narrative (basic)	Written Case Narrative (basic)
Chain of Custody (basic)	Chain of Custody (basic)
Parameters Requested Listing (basic)	Parameters Requested Listing (basic)
Data Summary Report	Data Summary Reports
Form II	Form I (not including Method Blank or LCS/MS/MSD)
Form III (LCS/MS/MSD)	Form II.
Form IV	Form III (LCS/MS/MSD)
Sample Form I with corresponding Quant Report and Chromatogram	Form IV followed by the corresponding Method Blank Form I
Form VI – organized by column in chronological order	
Form VII (PEM) – organized by column in chronological order (pesticides only)	
Form VII (CCV)– organized by column in chronological order	
Form VIII - organized by column in chronological order	
Form X – organized by sample number (Pest/Herb and sometimes PCB)	
PEM Data – organized by column in chronological order (pesticide only)	
Curve Data – organized by column in chronological order	
CCV Data – organized by column in chronological order	
Form I for Method Blank with corresponding Quant Report and Chromatogram	
Laboratory Control Sample Form I with corresponding Quant Report and Chromatogram	
Matrix Spike Form I with corresponding Quant Report and Chromatogram	
Matrix Spike Duplicate Form I with corresponding Quant Report and Chromatogram	
Internal Chain of Custody Logs including: Sample Storage Refrigerator Extract Storage Refrigerator Extraction Log Analytical Run Log	
% Solid Sheet (Only for Soil/Sediment Samples)	

APPENDIX C

GLOSSARY OF QC ABBREVIATIONS

CCB	Continuing Calibration Blank
CCV	Continuing Calibration Verification
CRI	Contract Required Detection Limit standard
CS	TCLP extract soil or other matrix
CW	TCLP extract water (water as original matrix)
DCV	Distilled Check Standard Verification (for cyanide only)
DUP	Sample duplicate
DW	Dissolved analyte in water matrix
FCB	Final Calibration Blank (used for mercury and cyanide)
FCV	Final Calibration Verification (used for mercury)
ICB	Initial Calibration Blank
ICSA	Interference Check Standard A
ICSAB	Interference Check Standard AB
ICV	Initial Calibration Verification
LCSS	Laboratory Control Sample Soil
LCSW	Laboratory Control Sample Water
MSD	Matrix spike duplicate
PBS	Preparation Blank Soil
PBW	Preparation Blank Water
PDS	Post digestion spike
TS	Total analyte in Soil/Sediment
TW	Total analyte in Water

APPENDIX D

CERTIFIED ANALYTE LIST

APPENDIX E

EMPLOYEE SIGNATURE
&
INITIAL DOCUMENTATION

EMPLOYEE SIGNATURE & INITIAL DOCUMENTATION 2007

NAME(*Signature*)	INITIALS
Barnett, Amy	
Boyd, Bob	
Burr, Roger	
Davis, Rick	
Dawson, Barbara	
Deville, Betty	
Dillard, Brian	
Gordon, Sonya	
Hallquist, Gwen	
~~Halter, Mary~~	
Holliman, Jade	
Hughes, John	
Johnson, Herbie	
Johnson, Yolanda	
Kim, Andrew	
Latham, Michael	
Little, Josh	
McCoy, Natasha	
McGinnity, Marcia	
Monteiro, Antonio	
Moore, Chrisie	
Powers, Brenton	
Richard, Brian	
Robbins, Bethany	
Robinson, Andy	
Taylor, Ted	
Thompson, Christy	
Tolbert, Binta	
Vogel, Renee	
Ward, Randy	
Weber, Delia	

Appendix B

Quality Assurance Manual
Air Toxics Laboratory

(Provided on CD)

Appendix C

TCLP Data Report

(Provided on CD)

ANALYTICAL SUMMARY DATA PACKAGE
SDG # 1010173

PROJECT NAME: Radford Army Ammunition Plant
PROJECT LOCATION: Pulaski and Montgomery Counties, Virginia

SUBMITTAL TO:
Jace'que Powell
Arcadis
2929 Briarpark Dr., Suite 300
Houston, TX 77042

SUBMITTAL BY:
Empirical Laboratories, LLC (EL)
621 Mainstream Drive, Suite 270
Nashville, TN 37228
Tel (615)345-1115
Fax (615)846-5426

LABORATORY CONTACT PERSON:
Project Manager: Sonya Gordon
Tel (615)345-1115
Fax (615)846-5426
Email: sgordon@empirlabs.com

Original Report Date: November 2, 2010
Report Revision #: N/A
Revision Date: N/A
Total # of Pages: 46

THIS DOCUMENT MEETS DoD QSM 4.1 STANDARDS

The results relate to only the samples associated with the referenced SDG and the submitted data has been produced in accordance with laboratory procedures. The Laboratory's Technical Lab Director, Mr. Rick Davis, is responsible for the final data produced and reported. His signature is listed at the end of the Case Narrative within the Analytical Data Package. If applicable to this report package, details on report revisions and the information on subcontracted analysis are listed in the package Case Narrative. This report shall not be reproduced, except in full, without the written approval of Empirical Laboratories, LLC.

Table of Contents

Sample Delivery Group Case Narrative

Receipt Information
The samples were received within the preservation guidelines for the associated methods. The information associated with sample receipt and the Sample Delivery Group (SDG) are included within section 4 of this package, which also provides information on the link between the client sample ID listed on the COC and laboratory's assigned unique sample ID or WorkOrder #. The sample is tracked through the laboratory for all analysis via the assigned WorkOrder #.

All samples that were received were analyzed and none of the samples were placed on hold without analyses. The sample was subcontracted to Beaver Engineering Inc. for Grain Sized ASTM D422.

Changes to the Revision
This is an original submittal of the final report package.

Analytical Information
All samples were prepped (where applicable) and analyzed within the standard allowed holding times, unless noted within the exceptions listed below. The laboratory analyzed all samples within the program and method guidelines. The following information is provided specific to individual methods:

Chromatographic Flags for Manual Integration:
The following letters are used to denote manual integrations on the laboratory's raw data in association with chromatographic integrations:

A: The peak was manually integrated as it was not integrated in the original chromatogram.
B: The peak was manually integrated due to resolution or coelution issues in the original chromatogram.
C: The peak was manually integrated to correct the baseline from the original chromatogram.
D: The peak was manually integrated to identify the correct peak as the wrong peak was identified in the original chromatogram.
E: The peak was manually integrated to include the entire peak as the original chromatogram only integrated part of the peak.

SW6010B\SW7470A:
No anomalies or deviations are noted.

Data Qualifiers
As applicable and where required, the following general qualifiers are associated with the sample results. Additional qualifiers will be specified within the reporting sections of the data package or within the body of the Case Narrative.

Analytical Report Terms and Qualifiers

MDL: The method detection limit (MDL) is defined as the minimum concentration of a substance that can be measured and reported with 99% confidence that the analyte concentration is greater than zero. The MDL is determined from analysis of a sample containing the analyte in a given matrix.

EQL: The estimated quantitation limit (EQL), also known as Reporting Limit **(RL),** is defined as the estimated concentration above which quantitative results can be obtained with a specific degree of confidence. Empirical Laboratories defines the EQL to be at or near the lowest standard of the calibration curve.

*****: An exceeding quality control criteria is associated with the reported result.

B: The presence of a "B" to the right of an analytical value indicates that this compound was also detected in the method blank and the data should be interpreted with caution. One should consider the possibility that the correct sample result might be less than the reported result and, perhaps, zero.

D: When a sample (or sample extract) is rerun diluted because one of the compound concentrations exceeded the highest concentration range for the standard curve, all of the values obtained in the dilution run will be flagged with a "D".

E: The concentration for any compound found which exceeds the highest concentration level on the standard curve for that compound will be flagged with an "E". Usually the sample will be rerun at a dilution to quantitate the flagged compound.

H1: The result was analyzed outside of the EPA recommended holding time.

H2: The result was extracted outside of the EPA recommended holding time

J: The presence of a "J" to the right of an analytical result indicates that the reported result is estimated. The mass spectral data pass the identification criteria showing that the compound is present, but the calculated result is less than the EQL. One should feel confident that the result is greater than zero and less than the EQL.

M: Indicates that the sample matrix interfered with the quantitation of the analyte. In dual column analysis the result is reported from the column with the lower concentration. In inorganics, it indicates that the parameters MDL/RL have

been raised.

N: The MS/MSD accuracy and/or precision are outside criteria. The predigested spike recovery is not within control limits for the associated parameter.

P: The associated numerical value is an estimated quantity. There is greater than a 40% difference between the two GC columns for the detected concentrations. The higher of the two values is reported unless matrix interference is obvious or for HPLC analysis where the primary column is reported.

Q: The RPD and/or percent recovery exceeded limits in the associated Blank Spike and/or Blank Spike Duplicate.

S: The associated internal standard failed criteria.

U: The presence of a "U" indicates that the analyte was analyzed for but was not detected or the concentration of the analyte quantitated below the MDL.

X: The parameter shows a potential positive bias on a reported concentration due to an ICV or CCV exceeding the upper control limit on the high side.

Y: The parameter shows a potential negative bias on a reported concentration due to an ICV or CCV exceeding the lower control limit on the low side.

LIMS Definitions / Naming Conventions:

The following are general naming conventions that are used throughout the laboratory; however, on a method by method basis, there are additional QAQC items that are named in a consistent format.

BLK: LIMS assigns a unique identifier to the Method Blank by naming it as the letters BLK appended to the Batch ID. A Method Blank is an analyte-free matrix to which all reagents are added in the same volumes or proportions as used in sample processing. The Method Blank is used to assess for possible contamination during preparation and/or analysis steps. Method Blanks within a Batch or Analytical sequence will be appended with a numerical value beginning with 1 that will increase incrementally.

BS: LIMS assigns a unique identifier to the Blank Spike by naming it as the letters BS appended to the Batch ID. The Blank Spike or Lab Control Sample is a controlled analyte-free matrix, which is spiked with known and verified concentrations of target analytes. Spiking concentrations can be referenced in the method SOP. The BS is used to evaluate the viability of analytes taken through the entire prep (when applicable) and analytical process. Blank Spikes within a Batch or Analytical sequence will be appended with a numerical value beginning with 1 that will increase incrementally. A duplicate Blank Spike will be designated as a BSD.

MS: The LIMS assigns each Client sample with a unique identifier. The Matrix Spike is designated with a MS at the end of the sample's unique identifier. The Matrix Spike sample is used to assess the effect of the sample matrix on the precision and accuracy of the results generated using the selected method. A duplicate Matrix Spike will be designated as a MSD.

IDs: The LIMS assigns each Client sample with a unique identifier. The letter "RE" may potentially be appended to the end of the LIMS Sample ID. And "**RE"** implies that the sample was either re-prepped, re-analyzed straight, or re-analyzed at a dilution. Subsequent re-analysis for the sample will be appended with a numerical value beginning with 1 that will increase incrementally. Eg: RE1, RE2, RE3, etc.

Statement of Data Authenticity:
I certify that, based upon my inquiry of those individuals immediately responsible for obtaining the information and to the best of my knowledge, the data package is in compliance with the terms and conditions of the contract, both technically and for completeness, with the exception of the conditions detailed in this Case Narrative, as verified by my signature below. During absences, Ms. Marcia K. McGinnity is authorized to sign this Statement of Data Authenticity.

Mr. Rick D. Davis
Laboratory Technical Director / VP Operations

Sample Receipt Information

ARCADIS

Laboratory Task Order No./P.O. No. _____ **CHAIN-OF-CUSTODY RECORD** Page 1 of 1

Project Number/Name GP08RAAP.0044
Project Location RADFORD, VA
Laboratory EMPIRICAL LABS
Project Manager DIANE WISBECK
Sampler(s)/Affiliation CHRIS KALINOWSKI

Sample ID/Location	Matrix	Date/Time Sampled	Lab ID	TCLP METALS	4OZ JAR GRAIN SIZE	4OZ JAR				Remarks	Total
				ANALYSIS / METHOD / SIZE							
WBGSD(20101019)	S	10-19-20/1620		1	1					1010173-01	

Sample Matrix: L = Liquid; S = Solid; A = Air

Total No. of Bottles/ Containers: 2

Relinquished by: [signature]	Organization: ARCADIS	Date 10/20/10	Time 1700	Seal Intact?	
Received by: _____	Organization: _____	Date / /	Time _____	Yes No N/A	
Relinquished by: _____	Organization: _____	Date / /	Time _____	Seal Intact?	
Received by: [signature]	Organization: Empirical	Date 10/21/10	Time 08:30	Yes No N/A	

Special Instructions/Remarks:
SEND REPORT TO JACQUE POWELL

1.10c

Delivery Method: ☐ In Person ☒ Common Carrier FEDEX SPECIFY ☐ Lab Courier ☐ Other _____ SPECIFY

AG 05-12/01

8

1010173 Summ Package

EMPIRICAL LABORATORIES
COOLER RECEIPT FORM

LIMS Number: 1010173 Number of Coolers: 1 of 1

Client: Arcadis Project: Radford, VA

Date/Time Received: **10/21/10** **08:30** Date cooler(s) opened: **10/21/10**

Opened By (print): Will Schwab (signature): [signature]

Circle response below as appropriate

1. How did the samples arrive? (FedEx) UPS DHL Hand Delivered
   EL Courier Other: _____

If applicable, enter airbill number here: 2034

2. Were custody seals on outside of cooler(s)? ..... (Yes) No

How many: 2 Seal date: 10/20/10 Seal Initials: ?

3. Were custody seals unbroken and intact at the date and time of arrival?	(Yes)	No	N/A
4. Were custody papers sealed in a plastic bag included in the sample cooler?	(Yes)	No	N/A
5. Were custody papers filled out properly (ink, signed, etc.)?	(Yes)	No	N/A
6. Did you sign custody papers in the appropriate place for acceptance?	(Yes)	No	N/A
7. Was project identifiable from custody papers?	(Yes)	No	N/A
8. If required, was enough ice present in the cooler(s)?	(Yes)	No	N/A

Type of Coolant: (WET) DRY BLUE NONE

Temperature of Samples upon Receipt: Initial Value: 0.6 °C Correction Factor: **+0.5** °C Final Value: 1.1 °C

Dates samples were logged-in: **10/21/10**

9. Initial this form to acknowledge login of sample(s): (Name): Will Schwab (Initial) WS

10. Were all bottle lids intact and sealed tightly?	(Yes)	No	N/A
11. Did all bottles arrive unbroken?	(Yes)	No	N/A
12. Was all required bottle label information complete?	(Yes)	No	N/A
13. Did all bottle labels agree with custody papers?	(Yes)	No	N/A
14. Were correct containers used for the analyses indicated?	(Yes)	No	N/A
15. Were preservative levels correct in all applicable sample containers?	Yes	No	(N/A)
16. Was residual chlorine present in any applicable sample containers?	Yes	No	(N/A)
17. Was sufficient amount of sample sent for the analyses required?	(Yes)	No	N/A
18. Was headspace present in any included VOA vials?	Yes	No	(N/A)

If Non-Conformance issues were present, list by sample ID: _____

SUBCONTRACT ORDER

Empirical Laboratories, LLC

1010173

SENDING LABORATORY:

Empirical Laboratories, LLC
621 Mainstream Drive, Suite 270
Nashville, TN 37228
Phone: 615.345.1115
Fax: 866.417.0548
Project Manager: Sonya Gordon

RECEIVING LABORATORY:

Beaver Engineering Inc (SUB032)
7378 Cockrill Bend BLVD.
Nashville, TN 37209-
Phone :(615) 350-8124
Fax: (615) 350-8149

Analysis	Due	Expires	Laboratory ID	Comments
Sample ID: WBGSD (20101019)				
Reference No: 1010173-01	**Solid**	**Sampled: 10/19/2010 16:20**		
SUB_GrainSize ASTM D422	11/01/2010 14:00	10/26/2010 15:20		
Containers Supplied:				
0004J_NP (4oz Jar Unpreserved) (B)				

Released By	Date	Received By	Date
Released By	Date	Received By	Date

1010173

Empirical Laboratories, LLC

Client: Arcadis (A285)
Project: Radford Army Ammunition Plant2010

Project Manager: Sonya Gordon
Project Number: ARC_Radford

Report To:
Arcadis (A285)
Jace'que Powell
2929 Briarpark Dr., Suite 300
Houston, TX 77042
Phone: (281) 497-6900
Fax: (000) 000-0000

Invoice To:
Arcadis (A285)
Joyce Williams
630 Plaza Drive Suite 600
Highlands Ranch, CO 80129
Phone :(720) 344-3764
Fax: (000) 000-0000

Date Due: 11/04/2010 16:00 (10 day TAT)

Received By: William Schwab
Date Received: 10/21/2010 08:30

Logged In By: William Schwab
Date Logged In: 10/21/2010 09:41

Samples Received at: **1.1°C**

Custody Seals	Yes	Received On Ice	Yes
Containers Intact	Yes		
COC/Labels Agree	Yes		
Preservation Confir	Yes		

Method	Test Code	Due	TAT	Expires	Comments
1010173-01 WBGSD (20101019) [Solid] Sampled 10/19/2010 16:20 Eastern					
varies	MET_PKG_TCLP_ALL	11/01/2010 14:00	10	11/02/2010 15:20	

Beaver Engineering Inc (SUB032)

1010173-01 WBGSD (20101019) [Solid] Sampled 10/19/2010 16:20 Eastern					
bGrainSize AS	SUB_GrainSize ASTM D422	11/01/2010 14:00	10	10/26/2010 15:20	

Analysis groups included in this work order

MET_PKG_TCLP_ALL

TCLP STD MET TCLP 7470A MET TCLP 6010B

Reviewed By Date

Sample Delivery Group Assignment Form

CLIENT: Arcadis (A285)
PROJECT NAME: Radford Army Ammunition Plant2010
SDG #: 1010173
MATRIX: Solid

QC LEVEL: EDD/IV
Report Due: 11/4/2010 - 11/4/2010
Client Sample Count: 1

Sample Type	Sampled	Received	Lab ID	Client ID	bGrainSize ASTM D422-S	SW1311	SW1311_6010B	SW1311_7470A
Client Sample	10/19/2010	10/21/2010	1010173-01	WBGSD (20101019)	X	X	X	X

Data for SW6010B / SW7470A Forms

ANALYSIS DATA SHEET

WBGSD (20101019)

Laboratory: Empirical Laboratories, LLC
Client: Arcadis (A285)
Matrix: Solid
Sampled: 10/19/10 16:20
% Solids: 0.00

SDG: 1010173
Project: Radford Army Ammunition Plant2010
Laboratory ID: 1010173-01
Received: 10/21/10 08:30

CAS NO.	Analyte	Conc. (mg/L)	MDL	RL	D.F.	Q	Method	Batch	Analyzed
7439-97-6	Mercury TCLP		0.000800	0.00200	1	U	SW1311_7470A	0J27920	10/28/10 09:35
7440-38-2	Arsenic TCLP		0.0300	0.100	1	U	SW1311_6010B	0J26006	10/27/10 18:57
7440-39-3	Barium TCLP	1.13	0.0500	0.400	1		SW1311_6010B	0J26006	10/27/10 18:57
7440-43-9	Cadmium TCLP	0.0128	0.0100	0.0500	1	J	SW1311_6010B	0J26006	10/27/10 18:57
7440-47-3	Chromium TCLP		0.0200	0.100	1	U	SW1311_6010B	0J26006	10/27/10 18:57
7439-92-1	Lead TCLP	1.28	0.0150	0.0300	1		SW1311_6010B	0J26006	10/27/10 18:57
7782-49-2	Selenium TCLP		0.0300	0.0600	1	U	SW1311_6010B	0J26006	10/27/10 18:57
7440-22-4	Silver TCLP		0.0100	0.100	1	U	SW1311_6010B	0J26006	10/27/10 18:57

INITIAL AND CONTINUING CALIBRATION CHECK

SW1311_6010B

Laboratory: Empirical Laboratories, LLC
SDG: 1010173
Client: Arcadis (A285)
Project: Radford Army Ammunition Plant2010
Instrument ID: ME-ICP
Calibration: 0301004
Sequence: 0J30108

Lab Sample ID	Analyte	True	Found	%R	Units	Control Limit
0J30108-ICV1	Arsenic	1000	1017	102	ug/L	+/- 10.00%
	Barium	1000	1026	103	ug/L	+/- 10.00%
	Cadmium	1000	1062	106	ug/L	+/- 10.00%
	Chromium	1000	932.0	93.2	ug/L	+/- 10.00%
	Lead	1000	999.0	99.9	ug/L	+/- 10.00%
	Selenium	1000	1008	101	ug/L	+/- 10.00%
	Silver	500.0	478.1	95.6	ug/L	+/- 10.00%
0J30108-CCV1	Arsenic	1000	1031	103	ug/L	+/- 10.00%
	Barium	1000	1029	103	ug/L	+/- 10.00%
	Cadmium	1000	1072	107	ug/L	+/- 10.00%
	Chromium	1000	950.5	95.0	ug/L	+/- 10.00%
	Lead	1000	985.6	98.6	ug/L	+/- 10.00%
	Selenium	1000	1054	105	ug/L	+/- 10.00%
	Silver	500.0	489.4	97.9	ug/L	+/- 10.00%
0J30108-CCV4	Arsenic	1000	1025	102	ug/L	+/- 10.00%
	Barium	1000	1035	103	ug/L	+/- 10.00%
	Cadmium	1000	1081	108	ug/L	+/- 10.00%
	Chromium	1000	946.1	94.6	ug/L	+/- 10.00%
	Lead	1000	945.9	94.6	ug/L	+/- 10.00%
	Selenium	1000	1067	107	ug/L	+/- 10.00%
	Silver	500.0	510.3	102	ug/L	+/- 10.00%
0J30108-CCV5	Arsenic	1000	1016	102	ug/L	+/- 10.00%
	Barium	1000	1039	104	ug/L	+/- 10.00%
	Cadmium	1000	1078	108	ug/L	+/- 10.00%
	Chromium	1000	960.3	96.0	ug/L	+/- 10.00%
	Lead	1000	905.3	90.5	ug/L	+/- 10.00%
	Selenium	1000	1068	107	ug/L	+/- 10.00%
	Silver	500.0	536.8	107	ug/L	+/- 10.00%

INITIAL AND CONTINUING CALIBRATION CHECK

SW1311_7470A

Laboratory: Empirical Laboratories, LLC
Client: Arcadis (A285)
Instrument ID: ME-FIMS
SDG: 1010173
Project: Radford Army Ammunition Plant2010
Calibration: 0301002
Sequence: 0J30109

Lab Sample ID	Analyte	True	Found	%R	Units	Control Limit
0J30109-ICV1	Mercury	4.000	4.170	104	ug/L	+/- 15.00%
0J30109-CCV2	Mercury	4.000	4.268	107	ug/L	+/- 15.00%
0J30109-CCV3	Mercury	2.000	2.030	102	ug/L	+/- 15.00%

CRDL STANDARD

SW1311_6010B

Laboratory: Empirical Laboratories, LLC

SDG: 1010173

Client: Arcadis (A285)

Project: Radford Army Ammunition Plant2010

Instrument ID: ME-ICP

Calibration: 0301004

Sequence: 0J30108

Lab Sample ID	Analyte	True	Found	%R	Units	QC Limts
0J30108-CRL1	Barium	10.00	10.32	103	ug/L	80 - 120
	Chromium	4.000	4.194	105	ug/L	80 - 120
	Silver	2.000	1.824	91.2	ug/L	80 - 120
0J30108-CRL2	Cadmium	4.000	4.207	105	ug/L	80 - 120
0J30108-CRL3	Arsenic	5.000	4.776	95.5	ug/L	80 - 120
	Lead	3.000	2.503	83.4	ug/L	80 - 120
	Selenium	5.000	5.028	101	ug/L	80 - 120

BLANKS
SW1311_6010B

Laboratory: Empirical Laboratories, LLC
SDG: 1010173
Client: Arcadis (A285)
Instrument ID: ME-ICP
Project: Radford Army Ammunition Plant2010
Sequence: 0J30108
Calibration: 0301004

Lab Sample ID	Analyte	Found	MDL	MRL	Units	C	Method
0J30108-ICB1	Arsenic	-0.01341	3.00	10.0	ug/L	U	SW1311_6010B
	Barium	-0.004590	5.00	40.0	ug/L	U	SW1311_6010B
	Cadmium	0.5691	1.00	5.00	ug/L	U	SW1311_6010B
	Chromium	-0.03323	2.00	10.0	ug/L	U	SW1311_6010B
	Lead	-1.382	1.50	3.00	ug/L	U	SW1311_6010B
	Selenium	0.7715	3.00	6.00	ug/L	U	SW1311_6010B
	Silver	0.03493	1.00	10.0	ug/L	U	SW1311_6010B
0J30108-CCB1	Arsenic	0.524	3.00	10.0	ug/L	U	SW1311_6010B
	Barium	-0.0663	5.00	40.0	ug/L	U	SW1311_6010B
	Cadmium	0.631	1.00	5.00	ug/L	U	SW1311_6010B
	Chromium	0.0320	2.00	10.0	ug/L	U	SW1311_6010B
	Lead	-0.0597	1.50	3.00	ug/L	U	SW1311_6010B
	Selenium	0.317	3.00	6.00	ug/L	U	SW1311_6010B
	Silver	-0.0145	1.00	10.0	ug/L	U	SW1311_6010B
0J30108-CCB4	Arsenic	0.545	3.00	10.0	ug/L	U	SW1311_6010B
	Barium	0.0824	5.00	40.0	ug/L	U	SW1311_6010B
	Cadmium	0.577	1.00	5.00	ug/L	U	SW1311_6010B
	Chromium	0.129	2.00	10.0	ug/L	U	SW1311_6010B
	Lead	-0.283	1.50	3.00	ug/L	U	SW1311_6010B
	Selenium	0.890	3.00	6.00	ug/L	U	SW1311_6010B
	Silver	0.103	1.00	10.0	ug/L	U	SW1311_6010B
0J26006-BLK1	Arsenic	-0.000491	0.00300	0.0100	mg/L	U	SW1311_6010B
	Barium	-0.0000712	0.00500	0.0400	mg/L	U	SW1311_6010B
	Cadmium	0.000764	0.00100	0.00500	mg/L	U	SW1311_6010B
	Chromium	0.000886	0.00200	0.0100	mg/L	U	SW1311_6010B
	Lead	-0.000635	0.00150	0.00300	mg/L	U	SW1311_6010B
	Selenium	0.00210	0.00300	0.00600	mg/L	U	SW1311_6010B
	Silver	-0.000125	0.00100	0.0100	mg/L	U	SW1311_6010B
0J30108-CCB5	Arsenic	0.700	3.00	10.0	ug/L	U	SW1311_6010B
	Barium	0.0911	5.00	40.0	ug/L	U	SW1311_6010B
	Cadmium	0.456	1.00	5.00	ug/L	U	SW1311_6010B
	Chromium	-0.122	2.00	10.0	ug/L	U	SW1311_6010B
	Lead	-0.525	1.50	3.00	ug/L	U	SW1311_6010B

BLANKS
SW1311_6010B

Laboratory: Empirical Laboratories, LLC
SDG: 1010173
Client: Arcadis (A285)
Instrument ID: ME-ICP
Project: Radford Army Ammunition Plant2010
Sequence: 0J30108
Calibration: 0301004

Lab Sample ID	Analyte	Found	MDL	MRL	Units	C	Method
0J30108-CCB5	Selenium	0.939	3.00	6.00	ug/L	U	SW1311_6010B
	Silver	-0.117	1.00	10.0	ug/L	U	SW1311_6010B

BLANKS
SW1311_7470A

Laboratory: Empirical Laboratories, LLC
SDG: 1010173
Client: Arcadis (A285)
Instrument ID: ME-FIMS
Project: Radford Army Ammunition Plant2010
Sequence: 0J30109
Calibration: 0301002

Lab Sample ID	Analyte	Found	MDL	MRL	Units	C	Method
0J30109-ICB1	Mercury	-0.07626	0.0800	0.200	ug/L	U	SW1311_7470A
0J30109-CCB2	Mercury	-0.0607	0.0800	0.200	ug/L	U	SW1311_7470A
0J27920-BLK1	Mercury	-0.000135	0.0000800	0.000200	mg/L	J	SW1311_7470A
0J30109-CCB3	Mercury	-0.0484	0.0800	0.200	ug/L	U	SW1311_7470A

ICP INTERFERENCE CHECK SAMPLE

SW1311_6010B

Laboratory: Empirical Laboratories, LLC
SDG: 1010173
Client: Arcadis (A285)
Project: Radford Army Ammunition Plant2010
Instrument ID: ME-ICP
Calibration: 0301004
Sequence: 0J30108

Lab Sample ID	Analyte	True	Found	%R	Units
0J30108-IFA1	Arsenic		0.27		ug/L
	Barium		2.51		ug/L
	Cadmium		0.01		ug/L
	Chromium		-1.39		ug/L
	Lead		6.30		ug/L
	Selenium		0.59		ug/L
	Silver		-0.46		ug/L
0J30108-IFB1	Arsenic	100.0	109.49	109	ug/L
	Barium	500.0	534.33	107	ug/L
	Cadmium	1000	1,178.20	118	ug/L
	Chromium	500.0	421.82	84.4	ug/L
	Lead	50.00	52.88	106	ug/L
	Selenium	50.00	56.47	113	ug/L
	Silver	200.0	192.05	96.0	ug/L

LCS / LCS DUPLICATE RECOVERY

SW1311_6010B

Laboratory:	Empirical Laboratories, LLC	SDG:	1010173
Client:	Arcadis (A285)	Project:	Radford Army Ammunition Plant2010
Matrix:	Water		
Batch:	0J26006	Laboratory ID:	0J26006-BS1
Preparation:	MET_3010A	Initial/Final:	50 mL / 50 mL

ANALYTE	SPIKE ADDED (mg/L)	LCS CONCENTRATION (mg/L)	LCS % REC.	QC LIMITS REC.
Arsenic	0.2500	0.2500	100	80 - 120
Barium	2.000	2.188	109	80 - 120
Cadmium	0.1250	0.1353	108	80 - 120
Chromium	0.2000	0.1969	98.4	80 - 120
Lead	0.2500	0.2410	96.4	80 - 120
Selenium	0.2500	0.2526	101	80 - 120
Silver	0.2500	0.2555	102	80 - 120

LCS / LCS DUPLICATE RECOVERY

SW1311_7470A

Laboratory:	Empirical Laboratories, LLC	SDG:	1010173
Client:	Arcadis (A285)	Project:	Radford Army Ammunition Plant2010
Matrix:	Water		
Batch:	0J27920	Laboratory ID:	0J27920-BS1
Preparation:	MET_HG_W_E	Initial/Final:	30 mL / 30 mL

ANALYTE	SPIKE ADDED (mg/L)	LCS CONCENTRATION (mg/L)	LCS % REC.	QC LIMITS REC.
Mercury	0.002000	0.002132	107	80 - 120

METHOD DETECTION AND REPORTING LIMITS

Laboratory: Empirical Laboratories, LLC **SDG:** 1010173

Client: Arcadis (A285) **Project:** Radford Army Ammunition Plant2010

Matrix: Water **Instrument:** ME-FIMS

Analyte	MDL	MRL	Units	Method
Mercury	0.0000800	0.000200	mg/L	SW1311_7470A

METHOD DETECTION AND REPORTING LIMITS

Laboratory: Empirical Laboratories, LLC **SDG:** 1010173

Client: Arcadis (A285) **Project:** Radford Army Ammunition Plant2010

Matrix: Water **Instrument:** ME-ICP

Analyte	MDL	MRL	Units	Method
Arsenic	0.00300	0.0100	mg/L	SW1311_6010B
Barium	0.00500	0.0400	mg/L	SW1311_6010B
Cadmium	0.00100	0.00500	mg/L	SW1311_6010B
Chromium	0.00200	0.0100	mg/L	SW1311_6010B
Lead	0.00150	0.00300	mg/L	SW1311_6010B
Selenium	0.00300	0.00600	mg/L	SW1311_6010B
Silver	0.00100	0.0100	mg/L	SW1311_6010B

USEPA - CLP

10A-IN
ICP-AES INTERELEMENT CORRECTION FACTORS (ANNUALLY)

Lab Name: Empirical Laboratories, LLC Contract: Arcadis (A285)

SDG No.: 1010173

ICP-AES Instrument ID: Thermo Jarrell Ashe ICAP Date: 9/11/2009

Analyte	Wave-length (nm)	Interelement Correction Factors for:				
		Al	Ca	Fe	Mg	Ag
Arsenic	189.0	0.0000120	0.0000000	0.0000020	0.0000000	0.0000000
Barium	233.5	0.0000000	0.0000000	0.0000090	0.0000000	0.0000000
Cadmium	228.8	0.0000000	0.0000000	-0.0000050	0.0021850	0.0000000
Chromium	267.7	0.0000000	0.0000000	0.0000040	0.0056080	0.0000000
Lead	220.3	0.0002980	0.0000000	0.0000080	0.0003250	0.0000000
Selenium	196.0	0.0000000	0.0000000	0.0000200	0.0000000	0.0000000
Silver	328.0	0.0000000	0.0000000	0.0000020	0.0000000	0.0000000

Comments:

FORM XA-IN

USEPA - CLP

10A-IN
ICP-AES INTERELEMENT CORRECTION FACTORS (ANNUALLY)

Lab Name: Empirical Laboratories, LLC Contract: Arcadis (A285)

SDG No.: 1010173

ICP-AES Instrument ID: Thermo Jarrell Ashe ICAP Date: 9/11/2009

Analyte	Wave-length (nm)	Interelement Correction Factors for:				
		As	B	Ba	Be	Cd
Arsenic	189.0	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
Barium	233.5	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
Cadmium	228.8	0.0045780	0.0000000	0.0000000	0.0000000	0.0000000
Chromium	267.7	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
Lead	220.3	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
Selenium	196.0	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
Silver	328.0	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000

Comments:

FORM XA-IN

USEPA - CLP

10A-IN
ICP-AES INTERELEMENT CORRECTION FACTORS (ANNUALLY)

Lab Name: Empirical Laboratories, LLC Contract: Arcadis (A285)

SDG No.: 1010173

ICP-AES Instrument ID: Thermo Jarrell Ashe ICAP Date: 9/11/2009

Analyte	Wave-length (nm)	Interelement Correction Factors for:				
		Co	Cr	Cu	K	Mn
Arsenic	189.0	0.0000000	-0.0126310	0.0000000	0.0000000	0.0000000
Barium	233.5	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
Cadmium	228.8	-0.0025320	0.0000000	0.0000000	0.0000000	0.0000000
Chromium	267.7	0.0000000	0.0000000	0.0000000	0.0000000	0.0002500
Lead	220.3	0.0000000	0.0000000	0.0022600	0.0000000	0.0000990
Selenium	196.0	0.0000000	0.0000000	0.0000000	0.0000000	0.0009430
Silver	328.0	0.0000000	0.0000000	0.0000000	0.0000000	0.0000650

Comments:

FORM XA-IN

USEPA - CLP

10A-IN
ICP-AES INTERELEMENT CORRECTION FACTORS (ANNUALLY)

Lab Name: Empirical Laboratories, LLC Contract: Arcadis (A285)

SDG No.: 1010173

ICP-AES Instrument ID: Thermo Jarrell Ashe ICAP Date: 9/11/2009

Analyte	Wave-length (nm)	Interelement Correction Factors for:				
		Mo	Na	Ni	Pb	Sb
Arsenic	189.0	-0.0001200	0.0000000	0.0000000	0.0000000	0.0000000
Barium	233.5	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
Cadmium	228.8	0.0000000	0.0000000	-0.0000880	0.0000000	0.0000000
Chromium	267.7	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
Lead	220.3	-0.0026440	0.0000000	0.0000000	0.0000000	0.0000000
Selenium	196.0	0.0000830	0.0000000	0.0000000	0.0000000	0.0000000
Silver	328.0	-0.0000590	0.0000000	0.0000000	0.0000000	0.0000000

Comments:

FORM XA-IN

10A-IN
ICP-AES INTERELEMENT CORRECTION FACTORS (ANNUALLY)

Lab Name: Empirical Laboratories, LLC Contract: Arcadis (A285)

SDG No.: 1010173

ICP-AES Instrument ID: Thermo Jarrell Ashe ICAP Date: 9/11/2009

Analyte	Wave-length (nm)	Interelement Correction Factors for:				
		Se	Sn	Ti	Tl	V
Arsenic	189.0	0.0000000	0.0000000	0.0000750	0.0000000	0.0000000
Barium	233.5	0.0000000	0.0000000	0.0000000	0.0000000	-0.0017020
Cadmium	228.8	0.0000000	0.0000000	0.0000000	0.0000000	0.0000560
Chromium	267.7	0.0000000	0.0000000	0.0000000	0.0000000	-0.0000700
Lead	220.3	0.0000000	0.0000000	0.0000000	0.0000000	-0.0000360
Selenium	196.0	0.0000000	0.0000000	0.0000220	0.0000000	0.0000540
Silver	328.0	0.0000000	0.0000000	0.0000000	0.0000000	-0.0064060

Comments:

FORM XA-IN

USEPA - CLP

10A-IN
ICP-AES INTERELEMENT CORRECTION FACTORS (ANNUALLY)

Lab Name: Empirical Laboratories, LLC Contract: Arcadis (A285)

SDG No.: 1010173

ICP-AES Instrument ID: Thermo Jarrell Ashe ICAP Date: 9/11/2009

Analyte	Wave-length (nm)	Interelement Correction Factors for: Zn				
Arsenic	189.0	0.0000000				
Barium	233.5	0.0000000				
Cadmium	228.8	0.0000000				
Chromium	267.7	0.0000000				
Lead	220.3	0.0000000				
Selenium	196.0	0.0000000				
Silver	328.0	0.0000000				

Comments:

FORM XA-IN

ICP-AES AND ICP-MS LINEAR RANGES (QUARTERLY)

Lab Name: Empirical Laboratories, LLC

Client: Arcadis (A285) SDG: 1010173

Project: Radford Army Ammunition Plant2010

ICP Instrument ID: ME-ICP Date: 09/11/2009

Analyte	Integ. Time (Sec.)	Concentration ug/L	M
Arsenic	15	10000	P
Barium	15	5000	P
Cadmium	15	10000	P
Chromium	15	10000	P
Lead	15	10000	P
Selenium	15	10000	P
Silver	15	2000	P

PREPARATION BATCH SUMMARY

SW1311_6010B

Laboratory: Empirical Laboratories, LLC SDG: 1010173

Client: Arcadis (A285) Project: Radford Army Ammunition Plant2010

Batch: 0J26006 Batch Matrix: Water Preparation: MET_3010A

SAMPLE NAME	LAB SAMPLE ID	DATE PREPARED	INITIAL VOL./WEIGHT	FINAL VOL.
Blank	0J26006-BLK1	10/26/10 10:29	50.00	50.00
LCS	0J26006-BS1	10/26/10 10:29	50.00	50.00
WBGSD (20101019)	1010173-01	10/26/10 10:29	5.00	50.00

PREPARATION BATCH SUMMARY

SW1311_7470A

Laboratory: Empirical Laboratories, LLC SDG: 1010173

Client: Arcadis (A285) Project: Radford Army Ammunition Plant2010

Batch: 0J27920 Batch Matrix: Water Preparation: MET_HG_W_E

SAMPLE NAME	LAB SAMPLE ID	DATE PREPARED	INITIAL VOL./WEIGHT	FINAL VOL.
Blank	0J27920-BLK1	10/27/10 08:28	30.00	30.00
LCS	0J27920-BS1	10/27/10 08:28	30.00	30.00
WBGSD (20101019)	1010173-01	10/27/10 08:28	3.00	30.00

ANALYSIS SEQUENCE SUMMARY

SW1311_6010B

Laboratory: Empirical Laboratories, LLC
SDG: 1010173
Client: Arcadis (A285)
Project: Radford Army Ammunition Plant2010
Sequence: 0J30108
Instrument: ME-ICP
Calibration: 0301004

Sample Name	Lab Sample ID	Lab File ID	Analysis Date/Time
Cal Standard	0J30108-CAL1	102710A-001	10/27/10 11:51
Cal Standard	0J30108-CAL2	102710A-002	10/27/10 11:55
Cal Standard	0J30108-CAL3	102710A-003	10/27/10 12:00
Cal Standard	0J30108-CAL4	102710A-004	10/27/10 12:04
Cal Standard	0J30108-CAL6	102710A-006	10/27/10 12:14
Initial Cal Check	0J30108-ICV1	102710B-001	10/27/10 13:01
Initial Cal Blank	0J30108-ICB1	102710B-002	10/27/10 13:08
Instrument RL Check	0J30108-CRL1	102710B-003	10/27/10 13:13
Instrument RL Check	0J30108-CRL2	102710B-004	10/27/10 13:18
Instrument RL Check	0J30108-CRL3	102710C-001	10/27/10 13:24
Interference Check A	0J30108-IFA1	102710D-001	10/27/10 13:38
Interference Check B	0J30108-IFB1	102710D-002	10/27/10 13:42
Calibration Check	0J30108-CCV1	102710D-004	10/27/10 13:57
Calibration Blank	0J30108-CCB1	102710D-005	10/27/10 14:04
Calibration Check	0J30108-CCV4	102710E-024	10/27/10 18:16
Calibration Blank	0J30108-CCB4	102710E-025	10/27/10 18:23
Blank	0J26006-BLK1	102710E-026	10/27/10 18:28
LCS	0J26006-BS1	102710E-027	10/27/10 18:33
WBGSD (20101019)	1010173-01	102710E-032	10/27/10 18:57
Calibration Check	0J30108-CCV5	102710E-036	10/27/10 19:17
Calibration Blank	0J30108-CCB5	102710E-037	10/27/10 19:24

ANALYSIS SEQUENCE SUMMARY

SW1311_7470A

Laboratory: Empirical Laboratories, LLC
SDG: 1010173
Client: Arcadis (A285)
Project: Radford Army Ammunition Plant2010
Sequence: 0J30109
Instrument: ME-FIMS
Calibration: 0301002

Sample Name	Lab Sample ID	Lab File ID	Analysis Date/Time
Cal Standard	0J30109-CAL1	COPY102810W-002	10/28/10 08:46
Cal Standard	0J30109-CAL2	COPY102810W-003	10/28/10 08:47
Cal Standard	0J30109-CAL3	COPY102810W-004	10/28/10 08:48
Cal Standard	0J30109-CAL4	COPY102810W-005	10/28/10 08:49
Cal Standard	0J30109-CAL5	COPY102810W-006	10/28/10 08:51
Cal Standard	0J30109-CAL6	COPY102810W-007	10/28/10 08:52
Cal Standard	0J30109-CAL7	COPY102810W-008	10/28/10 08:53
Cal Standard	0J30109-CAL8	COPY102810W-009	10/28/10 08:55
Initial Cal Check	0J30109-ICV1	COPY102810W-010	10/28/10 09:00
Initial Cal Blank	0J30109-ICB1	COPY102810W-011	10/28/10 09:01
Calibration Check	0J30109-CCV2	COPY102810W-033	10/28/10 09:25
Calibration Blank	0J30109-CCB2	COPY102810W-034	10/28/10 09:26
LCS	0J27920-BS1	COPY102810W-040	10/28/10 09:32
Blank	0J27920-BLK1	COPY102810W-041	10/28/10 09:34
WBGSD (20101019)	1010173-01	COPY102810W-042	10/28/10 09:35
Calibration Check	0J30109-CCV3	COPY102810W-045	10/28/10 09:38
Calibration Blank	0J30109-CCB3	COPY102810W-046	10/28/10 09:39

INITIAL CALIBRATION DATA

SW1311_7470A

Laboratory:	Empirical Laboratories, LLC	SDG:	1010173
Client:	Arcadis (A285)	Project:	Radford Army Ammunition Plant2010
Calibration:	0301002	Instrument:	ME-FIMS
Matrix:	Water	Calibration Date:	10/27/2010 2:25:09PM

	Level 01		Level 02		Level 03		Level 04		Level 05		Level 06	
Compound	ug/L	RF	ug/L	RF	ug/L	RF	ug/L	RF	ug/L	RF	ug/L	RF
Mercury	6	1.140833E-02	4	0.0111475	2	0.011555	1	0.01194	0.5	0.0127	0.2	0.01625

INITIAL CALIBRATION DATA (Continued)

SW1311_7470A

Laboratory:	Empirical Laboratories, LLC	SDG:	1010173
Client:	Arcadis (A285)	Project:	Radford Army Ammunition Plant2010
Calibration:	0301002	Instrument:	ME-FIMS
Matrix:	Water	Calibration Date:	10/27/2010 2:25:09PM

Compound	Level 07		Level 08		Level 09		Level 10		Level 11		Level 12	
	ug/L	RF	ug/L	RF	ug/L	RF	ug/L	RF	ug/L	RF	ug/L	RF
Mercury	0	0	10	0.01001								

INITIAL CALIBRATION DATA (Continued)

SW1311_7470A

Laboratory:	Empirical Laboratories, LLC	SDG:	1010173
Client:	Arcadis (A285)	Project:	Radford Army Ammunition Plant2010
Calibration:	0301002	Instrument:	ME-FIMS
Matrix:	Water	Calibration Date:	10/27/2010 2:25:09PM

Compound	Mean RF	RF RSD	Mean RT	RT RSD	Linear r	Quad COD	LIMIT	Q
Mercury	1.062635E-02	43.95218	0	0	0.9947353			

INITIAL CALIBRATION DATA

SW1311_6010B

Laboratory: Empirical Laboratories, LLC
SDG: 1010173
Client: Arcadis (A285)
Project: Radford Army Ammunition Plant2010
Calibration: 0301004
Instrument: ME-ICP
Matrix: Water
Calibration Date: 10/27/2010 4:14:34PM

Compound	Level 01		Level 02		Level 03		Level 04		Level 05		Level 06	
	ug/L	RF	ug/L	RF	ug/L	RF	ug/L	RF	ug/L	RF	ug/L	RF
Antimony	0	0	100	0.0006817	1000	7.3878E-04					10000	7.5679E-04
Arsenic	0	0	100	0.0003413	1000	3.5825E-04					10000	3.6081E-04
Barium	0	0	50	0.0106232	1000	0.010218	5000	0.0102634				
Cadmium	0	0	100	0.008788	1000	0.0086918					10000	0.0083438
Chromium	0	0	100	0.0000348	1000	3.331E-05					10000	3.3557E-05
Lead	0	0	100	0.0010173	1000	0.0010033					10000	0.0010335
Selenium	0	0	100	0.0003537	1000	3.6515E-04					10000	3.6636E-04
Silver	0	0	20	0.000053	500	5.134E-05	2000	5.406E-05				
Copper	0	0	100	0.0000797	1000	7.682E-05					10000	7.912399E-05
Nickel	0	0	100	0.0030912	1000	0.0031046					10000	0.0031823

INITIAL CALIBRATION DATA (Continued)

SW1311_6010B

Laboratory:	Empirical Laboratories, LLC	SDG:	1010173
Client:	Arcadis (A285)	Project:	Radford Army Ammunition Plant2010
Calibration:	0301004	Instrument:	ME-ICP
Matrix:	Water	Calibration Date:	10/27/2010 4:14:34PM

Compound	Level 07		Level 08		Level 09		Level 10		Level 11		Level 12	
	ug/L	RF	ug/L	RF	ug/L	RF	ug/L	RF	ug/L	RF	ug/L	RF
Antimony												
Arsenic												
Barium												
Cadmium												
Chromium												
Lead												
Selenium												
Silver												
Copper												
Nickel												

INITIAL CALIBRATION DATA (Continued)

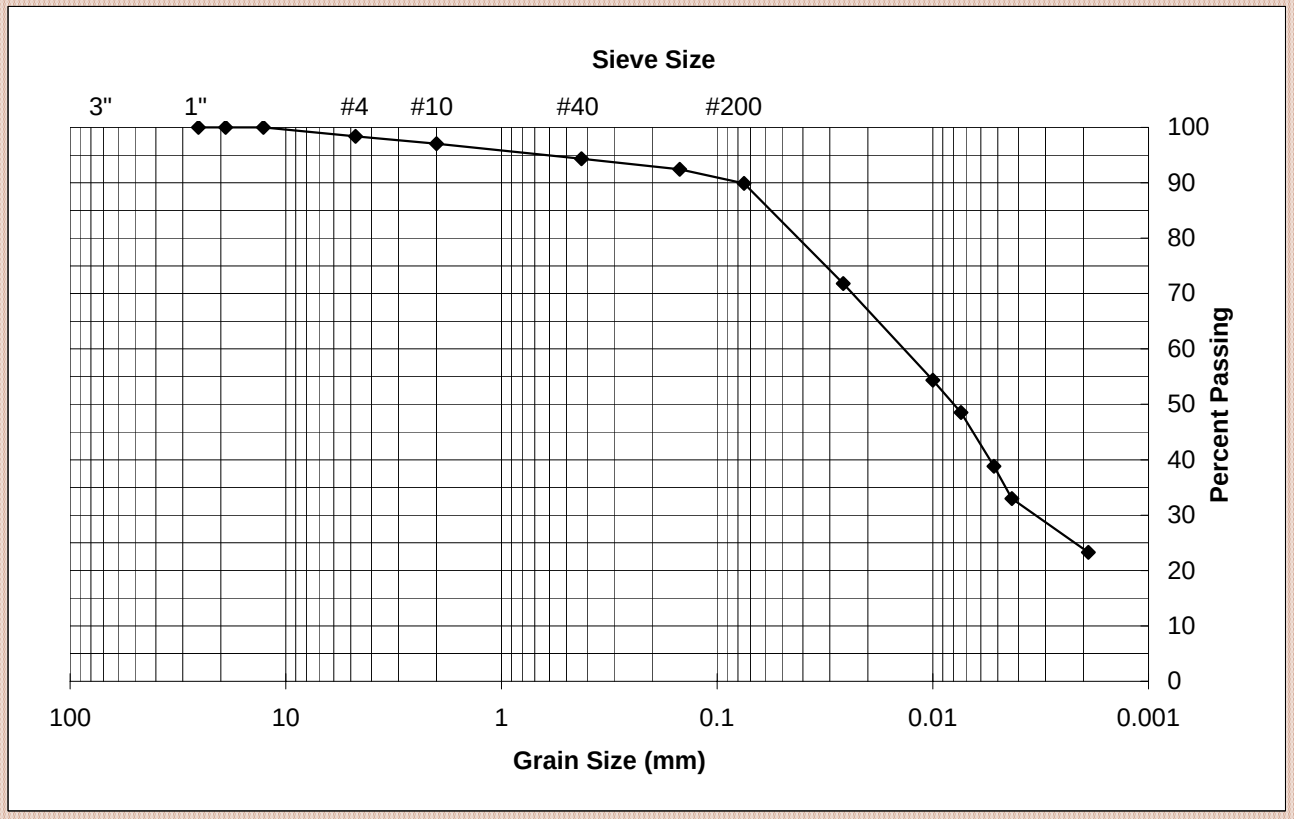
SW1311_6010B

Laboratory:	Empirical Laboratories, LLC	SDG:	1010173
Client:	Arcadis (A285)	Project:	Radford Army Ammunition Plant2010
Calibration:	0301004	Instrument:	ME-ICP
Matrix:	Water	Calibration Date:	10/27/2010 4:14:34PM

Compound	Mean RF	RF RSD	Mean RT	RT RSD	Linear r	Quad COD	LIMIT	Q
Antimony	5.443175E-04	66.92552	5.179395	184.6212	0.9999966		0.998	
Arsenic	2.6509E-04	66.7466	38.38579	197.8588	0.9999997		0.998	
Barium	7.77615E-03	66.70741	1.90965	179.4086	0.9999987		0.998	
Cadmium	0.0064559	66.73215	0.5468275	116.538	0.9999866		0.998	
Chromium	2.541675E-05	66.71601	8.927175	187.0544	0.9999991		0.998	
Lead	7.63525E-04	66.68625	42.75307	197.8136	0.9999917		0.998	
Selenium	2.713025E-04	66.69981	16.5588	195.056	0.9999998		0.998	
Silver	0.0000396	66.72657	3.02061	157.4422	0.9998227		0.998	
Copper	5.8911E-05	66.70012	2.875895	169.3438	0.9999908		0.998	
Nickel	2.344525E-03	66.68867	5.20516	191.8863	0.9999947		0.998	

Subcontractor Data Package

GRAIN SIZE DISTRIBUTION REPORT
ASTM D 422



PERCENT PASSING

SAMPLE ID	Seive Sizes for Mechanical Analysis								Diameters for Hydrometer Analysis (mm)					
	1.0(in)	0.75(in)	0.50(in)	#4	#10	#40	#100	#200	0.026	0.01	0.007	0.0052	0.004	0.002
WBGSD (20101019)														
1010173-01	100	100	100	98	97	94	92	90	72	54	49	39	33	23
	2%			8%					51%			39%		
LAB ID J 3628	GRAVEL			SAND					SILT			CLAY		

BEAVER ENGINEERING

PROJECT: EMPIRICAL LABORATORIES
RADFORD PO# 10-1215

PROJECT NUMBER: 10-6176

DATE: OCTOBER 28, 2010

GSI

BEAVER ENGINEERING, INC.
7378 COCKRILL BEND BLVD.
NASHVILLE, TENNESSEE 37209
615-350-8124

TEST DESCRIPTION:
PARTICLE SIZE ANALYSIS
ASTM D 422

PROJECT ELAB
LAB ID J3628
TYPE SAMPLE JAR
TECHNICIAN GBOWACOA

PROJ. NO. 10-6176
DATE: 10-25-10
LOCATION: 1010173-01
DRY WEIGHT 99.0 g

MECHANICAL ANALYSIS

SIEVE SIZE	INDIVIDUAL WEIGHT	CUMMULATIVE WEIGHT	PERCENT RETAINED	PERCENT PASSING
1"	0	0		
3/4"	0	0		
1/2"	0	0		
#4	1.6	1.6		
#10	1.3	2.9		

WASHOVER ANALYSIS DRY WEIGHT 509

A1

SIEVE SIZE	CUMMULATIVE WEIGHT	PERCENT RETAINED	PERCENT PASSING	PERCENT PASSING -#10
#40	1.4			
#100	2.4			
#200	3.7			

X-1
AF-X
AT

HYDROMETER ANALYSIS TIME OF DAY STARTED:

MINUTES SINCE START	TEMP (CENTIGRADE)	ORIGINAL READING	CORRECTION	FINAL
5	24°	43	6	37
30	24°	34	6	28
60	24°	31	6	25
120	25°	26	6	20
180	25°	23	6	17
1440	23	18	6	12

SUBCONTRACT ORDER

Empirical Laboratories, LLC

1010173

PO: 10-1215

SENDING LABORATORY:

Empirical Laboratories, LLC
621 Mainstream Drive, Suite 270
Nashville, TN 37228
Phone: 615.345.1115
Fax: 866.417.0548
Project Manager: Sonya Gordon

10 - 6176

RECEIVING LABORATORY:

Beaver Engineering Inc (SUB032)
7378 Cockrill Bend BLVD.
Nashville, TN 37209-
Phone :(615) 350-8124
Fax: (615) 350-8149

Project: Radford

Analysis	Due	Expires	Laboratory ID	Comments
Sample ID: WBGSD (20101019)			J3628	
Reference No: 1010173-01	**Solid**	**Sampled: 10/19/2010 16:20**		
SUB_GrainSize ASTM D422	11/01/2010 14:00	10/26/2010 15:20		
Containers Supplied: 0004J_NP (4oz Jar Unpreserved) (B)				

Released By	Date	Received By	Date
	10/22/10 11:25		
	10/22/10 11:23		

Appendix D

Permit Equivalency Application Package for Department of Army Nationwide Permit 38

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Radford Army Ammunition Plant-
Western Burning Ground

Permit Equivalency Application Package for Department of Army Nationwide Permit 38

April 20, 2011

ARCADIS

Diane Wisbeck
Project Manager

Joseph Shisler
Senior Project Scientist

Gwen Gibson
Project Scientist

Permit Equivalency Application Package for Department of Army Nationwide Permit 38

Radford Army Ammunition Plant

Prepared for:
U.S. Army

Prepared by:
ARCADIS U.S., Inc.
1114 Benfield Boulevard
Suite A
Millersville
Maryland 21108
Tel 410 987 0032
Fax 410 987 4392

Our Ref.:
GP08RAAP.4WBG

Date:
April 19, 2011

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APPLICATION FOR DEPARTMENT OF THE ARMY PERMIT
(33 CFR 325)

OMB APPROVAL NO. 0710-0003
EXPIRES: 31 August 2012

Public reporting burden for this collection of information is estimated to average 11 hours per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Department of Defense, Washington Headquarters, Executive Services and Communications Directorate, Information Management Division and to the Office of Management and Budget, Paperwork Reduction Project (0710-0003). Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to any penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number. Please DO NOT RETURN your form to either of those addresses. Completed applications must be submitted to the District Engineer having jurisdiction over the location of the proposed activity.

PRIVACY ACT STATEMENT

Authorities: Rivers and Harbors Act, Section 10, 33 USC 403; Clean Water Act, Section 404, 33 USC 1344; Marine Protection, Research, and Sanctuaries Act, Section 103, 33 USC 1413; Regulatory Programs of the Corps of Engineers; Final Rule 33 CFR 320-332. Principal Purpose: Information provided on this form will be used in evaluating the application for a permit. Routine Uses: This Information may be shared with the Department of Justice and other federal, state, and local government agencies, and the public and may be made available as part of a public notice as required by Federal law. Submission of requested information is voluntary, however, if information is not provided the permit application cannot be evaluated nor can a permit be issued. One set of original drawings or good reproducible copies which show the location and character of the proposed activity must be attached to this application (see sample drawings and instructions) and be submitted to the District Engineer having jurisdiction over the location of the proposed activity. An application that is not completed in full will be returned.

(ITEMS 1 THRU 4 TO BE FILLED BY THE CORPS)

1. APPLICATION NO.	2. FIELD OFFICE CODE	3. DATE RECEIVED	4. DATE APPLICATION COMPLETE
n/a	n/a	n/a	permit equivalency - application not intended for submittal

(ITEMS BELOW TO BE FILLED BY APPLICANT)

5. APPLICANT'S NAME:
First - James Middle - Last – McKenna
Company – U.S. Army-Radford Army Ammunition Plant
E-mail Address – jim.mckenna@us.army.mil

8. AUTHORIZED AGENT'S NAME AND TITLE (an agent is not required)
First - Diane Middle - Last – Wisbeck
Company – ARCADIS
E-mail Address – diane.wisbeck@arcadis-us.com

6. APPLICANT'S ADDRESS.
Address - Radford Army Ammunition Plant Route 114, Peppers Ferry Rd Building 220
City – Radford State – VA Zip – 24141 Country – USA

9. AGENT'S ADDRESS
Address - 1114 Benfield Blvd. Suite A
City – Millersville State – MD Zip – 21108 Country – Anne Arundel

7. APPLICANT'S PHONE NOs. W/AREA CODE.

a. Residence	b. Business	c. Fax
	540.639.8641	

10. AGENT'S PHONE NOs. W/AREA CODE

a. Residence	b. Business	c. Fax
n/a	410-923-7834	410-987-4392

STATEMENT OF AUTHORIZATION

11. I hereby authorize, Diane Wisbeck and ARCADIS to act in my behalf as my agent in the processing of this application and to furnish, upon request, supplemental information in support of this permit application.

APPLICANT'S SIGNATURE DATE

NAME, LOCATION, AND DESCRIPTION OF PROJECT OR ACTIVITY

12. PROJECT NAME OR TITLE (see instructions)
Sediment Removal at Western Burning Ground, Raford Army Ammunition Plant (RFAAP)

13. NAME OF WATERBODY, IF KNOWN (if applicable)
un-named stream flows into Claytor Lake in the New River watershed

14. PROJECT STREET ADDRESS (if applicable)
Address Radford Army Ammunition Plant
City - Dublin State – Virginia Zip - 24084

15. LOCATION OF PROJECT
Latitude: °N 37° 5'42.44"N
Longitude: °W 80°40'21.72"W

16. OTHER LOCATION DESCRIPTIONS, IF KNOWN (see instructions)
State Tax Parcel ID Municipality
Section – Township – Range –

17. DIRECTIONS TO THE SITE
Exit 98 off of I-81 to North Route 100 to Bagging Plant Road (east). Take Bagging Plant Road to Radford Army Ammunition Plant gate house.

18. Nature of Activity (Description of project, include all features)

Excavation, Transportation, and Off-Site Disposal of sediment from a ___ sized section on the northern shoreline of the impoundment in the Western Burning Ground (Figure 2, Attachment A). The implementation of the selected response action will consist of removal and off-site disposal of sediment, confirmation sampling to verify that the cleanup goals have been achieved, and site restoration activities to the extent practicable to restore the site to pre-existing conditions. The Remedial Action Work Plan presents complete details regarding the project. Site access roads, loading pads, and dewatering areas will be installed as described in Figure 2, Attachment A. Disturbed upland areas will be graded and seeded as described in the work plan. A wetland delineation was conducted to determine the extent of wetlands, open waters and transition areas around the project site in accordance with permit equivalency requirements described in Nationwide Permit (38) for Section 404 of the Clean Water Act (CWA) and Section 10 of the Rivers and Harbors Act. The Wetland Delineation Report is Attachment A.

19. Project Purpose (Describe the reason or purpose of the project, see instructions)

Multiple phases of environmental investigations were performed at WBG between 1997 and 2010. Human health and ecological risk assessments determined that sediments in an impoundment located in the Western Burning Ground (WBG) would need to be excavated to meet residential clean-up criteria for lead and chromium. The proposed dredging (to be performed as described in Block 18 and the Remedial Action Work Plan) will be conducted to remove sediments that contain lead and chromium at concentrations that have been determined to present unacceptable risks to current or hypothetical future receptors. Work is proposed to begin May 9 2011, and be completed in __.

USE BLOCKS 20-23 IF DREDGED AND/OR FILL MATERIAL IS TO BE DISCHARGED

20. Reason(s) for Discharge

No water or sediment will be discharged at the site or to the impoundment. Excavated sediment will be placed within the dewatering area, depicted on Figure 2, Attachment A. The dewatering area will be lined with a triple layer of Linear Low Density Polyethylene (LLDPE) geomembrane, or equivalent, to act as barrier to upland soil and collect water and sediments resulting from excavator bucket spillage. Spillage will be cleaned immediately and handled accordingly. Free liquids that accumulate within the sediment staging containment will be containerized and transported off-site for proper disposal. Dredged material is required to pass a paint filter test prior to transportation and disposal at the Wayne Disposal facility. Solidification agents, such as Portland cement, may be mixed with the sediment to allow the sediment to be transported off-site for disposal. Care will be exercised when mixing any solidification agents to prevent tearing of the containment liner and the generation of dust. Staged sediment will be loaded onto permitted trucks, covered and transported by Capitol Environmental, Inc., to Wayne Disposal, Bellville, MI, a subtitle C facility.

21. Type(s) of Material Being Discharged and the Amount of Each Type in Cubic Yards:

Type Amount in Cubic Yards	Type Amount in Cubic Yards	Type Amount in Cubic Yards
n/a		

22. Surface Area in Acres of Wetlands or Other Waters Filled (see instructions)

Acres 0

Or

Liner Feet 0

23. Description of Avoidance, Minimization, and Compensation (see instructions)

Impacts to wetlands/ waters are restricted to the area of sediments being removed from the impoundments. The minimum amount of sediments will be removed, based on threshold concentrations of lead and chromium. Removal of the contaminated sediments are expected to improve the overall sediment quality of the impoundment. As the area of sediments being disturbed is ___ square feet, the impoundment is man-made, and remediation is being conducted under NWP 38, mitigation is not expected. Impacts to waters are being minimized to the extent possible.

24. Is Any Portion of the Work Already Complete? Yes ☐ No ☑ IF YES, DESCRIBE THE COMPLETED WORK

25. Addresses of Adjoining Property Owners, Lessees, Etc., Whose Property Adjoins the Waterbody (If more than can be entered here, please attach a supplemental list).

Address – n/a, entire site is within confines of Radford Army Ammunition Plant

City – State – Zip –

26. List of Other Certifications or Approvals/Denials Received from other Federal, State, or Local Agencies for Work Described in This Application.

AGENCY	TYPE APPROVAL*	IDENTIFICATION NUMBER	DATE APPLIED	DATE APPROVED	DATE DENIED
n/a submitted as part of permit equivalency					

* Would include but is not restricted to zoning, building, and flood plain permits

27. Application is hereby made for a permit or permits to authorize the work described in this application. I certify that the information in this application is complete and accurate. I further certify that I possess the authority to undertake the work described herein or am acting as the duly authorized agent of the applicant.

SIGNATURE OF APPLICANT _____ DATE _____ SIGNATURE OF AGENT _____ DATE _____

The application must be signed by the person who desires to undertake the proposed activity (applicant) or it may be signed by a duly authorized agent if the statement in block 11 has been filled out and signed.

18 U.S.C. Section 1001 provides that: Whoever, in any manner within the jurisdiction of any department or agency of the United States knowingly and willfully falsifies, conceals, or covers up any trick, scheme, or disguises a material fact or makes any false, fictitious or fraudulent statements or representations or makes or uses any false writing or document knowing same to contain any false, fictitious or fraudulent statements or entry, shall be fined not more than $10,000 or imprisoned not more than five years or both.

Attachment A

Wetland Delineation Report

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Attachment A: Wetland Delineation Report

Western Burning Ground
Radford Army Ammunition Plant, New River Unit
(RAAP-044)
Radford, Virginia

April 2011

Attachment A: Wetland Delineation Report

Radford Army Ammunition Plant-
Western Burning Ground

Prepared for:
U.S. Army Environmental Command

Prepared by:
ARCADIS U.S., Inc.
326 First Street, Suite 202
Annapolis, Maryland
21403

Our Ref.:
GP08RAAP.4WBG

Date:
April 2011

ARCADIS

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Figures

Appendices

1. Introduction

ARCADIS U.S, Inc. (ARCADIS) has been retained by the United States Army Environmental Command (USAEC) to perform Installation Restoration Program (IRP) activities at the Radford Army Ammunition Plant (RFAAP). The RFAAP facility is located in Montgomery and Pulaski Counties in southwestern Virginia and consists of two noncontiguous units: the New River Unit (NRU) and the Main Manufacturing Area (MMA). The RFAAP-MMA is located approximately 5 miles northeast of the City of Radford, Virginia. The RFAAP-NRU is located about six miles southwest of the RFAAP-MMA, near the town of Dublin, Virginia. IRP activities for both the RFAAP-MMA and the RFAAP-NRU are being conducted as part of a Performance Based Contract awarded to ARCADIS under contract W91ZLK-05-D-0015: Task 0002. The RFAAP-NRU is managed under the Comprehensive Environmental Response and Compensation Liability Act (CERCLA).

As part of the remediation activities, it was determined that sediments in an impoundment located near the Western Burning Ground (WBG) Study Area would need to be excavated to meet residential clean-up criteria. The WBG is located in the NRU (Figure 1). The following wetland delineation identified the extent of wetlands, open waters and transition areas around the project site in accordance with permit equivalency requirements described in Nationwide Permit (38) for Section 404 of the Clean Water Act (CWA) and Section 10 of the Rivers and Harbors Act. The results of the wetland delineation will support the preparation of U.S. Army Corps of Engineers, Nationwide Permit #38 permit equivalency application packages for regulated activities occurring at the site in areas regulated under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA).

On March 17, 2011, ARCADIS wetland ecologists delineated wetland boundaries on the site in accordance with the *Federal Manual for Identifying and Delineating Jurisdictional Wetlands* (Manual) (Federal Interagency Committee for Wetland Delineation [FICWD] 1989) and the *DRAFT Interim Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Eastern Mountains and Piedmont Region* (United States Army Corps of Engineers [USACE] 2010). Appendix A presents resumes of key personnel involved in the wetland delineation.

This report is organized as follows:

- Section 2, Site Background, provides relevant site background information

- Sections 3, Methodology, and 4, Results, present the methodology and results, respectively, of the wetland delineation
- Section 5, Summary, provides a summary of wetland delineation findings
- Section 6, References, presents the references used to generate this WDR

2. Site Background

This section summarizes information regarding the site setting, ownership, operational history and remedial history.

2.1 Site Setting

2.1.1 Site location and Condition

The RFAAP-NRU facility is located in the mountains of southwestern Virginia in the Great Valley subprovince of the Valley and Ridge Physiographic Province. The RFAAP-NRU encompasses approximately 3,000 acres of Pulaski County, Virginia, near the town of Dublin. Active manufacturing operations at the facility ended in 1945, at the completion of World War II. The RFAAP-NRU currently serves as a storage facility for operations at the MMA. The storage facilities consist of magazine type buildings that are primarily located throughout the eastern portion of the RFAAP-NRU. Paved surface roads run throughout the facility to provide access to the storage magazines and areas utilized during historical operations at the site.

The WBG is a former burning ground located in the southwestern portion of the RFAAP-NRU, south of the Igniter Assembly Area. The WBG was used as a burning ground to decontaminate explosives contaminated material and to dispose of excess and off-specification explosives/energetics. The main burn area was approximately 170 feet (ft) long by 100 ft wide and is surrounded on three sides by an approximately 4 ft high earthen berm. A dirt road runs parallel to the open side of the former burn area, leading north to Alger Road, and south to the top of a steep slope above the impoundment. The dirt road was reportedly constructed on top of an ashy layer of material extending from the burning ground at the time of the impoundment construction. The site is surrounded with wooded areas, and is no longer active.

Despite the historical manufacturing operations that took place at the RFAAP-NRU, and its current use as a storage facility for the MMA, the majority of the land area consists of undeveloped grasslands, heavily forested areas, and agricultural tracts. A portion of the property has recently been converted for use as a military cemetery. The WBG is located in the western half of the RFAAP-NRU facility.

The area of the WBG delineated consists of the northern and eastern shores of a man-made impoundment located just south of the burning ground study area (Appendix A, Photograph 1). Lead contaminated sediments are scheduled for removal from a

portion of the impoundment adjacent to the northern shoreline. The impoundment was created in the 1990s when a dike with outfall was constructed to retain water from a natural stream. The stream feeding the impoundment originates at the northwestern corner of the impoundment.

The northern shoreline of the impoundment was rocky, covered with soil and successional vegetation. Elevation of the northern shoreline increased from north to south. The eastern shoreline of the impoundment consists of the manmade dike which retains the water form a natural stream. A drop pipe in the dike regulates water level in the impoundment. At the time of the site visit, water from the impoundment was flowing through the pipe (Photograph 2) and forming a stream which is known to eventually flow into the New River (Photograph 3). Water in the impoundment was clear with little to no vegetation in the bottom or water column. No water quality measurements were conducted during the site visit.

2.1.2 Surrounding Land Use

The site is located within a 3,000-acre former army ammunition plant. The plant is now primarily out of use. Landcover within the New River Unit is primarily forested or successional shrub and grass cover, with paved roads and scattered remains of buildings throughout. Neighboring areas north and west of the NRU are primarily residential with scattered commercial operations. Some land from the northern side of the NRU is being converted to a veterans' cemetery. Land east and south of the NRU is primarily undeveloped.

3. Methodology

The USEPA and United Sates Army Corps of Engineers (USACE) jointly define wetlands as “those areas that are inundated or saturated by surface water or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs and similar areas” (FICWD 1989).

Wetland delineations are conducted using the multi-parameter approach developed by the FICWD in 1989. This approach uses indicators of hydric soils, hydrophytic vegetation and wetland hydrology to identify the presence or absence of wetland areas. Wetland delineation activities conducted on site also followed guidance presented in the *Draft Interim Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Eastern Mountains and Piedmont Region* (USACE 2010).

The terminology used by Section 404 of the CWA includes “navigable waters,” defined in Section 502(7) as “waters of the United States including the territorial seas.” Waters of the United States include the following:

1. All waters which are currently used, or were used in the past, or may be susceptible in interstate or foreign commerce, including all waters which are subject to the ebb and flow of the tide;

2. All interstate waters including interstate wetlands;

3. All other waters such as interstate lakes, rivers, streams (including intermittent streams), mudflats, sand flats, wetlands, sloughs, prairie potholes, wet meadows, playa lakes, or natural ponds, the use, degradation or destruction of which could affect interstate or foreign commerce including any such waters:

    a. which are or could be used by interstate of foreign travelers for recreational or other purposes;

    b. from which fish or shellfish are or could be taken and sold in interstate or foreign commerce; or

    c. which are used or could be used for industrial purpose by industries in interstate commerce;

4. All impoundments of water otherwise defined as waters of the United States under the definition;

5. Tributaries of water identified in (1)-(4) of this section;

6. The territorial seas; and

7. Wetlands adjacent to waters (other than waters that are themselves wetlands) (33 CFR 328).

Prior to the site inspection, ARCADIS wetland ecologists reviewed preliminary data sources to gather remote sensing information to support the wetland delineation. These data sources included the following: USGS topographic maps, United States Fish and Wildlife Service (USFWS) National Wetlands Inventory (NWI) maps, and a soil survey of Pulaski County (United States Department of Agriculture [USDA] 2011).

ARCADIS wetland ecologists performed a field delineation of the site on March 17, 2011 to evaluate the site for changes in vegetation and topography that could indicate the potential presence of wetland areas. Soil borings were located in potential wetland areas to either confirm or refine potential wetland boundaries identified based on vegetation and hydrology. The evaluation of each soil boring location included a soil boring profile description, vegetation survey and observations of hydrology. The wetland delineation line was flagged at approximately 50- to 75-foot intervals and surveyed at the time of flagging using a sub-meter capable Trimble Geo XH handheld global positioning system (GPS). Figures 2 and 3 illustrate the wetland lines and locations of the observation points (OP). Appendix B presents wetland delineation data forms recorded at the observation (OP1 and OP2) points during the delineation.

3.1 Vegetation

Dominance of hydrophytic vegetation is the most conspicuous component of wetland delineation. Hydrophytic vegetation refers to plant species that occur in areas indundated with frequency and duration enough to influence the plant community (USACE 2010). The USFWS classifies plant species likely to be present in wetland areas, ranging from species almost exclusively associated with upland habitats (UPL) to obligate wetland species (OBL). Lists of USFWS hydrophytic species and classifications are presented in USFWS' *National List of Plant Species that Occur in Wetlands* (USFWS 1997).

Hydrophytic vegetation is dominant in areas when, under normal circumstances, one of the three following conditions is met (FICWD 1989).

1. More than 50 percent of the dominant species from all strata (e.g., tree, shrub and herbs) are OBL, facultative wetland (FACW), and/or facultative (FAC) species. For each stratum in the plant community, dominant species are those species whose basal area or aerial cover add up to 50 percent when ranked in descending order of abundance and cumulatively totaled, plus any additional species comprising 20 percent or greater of the total dominance measure for each stratum.

2. A frequency analysis of all species present in the community examined yields a prevalence index value of less than 3.0. Plant species are assigned the following values according to their hydrophytic vegetation indicator status (OBL = 1.0, FACW = 2.0, FAC = 3.0, facultative upland (FACU) = 4.0 and UPL = 5.0).

3. Less than or equal to 50 percent of the dominant species from all strata consists of OBL, FACW or FAC, or a frequency analysis of all species in the community yields a prevalence index greater than or equal to 3.0, but hydric soils and wetland hydrology are present.

3.2 Soils

Hydric soils are defined as soils that are saturated, flooded or ponded enough during the growing season to develop anaerobic conditions in the upper soil horizons (USDA 1987). The FICWD (1989) identifies hydric soils as follows:

1. All Histosols, except Folists; or

2. soils in Aquic suborders, Aquic subgroups, Albolls suborders, Salorthids great group, or Pell great group of Vertisols that are:

    a. somewhat poorly drained with a water table equal to 0 foot during the growing season; or

    b. poorly drained or very poorly drained and have either:

i. a water table less than 1.0 foot from the surface at some time during the growing season if permeability is equal to or greater than 6.0 inches per hour in all layers within 20 inches; or

ii. a water table less than 1.5 feet from the surface at some time during the growing season if permeability is less than 6.0 inches per hour in all layers within 20 inches; or

c. soils that are ponded for a long duration or a very long duration during the growing season; or

d. soils that are frequently flooded for a long duration or a very long duration during the growing season.

The soil series in an area can be identified through field inspection and comparison of the soil profiles with those described by the USDA Soil Survey Division (SSD). Soils were evaluated during delineation to assess the presence or absence of hydric soils on the site. Soil profiles were examined to an average depth of 2 feet using a 3.5-inch hand auger. Matrix (soils comprising usually greater than 50 percent of the soil sample, thereby giving the primary color) and mottle (spots of contrasting color) colors were evaluated using the Munsell Soil Colors Chart (Kollmorgen Corporation 1975).

3.3 Hydrology

The FICWD (1989) defines wetland hydrology, in general terms, as permanent or periodic inundation or prolonged soil saturation sufficient to create anaerobic conditions in the soil. It is the sum total of wetness characteristics in areas that are inundated or have saturated soils for a sufficient duration to support hydrophytic vegetation (Environmental Laboratory 1987). Inundation or saturation can occur due to a variety of hydrologic inflows such as direct precipitation, surface runoff, groundwater, tidal influence and overland flooding (Sipple 1988).

An area demonstrates wetland hydrology when saturated to the surface or inundated at some point during an average rainfall year, thereby exhibiting one of the following characteristics (FICWD 1989):

1. Saturation to the surface normally occurs when soils in the following natural drainage classes meet the following conditions:

a. in somewhat poorly drained mineral soils, the water table is less than 0.5 foot from the surface for usually one week or more during the growing season; or

b. in low permeability (<6.0 inches per hour), poorly drained or very poorly drained mineral soils, the water table is less than 1.5 feet from the surface for usually one week or more during the growing season; or

c. in more permeable (>6.0 inches per hour), poorly drained or very poorly drained mineral soils, the water table is less than 1.0 foot from the surface for usually one week or more during the growing season; or

d. in poorly drained or very poorly drained organic soils, the water table is usually at a depth where saturation to the surface occurs more than rarely. (Note: Organic soils that are cropped are often drained, yet the water table is closely managed to minimize oxidation of organic matter; these soils often retain their hydric characteristics and if so, meet the wetland hydrology criterion).

2. An area is inundated at some time, if ponded or frequently flooded with surface water for one week or more during the growing season.

Primary and secondary indicators of wetland hydrology, as listed on the wetland delineation data forms (Appendix B), were also identified during the delineation.

4. Results

This section presents information resulting from a review of wetland maps prepared by federal and state agencies (using remote sensing) and results of the wetland delineation for the site (based on site-specific information collected in the field). The wetland boundaries delineated by ARCADIS wetland ecologists are provided in Figures 2 and 3. Photographs of the site taken during the delineation are provided in Appendix C.

The wetland delineation identified two wetlands in the delineated area:

- Wetlands A - along the immediate northern shoreline of the impoundment (Line A on Figure 3). This wetland area occupies the shoreline on the edge of the pond below the ordinary high water mark (OHWM). Wetland A extends from the stream origination point at the northwest corner of the impoundment, along the northern shoreline to the dike at the southeastern side.
- Wetlands B - an overflow area on the eastern side of the dike adjacent to the impoundment and stream shoreline (Line B on Figure 3).

Both of the identified wetlands can be classified as regulated waters, as they originate from an impounded stream system that is part of the New River watershed.

4.1 Federal and State Wetland Information

Figure 3 present the USFWS NWI digitized data available on the USFWS NWI Wetlands Mapper (http://www.fws.gov/nwi/). The only wetlands area depicted in the NWI was the freshwater impoundment itself, classified as PUBHh (palustrine, unconsolidated bottom, permanently flooded, and diked or impounded). This agrees with the known history of the site as originating from a diked natural spring. The shoreline (Wetlands A) and overflow wetland area south of the dike (Wetlands B), or the stream flowing from the dike outlet were not classified in the NWI system as wetlands or waters.

The following sections present site-specific details pertaining to wetland vegetation, hydrology and soils in each delineated wetland.

4.2 Vegetation and Wildlife Observations

Data sheets in Appendix B list the plant species, as well as their USFWS hydrophytic classification, observed at each Observation Point collected during the wetland delineation. Wildlife observations around the impoundment include *Ardea herodias* (great blue heron) along the perimeter of the impoundment and *Odocoileus virginianus* (white tailed deer). Turtle tracks (species not identified) and probable raccoon tracks were also observed around the pound. A dead *Procambarus spp.* (crayfish) was observed in the impoundment.

4.2.1 Wetland Area A – Northern shoreline to Southern Dike

Wetland A is located along the shoreline at the impoundment's OHWM (Photograph 4, 5,6). The elevation of the land along the northern shore of the impoundment varied. Rock outcroppings under the soil raised the topography in this area and created a steep drop off into the impoundment in some areas (Photograph 4). Therefore Wetland A is generally narrow (Figure 3).

Dominant hydrophytic vegetation identified in Wetland A included *Juncus effusus* (soft rush), *Schoenoplectus tabernaemontani* (softstem bulrush), *Scirpus cyperinus* (woolgrass), *Panicum virgatum* (switchgrass), and *Schoenoplectus acutus* (hardstem bulrush). An observation point was documented in an upland area next to Wetland A. Vegetation in these upland areas adjacent to Wetland A consisted of switchgrass, *Berberis thunbergii* (Japanese barberry), *Juniperus virginiana* (eastern red cedar), and *Schizachyrium scoparium* (little bluestem grass).

4.2.2 Wetland Area B – Overflow Area East of Dike

Wetland area B is a freshwater wetland located in a low-laying area between Wetland A and the unnamed stream that flows out of the impoundment (Photograph 7). Vegetation in Wetland B is generally herbaceous, consisting of soft rush, *Typha latifolia* (cattail), and switchgrass. Observation Point 1 (OP1) was documented in Wetlands B (Appendix B).

4.3 Soils

Figure 2 presents the soil types present in the vicinity of the delineated wetlands. Three different soil types are documented in the delineated wetlands: Carbo-Rock outcrop complex, 10% to 45% slopes (6E), Lodi loam, 7% to 15% slopes(18C), and

Newark variant, silt loam (23) (USDA 2011). Additional description of each soil type is provided below:

- Lodi loam, 7%-15% slopes (18C) - Lodi loam is typically found in hilly settings, positioned in summits, backslopes, shoulders, convex slopes of 7%-15% grade, or interfluves. It is well drained; the depth to water table is documented as 80 inches. The parent material for Lodi loam is weathered interbedded dolomite, sandstone, and shale. Upper layers (0 to 12 inches) consist of loam, with lower stratums consisting of clay (12 to 40 inches) and clay loam (40 to 65 inches).

  This soil type is predominately in the upland areas of the Western Burning Ground, and only overlaps into in one small portion of Wetland A where a rock outcropping occurs adjacent to the impoundment (USDA 2011).

- Newark variant, silt loam (23) – Newark variant, silt loam typically occurs in floodplains or slopes of 0% to 2%. It has a water table of 6 to 18 inches, and is a poorly drained. The parent material consists of colluvian or alluvian derived from limestone, siltstone, or shale. The upper layers (0 to 42 inches) consist of silt loam and the lower layer (42- to 63 inches) consists of very gravelly clay.

  The mapped location of this soil type is along what may have been the original stream floodplain. The USDA soil survey documents Newark variant silt loam from the origination point of the spring, along the bed of the impoundment, and then follows the outflow of the impoundment along the stream bed. The mapped areas of this soil type include the western half of Wetlands A where the topography becomes flatter (USDA 2011).

- Carbo-Rock outcrop complex, 10 to 45% slopes – Carbo-Rock outcrop complex typically occurs on convex slopes of 10 to 45% in hilly areas. The depth to water table is generally 80 inches, and it is well-drained. The soil material is either weathered limestone or shale, or an outcrop of limestone. Typical soil profile consists of silty clay loam in the upper-most (0 to 5 inch) layer, clay at 5 to 31 inches, and bedrock in the lowest (31 to 41 inch) layer.

  The mapped location of the Carbo-Rock outcrop complex occurs in the steeper, rocky areas of Wetlands A, and throughout Wetlands B (USDA 2011).

Soil conditions observed during the site visit were consistent with the mapped soil types.

Exposed soil profiles were visible along the shoreline of the impoundment (Photo 5) in Wetland A. The exposed portion of the soils above the OHWM at the boundary of Wetland A did not exhibit hydric indicators. The bright color of the soil above the OHWM is indicative that these soils were not historically inundated.

Soil borings collected at the two Observation Points were documented during the wetland delineation. The soils at Observation Point 1 in Wetland B were saturated and contained oxidized rhizospheres. The soil color was determined to be gleyed in the 0 to 10 inch layer, the color was determined to be 10YR 3/3 when compared to the Munsell color guide (Kollmorgen Corporation 1975). Soils at Observation Point 2 next to Wetland A also did not exhibit hydric indicators. Figure 3 illustrates the location and extent of USDA mapped soil units. Appendix B presents wetland delineation data forms containing soil information.

4.4 Hydrology

The delineation site was historically a freshwater stream corridor. The stream was impounded in the 1990s for recreational use. At the time of the site visit, the site consisted of a freshwater impoundment, with a dike at its southeastern end. A pipe outlet is installed in the dike, allowing the impoundment to drain into an unnamed stream and eventually into the New River. The impoundment was full and flowing into the stream at the time of the site visit. Specific details related to the hydrology of each delineated wetland feature follow.

- Wetland A is primarily a narrow floodplain associated with the Ordinary High Water Mark (OHWM) of the existing impoundment.
- Wetland B is a wet meadow that appears to be fed by overflow drainage from the impoundment and pipe outlet. It is also contiguous with the floodplain for the unnamed stream.

5. Summary

Prior knowledge of historical site activities and a review of wetland maps prepared by federal and state agencies (using remote sensing), as well as a review of aerial and site photographs, indicated that wetlands/waters may be present on site. As such, ARCADIS wetland ecologists conducted a wetland delineation of the site.

Based on a review of available state and federal information and a wetland delineation using the USACE-mandated three-parameter methodology, it is ARCADIS's opinion that two wetland features exist within the boundaries of the site. The delineated wetlands delineated include:

- Wetland A – A narrow floodplain along the northern and eastern shore of the impoundment. The extent of this wetland is associated with the OHWM.

- Wetland B – An area of overflow from the impoundment adjacent to Wetland A.

The impoundment and unnamed stream are regulated waters. The impoundment was originally the headwaters of the unnamed stream, which flows into the New River, and is part of the Chesapeake Bay watershed.

6. Regulatory Context

Remediation of the sediments in the impoundment is being conducted by the U.S. Army under the Comprehensive Environmental Responsive, Compensation, and Liability Act (CERCLA). Remediation projects conducted under CERCLA are not required to submit permit applications for project activities for regulatory review; however, CERCLA projects must meet or waive the permitting provisions for applicable or relevant and appropriate requirements (ARARs). This wetland delineation report was prepared to fulfill permitting requirements for wetlands and waters of the United States, as per Section 404 of the Clean Waters Act, because this proposed sediment remediation involves dredging in surface waters.

7. References

Environmental Laboratory. 1987. Corps of Engineers Wetlands Delineation Manual. Technical Report Y-87-1, United States Army Engineer Waterways Experiment Station. Vicksburg, MS.

Federal Interagency for Wetland Delineation (FIWD). 1989. Federal Manual for Identifying and Delineating Jurisdictional Wetlands. United States Army Corps of Engineers, United States Environmental Protection Agency, United States Fish and Wildlife Service, and United States Department of Agriculture. Cooperative Technical Publication. Washington, DC.

Kollmorgen Corporation. 1975. Munsell Soil Color Charts. Baltimore, MD.

Sipple, W.S. 1988. Wetland Identification and Delineation Manual. Office of Wetlands Protection, United States Environmental Protection Agency. Washington, DC.

United States Army Corps of Engineers (USACE). 2010. Interim Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Eastern Mountain and Piedmont Region, ed. J.S. Wakeley, R.W. Lichvar, and C.V. Noble. ERDC/EL-TR-10-XX. Vicksburg, MS: U.S. Army Engineer Research and Development Center.

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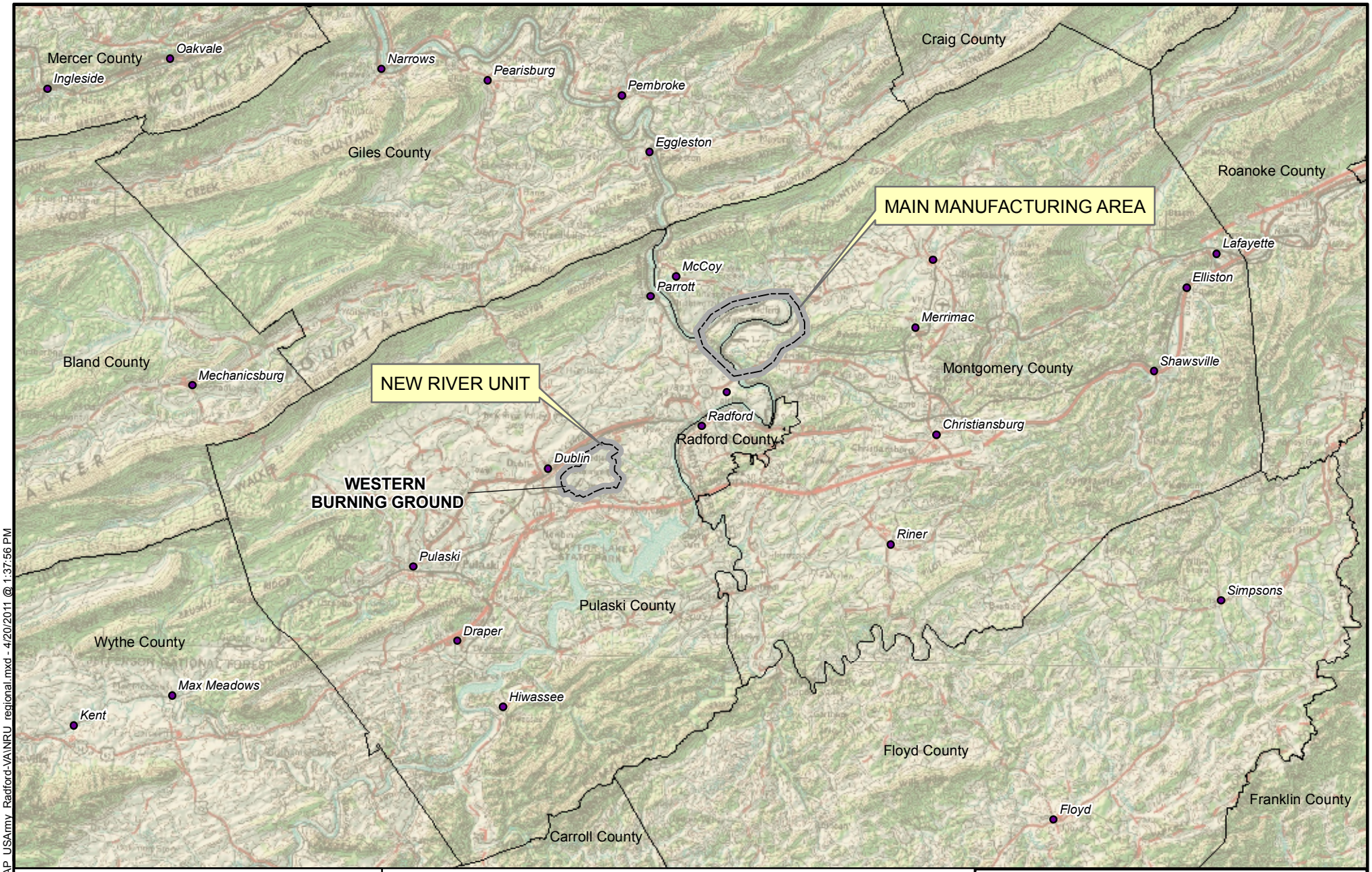
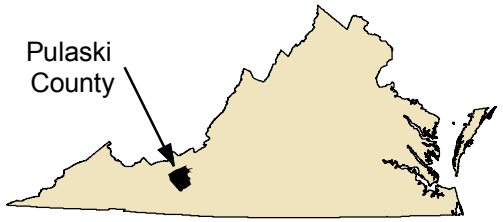
USDA. 2011. Web Soil Survey – Pulaski County, Virginia. Accessed at http://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx. Retrieved on March 15, 2011.

United States Fish and Wildlife Service (USFWS). 1997. National List of Vascular Plant Species that Occur in Wetlands: 1996 National Summary. National Wetlands Inventory. 209 pp.

ARCADIS

Figures





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Miles

N

RADFORD ARMY AMMUNITION PLANT
RADFORD, VA

SITE LOCATION MAP

ARCADIS

FIGURE
1

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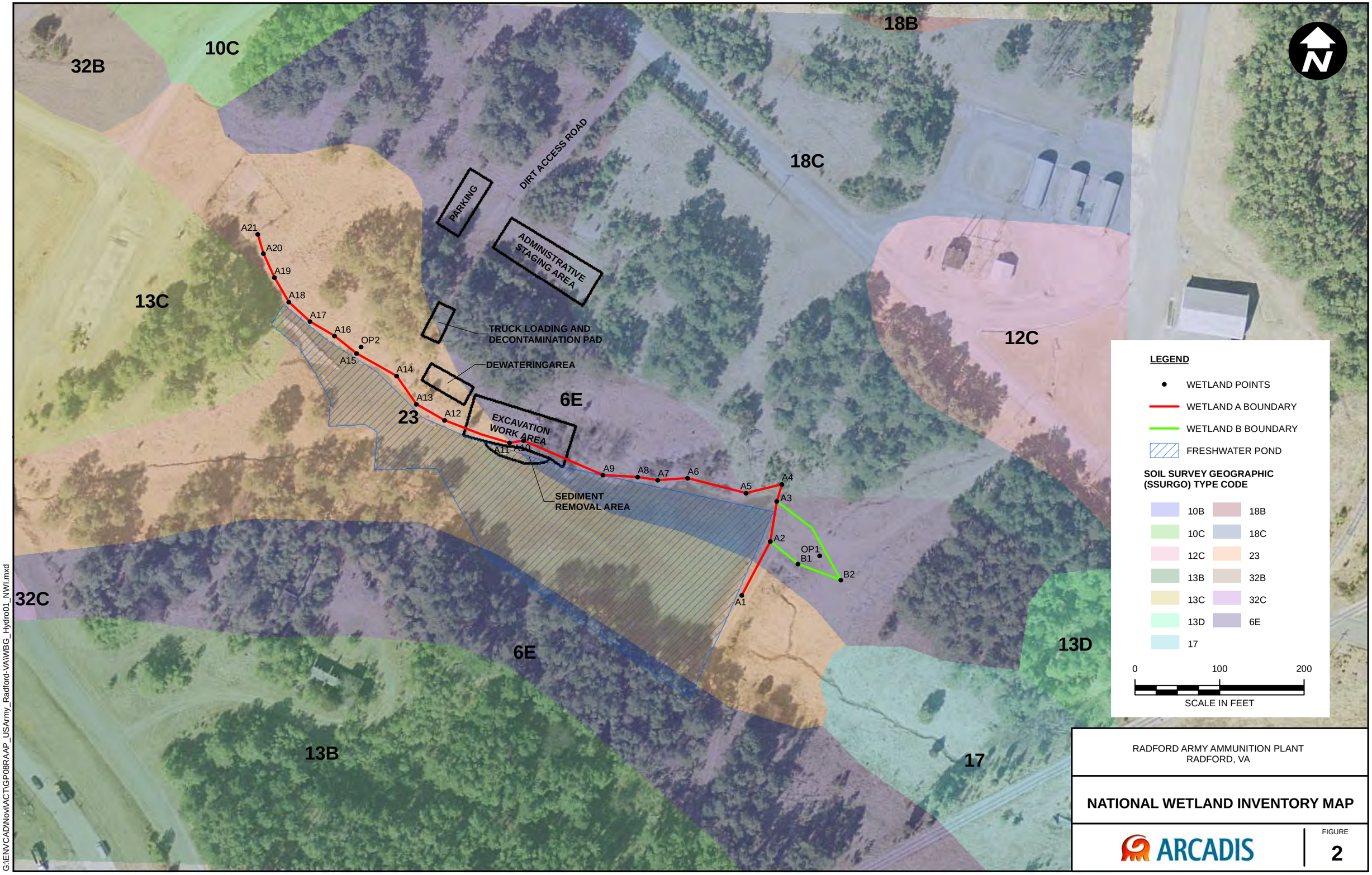

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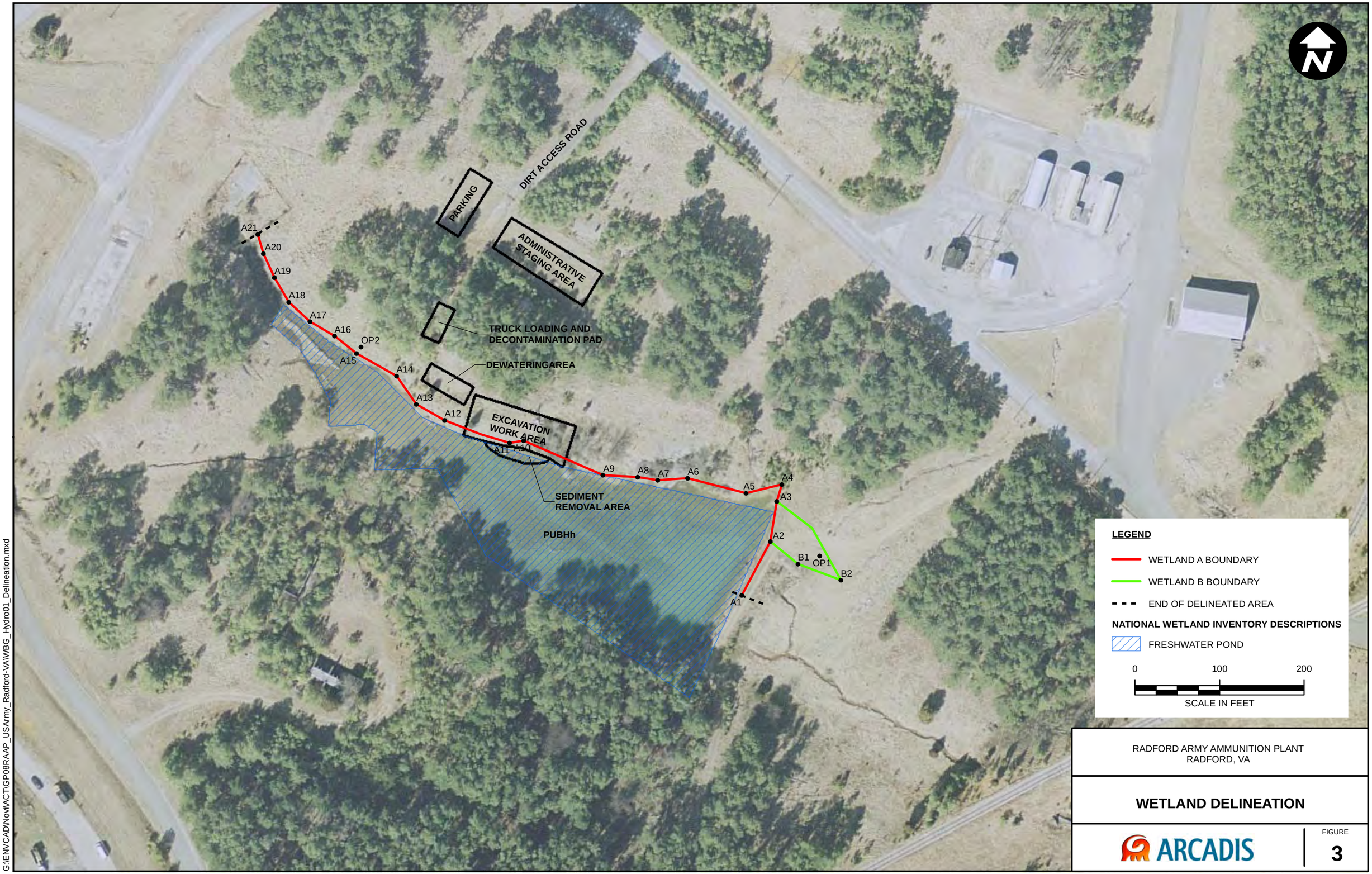
RADFORD ARMY AMMUNITION PLANT
RADFORD, VA

NATIONAL WETLAND INVENTORY MAP

ARCADIS

FIGURE
2



RADFORD ARMY AMMUNITION PLANT
RADFORD, VA

WETLAND DELINEATION

ARCADIS

FIGURE
3

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Appendix A

Resumes of Key Personnel

ARCADIS

Education

PhD/Zoology, Rutgers University, 1975

MA/Environmental Education, Glassboro State College, 1970

BS/Biology, Lenoir-Rhyne College, 1965

Years of Experience

With ARCADIS Since 2001

Professional Registrations

Ecological Society of America, Senior Ecologist

Society of Wetland Scientists-Professional Wetland Scientist

Professional Qualifications

- Association of State Wetland Managers
- Ecological Society of America
- Estuarine Research Federation
- New Jersey Wildlife Society
- Society of Ecological Restoration
- Society of Wetland Scientists
- The Wildlife Society

Advisory Boards

- Public Service Electric and Gas, Estuarine Enhancement Management Plan Advisory Committee
- American Wetland Research Foundation, Inc.

Joseph K. Shisler, PhD, PWS, CSE

Principal Scientist

A nationally recognized wetlands expert, Dr. Shisler has more than 35 years of experience conducting wetland evaluations and restoration projects. He was former president of Shisler Environmental Consultants, Inc. in Little Egg Harbor, New Jersey. Before that he was at Rutgers University for more than 15 years, where he directed research on wetlands, wildlife use, stormwater management, wetland mitigation, and coastal zone management issues. Dr. Shisler has been a consultant to various state, federal, and international agencies concerning wetlands and stormwater management issues, and he has published more than 125 papers. His work was recognized by the New Jersey Wildlife Society, which presented him with the 1980 Conservationist of the Year award. Dr. Shisler performed an extensive wetland evaluation on Staten Island for the New York Department of Environmental Conservation. Governor Kean appointed him chairperson of the New Jersey Wetlands Mitigation Council in 1989 where he served for 9 years. He has been a wetland restoration consultant for 20 years to the 10,000 acre PSE&G Estuarine Enhancement Program for the Delaware Bay. Dr. Shisler is a professional wetland scientist certified by the Society of Wetland Scientists and a senior ecologist certified by the Ecological Society of America.

Experience

Environmental Consultant for Superfund Sites

Various Locations in U.S.

Environmental consultant on a number of Superfund sites throughout the United States to address wetland, wildlife, and natural resource damages. Interacted with agencies to obtain necessary permits and meet cleanup requirements that have included wetland delineation, wetland mitigation plans and successful implementation, and habitat and wildlife surveys.

Evaluation of Sites

New Jersey and Surrounding States

Evaluated more than 3,000 sites as potential wetland sites and environmental impacts for a number of engineering firms and assisted in obtaining the necessary permits required by the state and federal agencies.

Wetland Management Methods
While at Rutgers University, served as a consultant to New Jersey to address wetland management methods associated with mosquito control. Under his direction, the open marsh water management and tidal restoration of impoundments have become major methods in the restoration of coastal wetland ecosystems.

Wetland Mitigation
Over the last 30 years has a number wetland restoration and mitigation projects that have been implemented and determined to be successful have been located in NJ, PA, NY, CT, DE, FL, GA, MI and MS.

Expert Witness
Been qualified in several courts as an expert witness in various environmental fields including wetland delineations and management, wildlife management, ecology, stormwater management issues, environmental impact assessments, and pest management and accepted as an expert in more than 100 municipal and county planning boards and environmental commissions in New Jersey, Pennsylvania, and New York.

Faculty Member
Rutgers University, University of South Carolina, and Trenton State College
Served as a faculty member at Rutgers University in the Department of Entomology and Economic Zoology and was an adjunct faculty member at the University of South Carolina and Trenton State College

Participant in Short Courses
Invited participant in a number of short courses for professionals for the USEPA; USCOE, the Office of Continuing Professional Education, Cook College - Rutgers University; The National Wetland Science Training Cooperative, Seattle, Washington; and Executive Enterprises, Washington, D.C. Instrumental in developing a short course series on wetlands and coastal issues at Rutgers University-Cook College. Has been invited participant in wetland mitigation, mosquito and vector control, dredge disposal issues, wildlife management, coastal zone development, and floodplain and stormwater management workshops (list available on request).

Overseas Consultant for Anti-malarial Project
Overseas consultant to the U.S. Department of State - Agency for International Development anti-malarial project in Zaire to address habitat management procedures and non-chemical methods in the control of vectors
Invited participant and chairperson of the Water and Weed Management, and Source Reduction Section for the Workshop “Comprehensive Vector Control - Current Status and Research Needs”

of the World Health Organization International Irrigation Management Institute Kandy, Sri Lanka-Environmental management for vector control

Evaluation of Mosquito Control Program
Evaluated the development of a comprehensive mosquito control program for Cape Cod National Park for the U.S. Department of Interior-Park Service

Consultant for Possible Lyme Disease Vectors
Mammal trapping and habitat identification consultant for possible Lyme disease vectors in New Jersey for the New Jersey Department of Health

Publications

Dr. Shisler has published more than 100 scientific papers in various periodicals and presented more than 200 scientific papers at various state, national, and international meetings (lists available on request). Papers have been published in following professional journals:

American Midland Naturalist
Biological Conservation
Bulletin of New Jersey Academy of Science
Bulletin of the Ecological Society of America
Condor
Ecological Restoration
Estuaries
Ibis
Human and Ecological Risk Assessment: An International Journal
J. of American Mosquito Control Association
J. of Medical Entomology
Marine Biology
Proc. of the Coastal Society
Proc. of Colonial Waterbird Group
Proc. of New Jersey Mosquito Control Association
Proc. of NE Fish and Wildlife
Science
Transactions of the American Fisheries Society
Wetlands
Wilson's Bulletin
Yale J. Biology and Medicine

ARCADIS

Education

B.S. Ecology, Evolutionary Biology, and Behavior, University of Maryland, College Park, 1996

Years of Experience

Total - 12

With ARCADIS – 5

Specialized Training

OSHA 40-Hour HAZWOPER Training, 2005

OSHA 8-Hour HAZWOPER Refresher, 2006-2007

Wetland Delineation 40-hour Training, 1999

Work History

ARCADIS, Annapolis, Maryland, August 2005 to present

Maryland Environmental Service, August 2000 to August 2005

Andrew Garte and Associates, Environmental Consulting, May 1998 to August 2000

Gwen Gibson

Project Scientist

Ms. Gibson is a Staff Scientist within the Risk Assessment and Ecological Sciences Group of ARCADIS, specializing in environmental planning for habitat restoration projects (particularly in the Chesapeake Bay region), natural resource damage assessments, ecosystem risk assessment, and remedial investigation/ feasibility studies. Ms. Gibson has experience with critical areas, permitting, wetland delineation, land use, dredged material reuse, habitat modeling and product stewardship; as well as developing and implementing field sampling programs, adaptive management plans, and monitoring plans. She graduated with a Bachelors of Science in Ecology, Evolutionary Biology, and Behavior from the University of Maryland, College Park in 1996, and is currently pursuing a Masters of Science in Environmental Policy and Management. Prior to coming to ARCADIS, Ms. Gibson worked for the Maryland Environmental Service (MES), providing environmental technical support to wetlands restoration projects for the State's Dredged Material Management Program, and also previously worked for an environmental consulting company conducting National Environmental Policy Act (NEPA) reviews and Phase I and II environmental site assessments.

Environmental Planning and Permitting

Environmental planning and ecological technical support for habitat restoration and dredged material placement projects in the Chesapeake Bay and within Baltimore Harbor. General experience includes county and State permit coordination, assessing project impacts to natural resources relative to county, State and Federal laws (i.e. critical areas, coastal zone management, clean water act), and facilitating/conducting inter-agency consultation for habitat restoration projects. Specific project descriptions are provided below:

Garner Scrap Tire Clean-Up Site
Maryland Environmental Service
Prince Georges' County, MD

Project Manager for planning and permitting the clean-up and stream habitat restoration of the largest illegal scrap tire dump site in Maryland. Project consists of coordinating county and State permit submittals for stormwater management, grading, sediment erosion control, wetland disturbance, stream restoration, and tree conservation. The initial phases of the project included conducting wetland delineation and coordinating the site surveys and forest stand delineation.

Mid-Chesapeake Bay Island Ecosystem Restoration Project
Maryland Environmental Service/ Maryland Port Administration
Chesapeake Bay, MD

Ecological technical support for a large-scale island habitat restoration/ creation project using dredged material located in the Chesapeake Bay. Duties include providing technical support for the feasibility study and environmental impact statement, drafting an Adaptive Management Plan and Ecological Design Criteria for habitat/ wetlands restoration, participating in the inter-agency working group for project planning, and assessing baseline habitat conditions in the project area and evaluating the project impacts to natural resources such as critical areas, commercial fisheries, and aquatic species and habitats.

Anne Arundel County Central Sanitation Facility Construction and Stream Restoration
Anne Arundel County Government
Millersville, Maryland

Stream restoration and environmental compliance inspection for a construction and stream restoration project. Duties include overseeing contractors for compliance with environmental permits and correct implementation of stream restoration designs. General environmental compliance consulting for issues arising on-site.

NEPA Reviews and Permitting Assessment for Transportation Corridor Construction
Confidential Client

Identification of potential NEPA issues and permitting needs for construction in a transportation corridor. Duties include conducting a NEPA desktop review, site walkover, and researching environmental permitting needs for construction of a transportation project on previously undeveloped land.

Maryland Dredged Material Management Plan (DMMP) Support
Maryland Environmental Service/ Maryland Port Administration
Chesapeake Bay, MD

General consulting services for Maryland's Dredged Material Management Plan projects, including marsh thin-layering, island habitat restoration, and material placement facilities located in Baltimore Harbor. Specific duties include continued participation in the inter-agency environmental planning committee for dredged material placement facilities and developing environmental baseline study plans for new wetland habitat restoration projects using dredged material. Former project experience, while at MES, included assisting with operations and environmental planning at the Cox Creek Dredged Material Containment Facility in Baltimore Harbor, facilitating the inter-agency environmental planning working group, conducting wetland plant field surveys, performing water quality monitoring, and developing and implementing environmental monitoring plans (including discharge) at containment facilities and wetland

restoration sites.

Natural Resource Damage Assessment, Ecological Risk Assessment, and Remedial Investigation/ Feasibility Studies (RI/FS)

Natural Resource Damage Assessment, Ecological Risk Assessment, and RI/FS
Palmerton Zinc Superfund Site,
Palmerton, PA

Provided technical and field survey/ sampling support for cooperative NRD, ecological risk, and RI/FS investigations-- including data management and reporting, and natural resource damage modeling. Researched metals toxicity in relation to contaminants of concern on the site. Planned and conducted surface water sampling at the site and reference locations. Performed and documented habitat equivalency modeling to quantify natural resource damages.

Natural Resource Damage Assessment, Ecological Risk Assessment, and RI/FS
Akzo Nobel,
Axis, AL

Provided technical and contract management for monitoring mercury levels in sediment and biota (fish) around the project site. Duties included developing a scope of work, drafting sampling plans, planning field investigations, environmental sampling, and documenting sampling results in a report to the client.

Natural Resource Damage Assessment, Ecological Risk Assessment, and RI/FS
Anniston, AL

Participated in ecological sampling (benthic, water quality, herptile) at the project and reference sites. Assisted with planning the environmental sampling and provided technical support for drafting the analytical report.

Hudson River Study
Fort Edward, NY

Provided technical assistance for the baseline habitat assessment and reconstruction project for PCB remediation of the Hudson River. Duties included assisting with development of the adaptive management plan and processing/ identification of wetland plants for the baseline habitat characterization and restoration planning.

Risk-Based Corrective Action Reporting
Confidential Client
Various Locations in Caribbean and South America

Prepare Risk-Based Corrective Action Reports based on results of a desktop review, site visit documentation, and laboratory results. The assessment consists of using the available data to determine if complete exposure pathways are present and if contamination is present on-site at levels above risk-based criteria.

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Product Stewardship

REACH (Registration, Evaluation, and Authorization of Chemicals) Classification/ GHS (Globally Harmonized System) for Classification and International Uniform Chemical Information Database (IUCLID) Study Evaluation and Data Entry
Client Confidential

Conduct toxicological classifications to metals, organics, and other chemicals for the REACH and GHS classification systems. To fulfill European Union requirements, REACH and GHS chemical classifications must be performed for each chemical sold within the EU. Duties for this project include evaluating chemicals to fulfill both REACH and GHS requirements. REACH classification consists of ranking the quality of human health and ecological risk studies for each chemical, and entering robust summaries of the results and data quality into the IUCLID (International Uniform Chemical Information Database). GHS classification consists of assessing the hazards of a substance using all available reliable data, and documenting the hazards in self-classification memos for the client.

Appendix B

Wetland Delineation Data Sheets

WETLAND DETERMINATION DATA FORM – Eastern Mountains and Piedmont

Project/Site: Radford - WB6 City/County: Pulaski County Sampling Date: 3/17/11

Applicant/Owner: State: VA Sampling Point: ~~SP1~~ SP1

Investigator(s): J. Shisler G. Gibson Section, Township, Range:

Landform (hillslope, terrace, etc.): floodplain Local relief (concave, convex, none): concave Slope (%): 2%

Subregion (LRR or MLRA): Lat: Long: Datum:

Soil Map Unit Name: UE: Carbo-rockhouse complex, 10-45% slope NWI classification: none

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ✓ No (If no, explain in Remarks.)

Are Vegetation ____, Soil ____, or Hydrology ____ significantly disturbed? no Are "Normal Circumstances" present? Yes ____ No ✓

Are Vegetation ____, Soil ____, or Hydrology ____ naturally problematic? no (If needed, explain any answers in Remarks.)

Region 1

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes ✓	No ____	**Is the Sampled Area within a Wetland?** Yes ✓ No ____
Hydric Soil Present?	Yes ✓	No ____	
Wetland Hydrology Present?	Yes ✓	No ____	

Remarks:
area was impounded in the 1990's ? this is an overflow area behind dike

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

- ✓ Surface Water (A1)
- ~~✓~~ High Water Table (A2)
- ✓ Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Water-Stained Leaves (B9)
- ___ Aquatic Fauna (B13)
- ___ True Aquatic Plants (B14)
- ___ Hydrogen Sulfide Odor (C1)
- ✓ Oxidized Rhizospheres on Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ___ Surface Soil Cracks (B6)
- ___ Sparsely Vegetated Concave Surface (B8)
- ✓ Drainage Patterns (B10)
- ___ Moss Trim Lines (B16)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ✓ Stunted or Stressed Plants (D1)
- ___ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ Microtopographic Relief (D4)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes ✓ No ____ Depth (inches): @1" in depressions

Water Table Present? Yes ____ No ____ Depth (inches): ____

Saturation Present? (includes capillary fringe) Yes ✓ No ____ Depth (inches): @surface

Wetland Hydrology Present? Yes ✓ No ____

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:
soils were saturated w/some ponding @ surface. Trees on edge of area were dying/stressed/dead.
Oxidized Rhizospheres evident in soil borings

VEGETATION (Four Strata) – Use scientific names of plants. Sampling Point: OP1

Tree Stratum (Plot size:)	Absolute % Cover	Dominant Species?	Indicator Status
1. n/a			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
	= Total Cover		
Sapling/Shrub Stratum (Plot size:)			
1. n/a			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
	= Total Cover		
Herb Stratum (Plot size:)			
1. panicum virgatum (switch grass)	75%	Y	FAC
2. Typha latifolia	5%	Y	OBL
3. juncus effusus	10%	Y	FACW+
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
	= Total Cover		
Woody Vine Stratum (Plot size:)			
1. n/a			
2.			
3.			
4.			
5.			
6.			
	= Total Cover		

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 3 (A)

Total Number of Dominant Species Across All Strata: 0 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 100% (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:	
OBL species		x 1 =	
FACW species		x 2 =	
FAC species		x 3 =	
FACU species		x 4 =	
UPL species		x 5 =	
Column Totals:	(A)		(B)

Prevalence Index = B/A =

Hydrophytic Vegetation Indicators:

__ 1 - Rapid Test for Hydrophytic Vegetation

__ 2 - Dominance Test is >50%

__ 3 - Prevalence Index is ≤3.0[1]

__ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

__ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Four Vegetation Strata:

Tree – Woody plants, excluding vines, 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/Shrub – Woody plants, excluding vines, less than 3 in. DBH and greater than 3.28 ft (1 m) tall.

Herb – All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.

Woody vine – All woody vines greater than 3.28 ft in height.

Hydrophytic Vegetation Present? Yes ✓ No

Remarks: (Include photo numbers here or on a separate sheet.)

Rapid Test used

SOIL

Sampling Point: OP1

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	%	Redox Features Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
0-10"	10YR 3/3							oxidized root channels

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5)
- ___ 2 cm Muck (A10) **(LRR N)**
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1) **(LRR N, MLRA 147, 148)**
- ✓ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Dark Surface (S7)
- ___ Polyvalue Below Surface (S8) **(MLRA 147, 148)**
- ___ Thin Dark Surface (S9) **(MLRA 147, 148)**
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)
- ___ Iron-Manganese Masses (F12) **(LRR N, MLRA 136)**
- ___ Umbric Surface (F13) **(MLRA 136, 122)**
- ___ Piedmont Floodplain Soils (F19) **(MLRA 148)**

Indicators for Problematic Hydric Soils[3]:

- ___ 2 cm Muck (A10) **(MLRA 147)**
- ___ Coast Prairie Redox (A16) **(MLRA 147, 148)**
- ___ Piedmont Floodplain Soils (F19) **(MLRA 136, 147)**
- ___ Red Parent Material (TF2)
- ___ Very Shallow Dark Surface (TF12)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: _____

Depth (inches): _____

n/a

Hydric Soil Present? Yes ✓ No ____

Remarks:

WETLAND DETERMINATION DATA FORM – Eastern Mountains and Piedmont

Project/Site: Radford-WBG City/County: Pulaski Sampling Date: 9/2

Applicant/Owner: State: Sampling Point: DP2

Investigator(s): G. Gibson, J. Shisler Section, Township, Range:

Landform (hillslope, terrace, etc.): Local relief (concave, convex, none): none Slope (%): 3%

Subregion (LRR or MLRA): Lat: Long: Datum:

Soil Map Unit Name: ~~35~~ 23 - Newark variant, silt loam NWI classification: none

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ____ No ____ (If no, explain in Remarks.)

Are Vegetation ____, Soil ____, or Hydrology ____ significantly disturbed? no Are "Normal Circumstances" present? Yes ✓ No ____

Are Vegetation ____, Soil ____, or Hydrology ____ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes ____	No ✓	**Is the Sampled Area within a Wetland?** Yes ____ No ✓
Hydric Soil Present?	Yes ____	No ✓	
Wetland Hydrology Present?	Yes ____	No ✓	

Remarks:
area was impounded in the 1990's.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Water-Stained Leaves (B9)
- ___ Aquatic Fauna (B13)
- ___ True Aquatic Plants (B14)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres on Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

none

Secondary Indicators (minimum of two required)

- ___ Surface Soil Cracks (B6)
- ___ Sparsely Vegetated Concave Surface (B8)
- ___ Drainage Patterns (B10)
- ___ Moss Trim Lines (B16)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Stunted or Stressed Plants (D1)
- ___ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ Microtopographic Relief (D4)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present?	Yes ____	No ✓	Depth (inches): ____
Water Table Present?	Yes ____	No ✓	Depth (inches): ____
Saturation Present? (includes capillary fringe)	Yes ____	No ✓	Depth (inches): ____

Wetland Hydrology Present? Yes ____ No ✓

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

VEGETATION (Four Strata) – Use scientific names of plants. Sampling Point: OP2

Tree Stratum (Plot size:)	Absolute % Cover	Dominant Species?	Indicator Status
1. eastern red cedar (Juniperus virginiana)	5%	✓	FACU
2.			
3.			
4.			
5.			
6.			
7.			
8.			
	= Total Cover		
Sapling/Shrub Stratum (Plot size:)			
1. Japanese barberry (Berberis thunbergii)	5%	✓	FACU
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
	= Total Cover		
Herb Stratum (Plot size:)			
1. little bluestem (Schizachyrium scoparium)	30%	✓	
2. panicum virgatum	50%	✓	FAC
3. little bluestem			
4. (Schizachyrium scoparium)	50%	✓	FACU
5.			
6. switchgrass	50%	✓	FAC
7.			
8.			
9.			
10.			
11.			
12.			
	= Total Cover		
Woody Vine Stratum (Plot size:)			
1.			
2.			
3.			
4.			
5.			
6.			
	= Total Cover		

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 1 (A)

Total Number of Dominant Species Across All Strata: 4 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 25% (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:	
OBL species		x 1 =	
FACW species		x 2 =	
FAC species		x 3 =	
FACU species		x 4 =	
UPL species		x 5 =	
Column Totals:	(A)		(B)

Prevalence Index = B/A =

Hydrophytic Vegetation Indicators:

__ 1 - Rapid Test for Hydrophytic Vegetation

__ 2 - Dominance Test is >50%

__ 3 - Prevalence Index is ≤3.0[1]

__ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

__ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Four Vegetation Strata:

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Herb – All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.

Woody vine – All woody vines greater than 3.28 ft in height.

Hydrophytic Vegetation Present? Yes ____ No ✓

Remarks: (Include photo numbers here or on a separate sheet.)

SOIL

Sampling Point: OP2

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	%	Redox Features Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
0-10"	10YR 5/6							not hydric

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5)
- ___ 2 cm Muck (A10) **(LRR N)**
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1) **(LRR N, MLRA 147, 148)**
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Dark Surface (S7)
- ___ Polyvalue Below Surface (S8) **(MLRA 147, 148)**
- ___ Thin Dark Surface (S9) **(MLRA 147, 148)**
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)
- ___ Iron-Manganese Masses (F12) **(LRR N, MLRA 136)**
- ___ Umbric Surface (F13) **(MLRA 136, 122)**
- ___ Piedmont Floodplain Soils (F19) **(MLRA 148)**

Indicators for Problematic Hydric Soils[3]:

- ___ 2 cm Muck (A10) **(MLRA 147)**
- ___ Coast Prairie Redox (A16) **(MLRA 147, 148)**
- ___ Piedmont Floodplain Soils (F19) **(MLRA 136, 147)**
- ___ Red Parent Material (TF2)
- ___ Very Shallow Dark Surface (TF12)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: _____

Depth (inches): _____

Hydric Soil Present? Yes _____ No ✓

Remarks:

No hydric indicators

Appendix C

Wetland Delineation Site Photographs

Photograph 1. View from northern shoreline of pond, facing east toward dike. White stakes indicate area of sediment removal (circled)

Photograph 2. The outfall pipe intake at the dike. Water can be seen flowing into the intake, and may be indicative that the water levels in the impoundment were at OHWM. Debris trapped over the intake may indicate how high water levels rose during recent rain events.

Photograph 3. Un-named stream flowing from the outflow pipe in the dike.

Photograph 4. Rock outcropping on northern shoreline of pond. Wetlands/ waters extent is at the edge of the rock outcropping as indicated by the pink flagging (Wetlands Point A5) is circled.

Photograph 5. View of exposed soils on northern shoreline (Wetland A). The bright color of the soil is indicative that these soils were not historically inundated, and are typically above the high water mark.

Photograph 6. Western portion of Wetland A. Photograph taken from the northern shoreline facing northwest toward where the stream originates in the impoundment.

Photograph 7. View of Wetland B, overflow area adjacent to dike.