RAAP 050506\ 05005

Team Radford

DELIVERY ORDER NO. 0018
ENVIRONMENTAL SERVICES
PROGRAM SUPPORT
CONTRACT DACA31-00-D-0011

# RADFORD ARMY AMMUNITION PLANT
# RADFORD, VIRGINIA

## MASTER WORK PLAN
## QUALITY ASSURANCE PLAN
## HEALTH AND SAFETY PLAN

## Addendum No. 11
## Soil Sampling and Reporting at SWMU 6

**FINAL DOCUMENT**

*November 2000*

URS
Dames & Moore

**5540 Falmouth Street, Suite 201**
**Richmond, Virginia 23230**
**(804) 965-9000 and (804) 965-9764 fax**

3-

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

December 11, 2000

In reply
Refer to 3HS13

CERTIFIED MAIL
RETURN RECEIPT REQUESTED

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

C.A. Jake
Environmental Manager
Alliant Techsystems, Inc.
Radford Army Ammunition Plant
P.O. Box 1
Radford, VA 24141-0100

Re: Radford Army Ammunition Plant
Work Plan submittal and review

Dear Mr. McKenna and Ms. Jake:

The U.S. Environmental Protection Agency (EPA) has reviewed the Army's draft *Work Plan Addendum No. 11* for soil sampling at SWMU 6, located at the Radford Army Ammunition Plant (RAAP). The Region has reviewed the proposed sampling outlined in the draft *Work Plan* and noted that it should be referred to as a *Site-Screening Work Plan* as outlined in Part II, Section D. of the RCRA Corrective Action Permit, as the intent of the proposed sampling is to demonstrate no further action at the SWMU, or at least to determine residual risk after construction activities have taken place. Based upon this, and the remainder of our review of the draft document, the *Work Plan Addendum No. 11* is approved. In accordance with Part II.(G)(2) of RAAP's Corrective Action Permit, the schedule contained within the *Work Plan Addendum No. 11* is henceforth incorporated into the Permit, via the Installation Action Plan. Thus, the complete schedule contained in Appendix C,

copy in 27l

including the deliverable date of **February 9, 2001** for the draft Report, i.e. Site-Screening Report, for SWMU 6 is now finalized.

If you have any questions, please call me at 215-814-3357.

Sincerely,

Robert Thomson, PE
Federal Facilities Branch

cc: Russell Fish, EPA
Leslie Romanchik, VDEQ-RCRA
Sharon Wilcox, VDEQ-CERCLA

1.

ATK
ALLIANT TECHSYSTEMS

Radford Army Ammunition Plant
Route 114, P.O. Box 1
Radford, VA 24141
USA

November 29, 2000

Mr. Robert Thomson
U. S. Environmental Protection Agency
Region III
1650 Arch Street
Philadelphia, PA 19103-2029

Subject: Work Plan Addendum 010: Facility Wide background Study
Work Plan Addendum 011: Soil Sampling and Reporting at SWMU 6,
EPA ID# VA1 210020730

Dear Mr. Thomson:

Enclosed is a copy of the Work Plan Addendum 010 and a copy of Work Plan Addendum 011. Two additional copies will be sent under separate cover.

The contents of Work Plan Addendum 010 were discussed in an August 10, 2000 team meeting at your office. An MS Word version of the minutes were distributed August 16, 2000. A WordPerfect version of these minutes was sent to you November 27, 2000. I apologize for the incompatibility.

The contents of Work Plan Addendum 011 were discussed in an October 26, 2000 team meeting at your office. Draft meeting minutes were provided to the attendees on November 1, 2000 via email. No comments were received and Work Plan Addendum 011 was revised per these meeting minutes. Within the email, a notification was provided that the Army's contractor, URS Corporation, would begin the sampling effort on November 13, 2000. Please note that the sampling effort did begin as scheduled on November 13 and was completed on November 18, 2000.

Please coordinate with and provide any questions or comments to, Jerry Redder of my staff (540) 639-7536 or Jim McKenna, ACO Staff (540) 639-8641.

Sincerely,

C.A. Jake

C. A. Jake, Environmental Manager
Alliant Ammunition and Powder Company LLC

Enclosure

c: w/o enclosure
Durwood Willis
Virginia Department of Environmental Quality
P. O. Box 10009
Richmond, VA 23240-0009

Sharon Wilcox
Virginia Department of Environmental Quality
P. O. Box 10009
Richmond, VA 23240-0009

00-815-180
JJRedder

Copy 12.27e

ℓ

w/o enclosure
Russell Fish, P.E., EPA Region III

bc: Administrative File
J. McKenna, ACO Staff
S. J. Barker-ACO Staff
Rob Davie-ACO Staff
C. A. Jake
J. J. Redder
Env. File - Enclosures (Work Plan Addendum 010 & 011) filed in Groundwater Library

Coordination: ______
J. McKenna

00-815-180
JJRedder

Concerning the following documents:

Work Plan Addendum 010: Facility –Wide Background Study
Work Plan Addendum 011: Soil Sampling and Reporting at SWMU 6, Radford Army Ammunition Plant

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

SIGNATURE:
PRINTED NAME: Rodney K. Alston
TITLE: LTC, CM, Commanding
Radford AAP

SIGNATURE:
PRINTED NAME: Ken Dolph
TITLE: Vice President Operations
Alliant Ammunition and Powder Company, LLC

00-315-180
JJKedder

b.

**McKenna, Jim**

---

**m:** McKenna, Jim
**t:** Wednesday, November 01, 2000 5:18 PM
**To:** 'rob thomson'; 'sam rotenberg'; 'jack hwang'; 'sharon wilcox'
**Cc:** Redder, Jerome; 'john e tesner'; 'bob shaffer'
**Subject:** Minutes of 10/26/2000 SWMU 6 meeting

All:

Attached file contains the subject meeting minutes. URS will be mobilizing for the field sampling effort on Monday, November 13, 2000.

Thanks,

Jim

PS Bob S., please forward to Jim Spencer, I don't have his email address. Reminder to send me 4 copies of the revised work plan addendum by 11/13/2000.

Meetingminutes10-26-2000.doc

# Radford Army Ammunition Plant
# Restoration Program Review
# Work Plan Addendum 11: SWMU 6
# U.S. Environmental Protection Agency, Region III
# Meeting Minutes - October 26, 2000

Meeting convened at 1:30 p.m. with the following present:

| | |
|---|---|
| EPA Region III, Superfund: | Rob Thomson |
| EPA Region III, RCRA: | Sam Rotenberg, Jack Hwang |
| VDEQ: | Sharon Wilcox (via telephone conference call) |
| RFAAP: | Jim McKenna |
| ATK: | Jerry Redder |
| Army Corps of Engineers: | John Tesner |
| URS Corporation: | Bob Shaffer<br>James Spencer |

Meeting opened with Jim McKenna providing a briefing and overview of restoration program and SWMU 6 project.

John Tesner followed by discussing the following:

- Objective and scope of the production based support project at SWMU 6 (presentation slide 4);
- Overview of the purpose of the sampling program (presentation slide 5); and
- Proposed timeline for providing sampling data to Norfolk Corps of Engineers was also discussed (end of November).

Bob Shaffer then discussed the technical aspects of the planned sampling at SWMU 6 including a discussion:

- Background information (presentation slides 5-7);
- Sampling strategy (presentation slides 8-11);
- Data quality objectives (presentation slides 12-13); and
- Project organizational chart (presentation slide 14).

EPA and VDEQ gave verbal approval to proceed with the fieldwork on the condition that the action items discussed below are incorporated into Work Plan Addendum #11.

Jim McKenna closed the meeting at 3:15 p.m.

Action Items to address EPA and VDEQ comments:

1. Verify SWMU boundaries (in particular southern boundary) shown on Work Plan figures by reviewing existing information at RFAAP (i.e., aerial photographs, maps, facility records, EPA RFA). EPA will be provided with supporting information used for this verification (e.g., copy of aerial photograph).
2. Revise Figure 1-5 in Work Plan to show footprint of proposed excavation relative to SWMU 6. If precise SWMU boundaries cannot be verified (see action item 1), then the proposed grid of 12 borings will be extended to provide coverage of excavation area.
3. Additional discussion will be added to the Work Plan regarding the method of composite sampling of overburden soils.
   a) The method of composite sampling in soil and sludge materials will be clarified.
   b) The VOC portion of a "composite" sample submitted for analysis will be collected from a single discrete interval. Encore samples will be collected from each four-foot interval of soil cored. PID screening and visual soil characteristics will be used to (1) select the location of the Encore samples within a given interval and (2) select the discrete sample to be submitted for VOC analysis.
4. Per the operational requirements of RFAAP, visual screening of overburden soils for NC will be conducted by RFAAP. Two samples of the overburden material will be provided to RFAAP for this screening. The Work Plan will be modified accordingly.
5. The Work Plan will be revised to indicate how material present below sludge layer(s) will be characterized and handled during excavation and disposal.
6. Up to two of the 12 composite samples of overburden will be re-positioned to sample the interval present above sludge material, if encountered. The Work Plan will be revised to indicate the revisions to the overburden sampling strategy.
7. Contingency language will be added to the Work Plan to discuss those actions that will be taken if design changes in the proposed construction project are made after completion of the soil investigation. Specifically, if the proposed excavation depth is increased from the current proposed maximum of 25 feet bgs, then additional soil samples will be collected from below the 25 foot depth, providing that the additional excavated material would consist of soil.
8. Reactivity tests for cyanide and sulfide will not be required and therefore, will be deleted from the Work Plan. These two tests will be replaced by a single reactivity test to be conducted by RFAAP. RFAAP will use its own method for determining soil reactivity, which assesses the percentage of explosive material. The Work Plan will be revised accordingly with specifications on the reactivity testing to be conducted at SWMU 6.
9. TCL pesticides/PCBs will be included in the analytical list for SWMU 6 per the requirements of EPA and VDEQ. The Work Plan will be modified accordingly.
10. At the request of EPA, Region III residential RBCs and SSLs (soil, for groundwater migration) will be used as screening benchmarks for SWMU 6 in addition to industrial RBCs specified in the Work Plan. At the request of EPA, a target HQ of 0.1 will be used for screening non-carcinogenic compounds. The Work Plan will be modified accordingly.

L-30

PACE Alliant U.S. Army
Team Radford

DELIVERY ORDER NO. 0018
ENVIRONMENTAL SERVICES
PROGRAM SUPPORT
CONTRACT DACA31-00-D-0011

# RADFORD ARMY AMMUNITION PLANT
# RADFORD, VIRGINIA

## MASTER WORK PLAN
## QUALITY ASSURANCE PLAN
## HEALTH AND SAFETY PLAN

## Addendum No. 11
## Soil Sampling and Reporting at SWMU 6

**FINAL DOCUMENT**

*November 2000*

URS
Dames & Moore

5540 Falmouth Street, Suite 201
Richmond, Virginia 23230
(804) 965-9000 and (804) 965-9764 fax

# EXECUTIVE SUMMARY

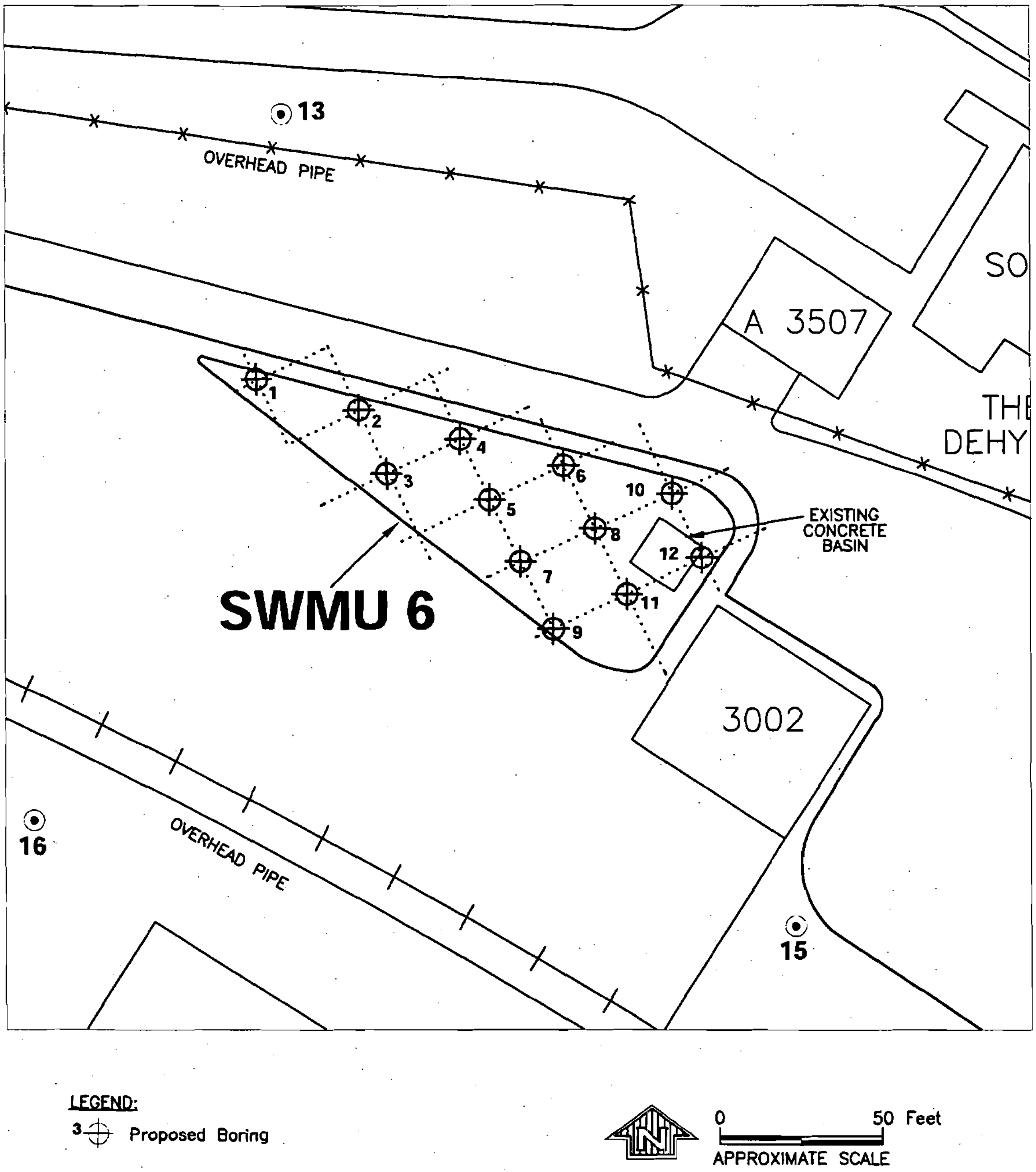
In accordance with Contract Number DACA31-00-D-0011, Delivery Order No. 0018, URS/Dames & Moore (URS) has been tasked by USACE, Baltimore District to perform soil sampling and reporting at Solid Waste Management Unit (SWMU) 6, Acid Wastewater Lagoon. SWMU 6 is located in the Main Manufacturing Area (MMA) at the Radford Army Ammunition Plant (RFAAP), Radford, Virginia. This effort is critical for the Production Base Support (PBS) project to construct nitrocellulose (NC) settling tanks in an area that includes SWMU 6. It will allow RFAAP to properly manage the excavated material during construction and to prevent future sampling under the tanks once the construction is complete.

The PBS project will require the excavation of soil within the area of SWMU 6 to a depth of 25 feet. Therefore, the objectives of the soil sampling and reporting at SWMU 6 are (1) to collect and chemically analyze subsurface soil samples from overburden soils; (2) to evaluate the data with respect to RCRA hazardous waste characteristics; and (3) to evaluate the data with respect to residual risk through comparison to USEPA Region III risk based concentrations (RBCs) and soil screening levels (SSLs).

To achieve these objectives, an evenly spaced distribution of 12 soil borings has been selected. This distribution will provide complete coverage of the SWMU area and allow for the collection of an appropriate number of samples to characterize soils within the SWMU 6. The following figure depicts the locations of the 12 soil borings. The borings will be advanced using the direct push (Geoprobe®) method of drilling.

Based on previous investigations conducted at SWMU 6, two different types of overburden material will likely be encountered in the borings: soil and sludge-like material. A representative composite sample will be collected from each material for RCRA hazardous waste characterization. The samples will be analyzed for complete TCLP, ignitability, reactivity (for percent explosive material), corrosivity, and paint filter. These data will be used to assess appropriate disposal method(s) for soils excavated during the planned construction. At locations where bedrock is less than 25 feet bgs, the depth of soil removal will likely be limited to the depth of bedrock

To evaluate the residual risk of soils that will remain in the SWMU after construction, a discrete sample will be collected at depth from each boring. The sample will be analyzed for target analyte list (TAL) metals, target compound list (TCL) VOCs, TCL SVOCs, TCL pesticides/aroclors, and explosives. These data will be compared with USEPA Region III RBCs and SSLs. The RBCs will be used to identify constituent concentrations that may require additional evaluation during a site-specific baseline risk assessment.



Radford Army Ammunition Plant (RFAAP)

Figure ES-1

Date/Drawing. No.

SWMU-6 Proposed Borings

Scale:

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## TABLE OF CONTENTS
## (Continued)

**FIGURES**

**TABLES**

**APPENDICES**

## LISTOF ACRONYMS AND ANTONYMS

| | |
|---|---|
| µ/L | Micrograms Per Liter |
| AR | Army Regulation |
| ARARs | Applicable Or Relevant And Appropriate Requirements |
| ATK | Alliant Techsystems, Inc. |
| BGS | Below Ground Surface |
| CFR | Code Of Federal Regulations |
| CVAA | Cold Vapor Atomic Absorption |
| DAF | Dilution-Attenuation Factor |
| DIUF | De-Ionized Ultra Filtered Water |
| DOD | Department Of Defense |
| DQO | Data Quality Objectives |
| ERIS | Environmental Restoration Information System |
| FPF | Field Parameter Form |
| GC/FID | Chromatograph/Flame Ionization Detector |
| GOCO | Government-Owned, Contractor-Operated |
| GPS | Global Positioning System |
| HAZCOM | OSHA Hazard Communication |
| HBN | Health Based Numbers |
| HSP | Health And Safety Plan |
| HSPA | Health And Safety Plan Addendum |
| HTRW | Hazardous, Toxic, Radioactive Waste |
| ICP | Inductively Coupled Plasma |
| IDM | Investigative-Derived Material |
| IRDMIS | Installation Restoration Data Management Information System |
| MHSP | Master Health And Safety Plan |
| MM&A | Marshall Miller & Associates |
| MMA | Main Manufacturing Area |
| MQAP | Master Quality Assurance Plan |
| MSDS | Material Safety Data Sheets |
| MSL | Mean Sea Level |
| MWP | RFAAP Master Work Plan |
| NC | Nitrocellulose |
| NRU | New River Unit |
| OSHA | Occupational Safety And Health Administration |
| PBS | Production Base Support |
| PID | Photoionization Detector |
| PPE | Personal Protective Equipment And Clothing |
| PQL | Practical Quantitation Limits |
| QA | Quality Assurance |
| QAP | Quality Assurance Plan |
| QAPA | Quality Assurance Plan Addendum |
| QC | Quality Control |
| RBC | Risk Based Criteria |
| RCRA | Resource Conservation And Recovery Act |
| RFAAP | Radford Army Ammunition Plant |
| SB | Soil Boring |
| SHSO | Site Health And Safety Officer |
| SOP | Standard Operating Procedures |
| SOQs | Statements Of Qualifications |
| SSL | Soil Screening Level |

## LISTOF ACRONYMS AND ANTONYMS
## (Continued)

| | |
|---|---|
| SWMU | Solid Waste Management Unit |
| TAL | Target Analyte List |
| TDS | Total Dissolved Solids |
| TOC | Total Organic Carbon |
| TOX | Total Organic Halogen |
| TSDF | Transportation, Storage And Disposal Facility |
| TWA | Time-Weighted Average |
| USACE | U.S. Army Corps of Engineers |
| USEPA | U.S. Environmental Protection Agency, Region III |
| UXO | Unexposed Ordnance |
| VAC | Virginia Administrative Code |
| VI | Verification Investigation Program |
| WPA | Work Plan Addendum |

# 1.0 WORK PLAN ADDENDUM

In accordance with Contract Number DACA31-00-D-0011, Delivery Order No. 0018., URS/Dames & Moore (URS) has been tasked by USACE, Baltimore District to perform Soil Sampling and Reporting at Solid Waste Management Unit (SWMU) 6, Acid Wastewater Lagoon, located in the Main Manufacturing Area (MMA) at the Radford Army Ammunition Plant (RFAAP), Radford, Virginia (Figure 1-1). The objective is to collect and analyze subsurface soil samples from SWMU 6 and perform an evaluation of the resultant data with respect to Resource Conservation and Recovery Act (RCRA) hazardous waste characteristics and U.S. Environmental Protection Agency, Region III (USEPA) Risk Based Concentrations (RBCs) and USEPA Region III soil screening levels (SSLs) for migration to groundwater.

## 1.1 OBJECTIVE AND SCOPE

The purpose of this site specific work plan addendum (Work Plan Addendum No. 11) is to provide the rationale and methods for the SWMU 6 Soil Sampling and Reporting. Work Plan Addendum No. 11 (WPA or Addendum) is written as an addendum to the RFAAP Master Work Plan (MWP) (ICF KE 1998) and comprises the following three sections, consistent with the MWP:

- Section 1, Work Plan;
- Section 2, Quality Assurance Plan (QAP); and
- Section 3, Health and Safety Plan (HSP).

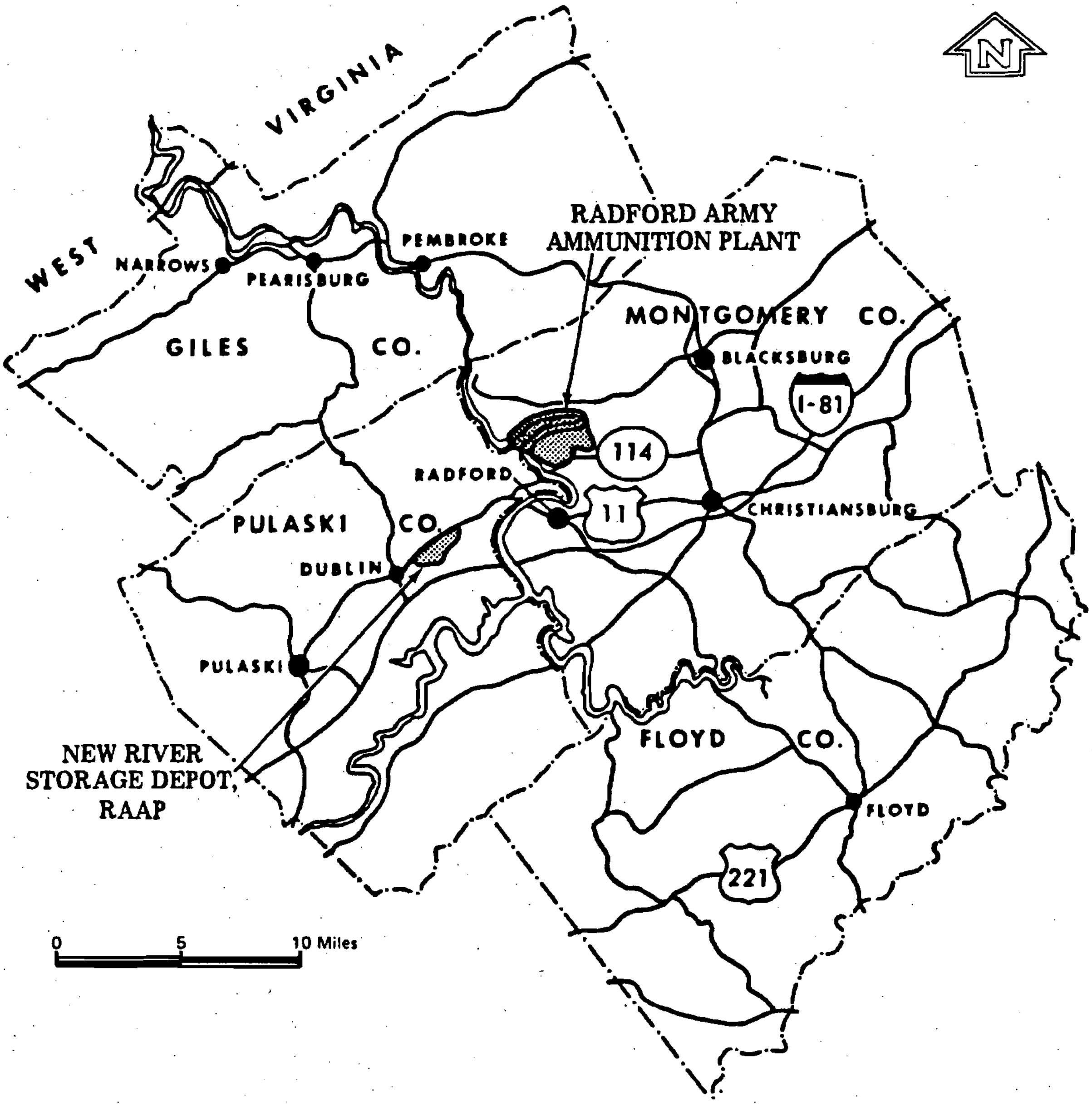
This Addendum specifically addresses sections and Standard Operating Procedures (SOPs) contained in the MWP. The MWP will be maintained onsite and referenced during field activities.

USACE, USEPA, and RFAAP have approved the MWP as RFAAP's work plan for performing routine investigative activities. Investigative activities that will be performed as specified in the MWP are listed in Table 1-1. The investigative activities conducted as part of this effort will be conducted in accordance with the MWP and the SOPs contained therein. Copies of the SOPs are included in Appendix A.

Changes to the approved WPA will be documented using the Work Plan Revision Form (Form 1-1). Revisions must be reviewed and approved by USACE and RFAAP prior to implementation.

Project personnel will be required to read this addendum and to sign and date a Worker Acknowledgement Form (Form 1-2). The Site Health and Safety Officer (SHSO) will retain this form onsite during investigation activities.

4



Radford Army Ammunition Plant (RFAAP)

| Figure 1-1 | Date/Dwg. No. |
|---|---|
| Vicinity Map | Scale: |

URS Dames & Moore

5540 Falmouth Street, Suite 201
Richmond, Virginia 23230

## Table 1-1
## Applicable MWP Activities and Related SOPs
## SWMU 6 Soil Sampling
## Radford Army Ammunition Plant, Radford, Virginia

| Subject | MWP Section | Standard Operating Procedures [SOP(s)] MWP Appendix A |
|---|---|---|
| Installation Description | 2.0 | N/A |
| Environmental Setting | 3.0 | N/A |
| Documentation | 4.3 | 10.1 Field Logbook<br>10.2 Sample Logbook<br>10.3 Boring Logs<br>10.4 Chain-of-Custody |
| Subsurface Investigation | 5.0 | 20.2 Boring Abandonment<br>20.6 Stratigraphic Characterization |
| Soil Sampling | NA | 30.1 Soil Sampling<br>30.6 Containerized Material<br>VOC003 VOC sample collection using Disposable Encore® sampler. |
| Sample Management | 5.1 | 50.1 Sample Labels<br>50.2 Packaging<br>50.3 Preservation & Containers Requirements |
| Decontamination Requirements | 5.13 | 80.1 Decontamination |
| Investigative-Derived Material (IDM) | 5.14 | 70.1 IDM |
| Air Monitoring (PID – 101) | | 90.1 PID (HNu) |

# Form 1-1
# Work Plan Revision Form
# Work Plan – Quality Assurance Plan – Health and Safety Plan Addendum
# SWMU 6 Soil Investigation
# Radford Army Ammunition Plant, Radford, Virginia

SITE DESIGNATION/LOCATION:

Radford Army Ammunition Plant

Radford, VA

Section: ______________________________

Addendum: ____________________________

Version: ______________________________

Effective Date: __________________________

SUBJECT:

Approved by:

Field Operations Leader

______________________________________

Date: _______________________________

Concurrence:

Project Manager

______________________________________

Date _______________________________

Sheet _____ of _____

# Form 1-2
# Worker Acknowledgement Form
# SWMU 6 Soil Investigation
# Radford Army Ammunition Plant, Radford, Virginia

| | |
|---|---|
| Document: | Master Work Plan/QAP/HSP and Addendum 011 |
| Version: | Draft |
| Project: | Radford Army Ammunition Plant |
| Location: | Main Manufacturing Area, SWMU6 |

Prior to the initiation of field activities, I have been given an opportunity to read and question the contents of this Master Work Plan/QAP/HSP, this Site-Specific Addendum, and approved revisions through the number listed above. With my signature, I certify that I have read, understood, and agree to comply with the information and directions set forth in these plans. I further certify that I am in full compliance with 20 CFR 1910.120 in regard to training and medical monitoring requirements.

Site Personnel:

Name (please print) Signature Date

### 1.1.1 Investigation Overview

The objectives of the soil sampling and reporting at SWMU 6 are -- (1) to collect and chemically analyze composite and discrete subsurface soil samples from overburden soils; (2) to perform an evaluation of the data with respect to RCRA hazardous waste characteristics; and (3) to provide data that can be used to evaluate residual risk through comparison to USEPA Region III RBCs (residential and industrial) and USEPA Region III SSLs. This is necessary to properly manage excavated soils that will be generated as part of the Production Base Support (PBS) project to construct nitrocellulose (NC) settling tanks at SWMU 6. The planned depth of excavation is 25 feet. Primary components associated with achieving these objectives include – (1) assessing the appropriate intermediate depths from which to collect the composite samples; (2) designing a sampling strategy that will ensure the collection of representative samples from SWMU 6; and (3) ensuring the resultant information can be relied upon by RFAAP in making decisions regarding the site.

Appropriate health and safety precautions must be taken due to the potential handling of hazardous materials, energetics, or their degradation compounds. Additionally, the project location has active overhead piping that is transporting highly acidic and explosive material; therefore, appropriate precaution and coordination is required with both government and operating contractor safety personnel.

The investigation program focuses on obtaining data to allow for the project objectives to be achieved. The program articulates project objectives, assumptions, and data use specifications. Program elements include:

- **Site Characteristics:** A site description of SWMU 6 is included in this document. A discussion of previous investigations at SWMU is also provided.
- **Sampling Program:** A site investigation will be performed to collect representative samples from SWMU 6 and achieve project Data Quality Objectives (DQOs). The sampling program presented for this investigation has been structured to meet DQOs.
- **Quality Assurance/Quality Control (QA/QC):** Independent quality control (QC) checks are used to demonstrate investigation and laboratory accuracy, precision, and integrity. Section 2.0 of this addendum establishes requirements for documentation, data collection and reporting, management and tracking of electronic and hard copy data, and presentation format. The Quality Assurance Plan Addendum (QAPA) provides assurance that data of known and documented quality is generated to allow the Department of Defense (DOD) to make accurate characterizations and evaluations of SWMU 6 per the Project Objectives.
- **Health and Safety:** Site-specific training, personal protective equipment and clothing (PPE), and applicable monitoring requirements are presented in Section 3.0 of this WPA. These procedures were developed to provide the requirements for protection of site personnel, including government employees, regulators, contractors, and visitors, who are expected to be involved with site activities.

## 1.2 INSTALLATION DESCRIPTION AND SITE CHARACTERISTICS

RFAAP is a government-owned, contractor-operated (GOCO) industrial complex located in Radford, Virginia. It is owned by the U.S. Department of the Army and was operated under contract with Hercules, Inc., from 1941 until 1995 when Alliant Techsystems, Inc. (ATK), became the operating contractor. The installation consists of two noncontiguous areas: the Main Manufacturing Area (MMA) and the New River Unit (NRU). Site activities will be conducted in the MMA of RFAAP.

The MMA contains approximately 1,969 buildings and occupies 6,900 acres. Facility activities include the manufacturing of solid propellants used in small arms, anti-aircraft and anti-tank weapons, rockets, torpedoes, missile systems, igniters, gas generators, and related items.

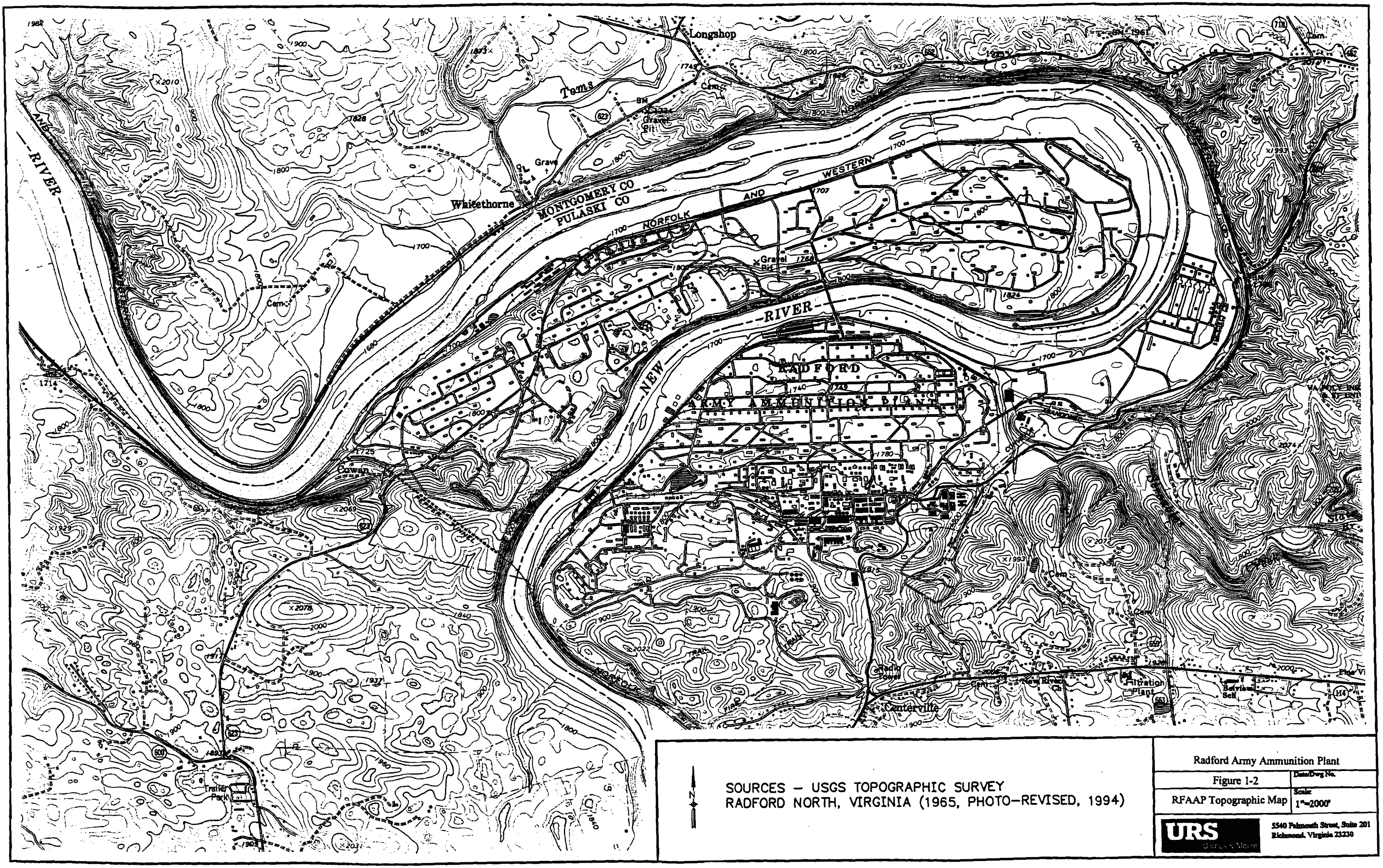
The Acidic Wastewater Lagoon (SWMU 6) was historically used as an unlined surface impoundment. It is located approximately 2,000 feet northwest of the administration area. The lagoon was described in previous investigation reports as "tear-dropped" or "triangular" in shape. The boundaries of SWMU 6 were determined by reviewing aerial photographs of RFAAP for the period 1937 through 1986. SWMU 6 was first detected in photography from 1975 and was visible in later photographs from 1981 and 1986. The appearance of the SWMU 6 did not change on the photographs in which it was visible. A copy of the 1986 aerial photograph, which shows the location and boundary of SWMU 6, is provided in Attachment B.

From 1974 to 1980, the lagoon received overflows and rinse waters from an acid storage tank area in the C-Line NC manufacturing area. During its active life, SWMU 6 received wastewaters that typically exhibited the characteristic of a corrosive liquid (RCRA hazardous waste characteristic code D002). There were no overflow controls at the lagoon.

Between 1980 and 1987, the C-Line NC manufacturing area was shut down and no wastewaters were introduced to the lagoon. In 1987, the lagoon was filled with soil and replaced by a stormwater holding tank, which discharges to the C-Line Waste Acid Treatment Plant, Building 420-2.

### 1.2.1 Location

The RFAAP MMA is located approximately 10 miles west of Blacksburg and 47 miles southwest of Roanoke (Figure 1-1). It lies in one of a series of narrow valleys typical of the Appalachian Mountain region. The valley is oriented in a northeast-southwest direction, and is approximately 25 miles long, 8 miles wide at the southwest end, narrowing to 2 miles at its northeast end. The facility is situated along the New River in the relatively narrow northwest region of the valley and is divided into northern and southern areas. The northern half or "Horseshoe Area" is located within a meander of New River. The southern area is principally used for the manufacture of single- and multi-base propellants. SWMU 6 is located in the MMA, approximately 2,000 feet northwest of the administration area (Figure 1-2).



SOURCES – USGS TOPOGRAPHIC SURVEY
RADFORD NORTH, VIRGINIA (1965, PHOTO-REVISED, 1994)

| Radford Army Ammunition Plant | |
|---|---|
| Figure 1-2 | Date/Dwg No. |
| RFAAP Topographic Map | Scale:<br>1"=2000' |

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Richmond, Virginia 23230

### 1.2.2 Environmental Setting

The site-wide environmental setting is presented in Section 3.0 of the MWP. Project specific physiography is presented below.

SWMU 6 is a flat level area; approximately 1,800 feet above mean sea level (msl), located between two upland ridges. To the north, the ridge rises approximately six feet; there are asphalt roads and buildings located on this ridge. The ridge to the south rises approximately 10 feet, where railroad tracks and an asphalt road are present. SWMU 6 is located in the middle of an industrial area with numerous buildings, overhead pipes, railroad tracks, and asphalt roads. The area is level with adjacent areas and covered with grass. Figure 1-3 shows the location of SWMU 6 and its boundaries as determined for the Verification Investigation (VI) conducted at SWMU 6 in 1991 and 1992 (Dames & Moore, 1992).

Based on topography, surface water runoff from these upland ridges on the northern and southern sides of the SWMU is expected to flow into the SWMU 6 area. The surface runoff within SWMU 6 likely flows into storm water catch basins that are located on the northeast and southeast ends of the SWMU.

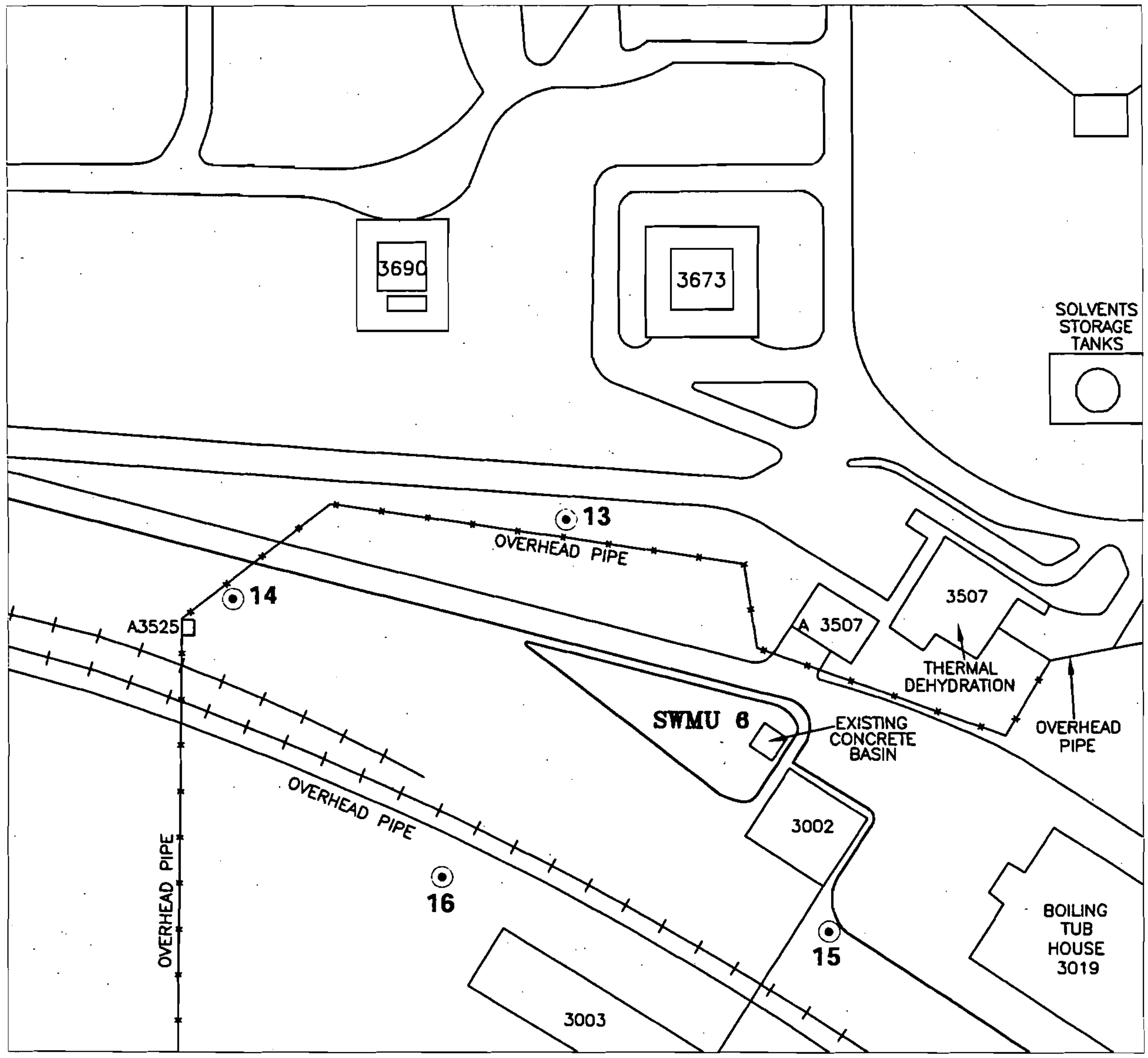
### 1.2.3 Geology

Sitewide and regional geology are presented in Sections 3.5 and 3.6 of the MWP. Project specific geology is presented below.

RFAAP exhibits prominent karstic features, including sinkholes, caves, and caverns. Karst landforms occur in carbonate rock formations as the result of the dissolution of rock by naturally occurring carbonic acid in rainwater. As the rock is dissolved, cavities or caverns are formed beneath the earth's surface. Occasionally, large caverns collapse, producing a depression or sinkhole on the surface. Numerous sinkholes are apparent along the western and southern boundaries of the facility.

SWMU 6 is suspected to occupy a collapsed sinkhole. Previous investigations in SWMU 6 (USAEHA, 1981) identified the presence of subsurface cavities during the drilling and installation of four monitoring wells. In addition, a geophysical survey investigation conducted at SWMU 6 in 1984 (USACE, 1984) indicated the presence of a soil horizon at 17.6 feet below the ground surface (bgs). This horizon was interpreted as a lithologic change in the overburden. A break in the profile was interpreted as a possible collapsed sinkhole. The suspected presence of a sinkhole is also supported by a reported history of collapses and subsidences of road and foundations near the former lagoon (Dames & Moore, 1992).

According to previous studies, the subsurface conditions encountered in the vicinity of SWMU 6 consisted of a reddish-brown silty clay extending in each boring to bedrock or borehole termination. These residual deposits (clays and silts) are a result of chemical and physical weathering of the parent bedrock, which is composed primarily of Elbrook dolomite. The depth to the Elbrook Formation bedrock ranges from 21 feet to greater than 45 feet.



LEGEND:

● Existing Monitoring Well/Boring

0 100 Feet
APPROXIMATE SCALE

Radford Army Ammunition Plant (RFAAP)

Figure 1–3

Date/Drawing. No.

SWMU 6
Acidic Wastewater Lagoon

Scale:

URS
Dames & Moore

5540 Falmouth Street, Suite 201
Richmond, Virginia 23230

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## 1.3 BACKGROUND INFORMATION (From VI Report, Dames & Moore, 1992)

SWMU 6 was used from 1974 to 1980 as an unlined surface impoundment that received overflow and rinse waters from an acid storage tank area in the C-Line NC manufacturing area.

Between 1980 and 1987, the C-Line NC manufacturing area was shut down and no wastewater was introduced to the lagoon. In 1987, the lagoon was filled with soil and replaced by a holding tank, for storm water prior to its discharge to the C-Line Waste Acid Treatment Plant, Building 420-2.

In 1981, four monitoring wells (MW13, MW14, MW15 and MW16) were installed at the unit as part of a U.S. Army Pollution Abatement Study at SWMUs 4, 5, 6 and 7 (USAEHA, 1981). Well locations are shown in Figure 1-3.

Three of these wells (MW14, MW15 and MW16) could not be sampled after installation because no groundwater was present after well development. Sampling of MW13 indicated detectable groundwater concentrations of sulfate, sodium, manganese, zinc, nitrate, and total dissolved solids (TDS). The high conductivity of the sample from MW13 indicated potential groundwater contamination. Later sampling of MW14 and MW15 indicated the presence of acetone at concentrations of 7 and 27 micrograms per liter (μ/L) respectively (BCM, 1984). However, acetone is a typical laboratory cleaning agent. The groundwater table apparently rose to intersect the well screens of MW14 and MW15. Well MW16 was terminated at a very shallow depth and may have been installed permanently above the unconfined water table.

Verification Investigation (VI) (Dames & Moore, 1992), sampling was conducted at SWMU 6 to assess whether soil contamination existed from acidic wastewater that was formerly discharged to the lagoon. Two boreholes (6SB1 and 6SB2) were drilled at this SWMU (Figure 1-4). Boring 6SB1 was drilled to a depth of 21.0 feet bgs in what was thought to likely be the deepest part of the lagoon, which would have contained wastewater over the longest period. No apparent zone of contamination was observed. Two samples were collected from this boring for chemical analysis at depths of 18.0 feet and 20.5 feet bgs and were analyzed for metals and pH.

Boring 6SB2 was drilled to a depth of 22.9 feet bgs in what was thought to be a shallower section of the lagoon. However, Boring 6SB2 was one foot deeper than boring 6SB1, and showed indications of sludge material from 14.0 feet to 20.0 feet. Two samples were collected from this boring for chemical analysis, 6SB2A and 6SB2B, at depths of 14.0 and 22.0 feet bgs, respectively, and were analyzed for metals and pH.

During the VI, a groundwater sample was collected from MW 13 and analyzed for metals, pH, Total Organic Carbon (TOC), and Total Organic Halogen (TOX). MW 14, 15, and 16 were dry and could not be sampled.

No new monitoring wells were installed at SWMU 6 due to the karst terrain and the uncertainty that wells would actually intercept groundwater flowing beneath the former lagoon area. The suspected sinkhole occupied by the lagoon makes the investigation of groundwater extremely difficult. Installation of additional wells at this location was not considered to be appropriate.

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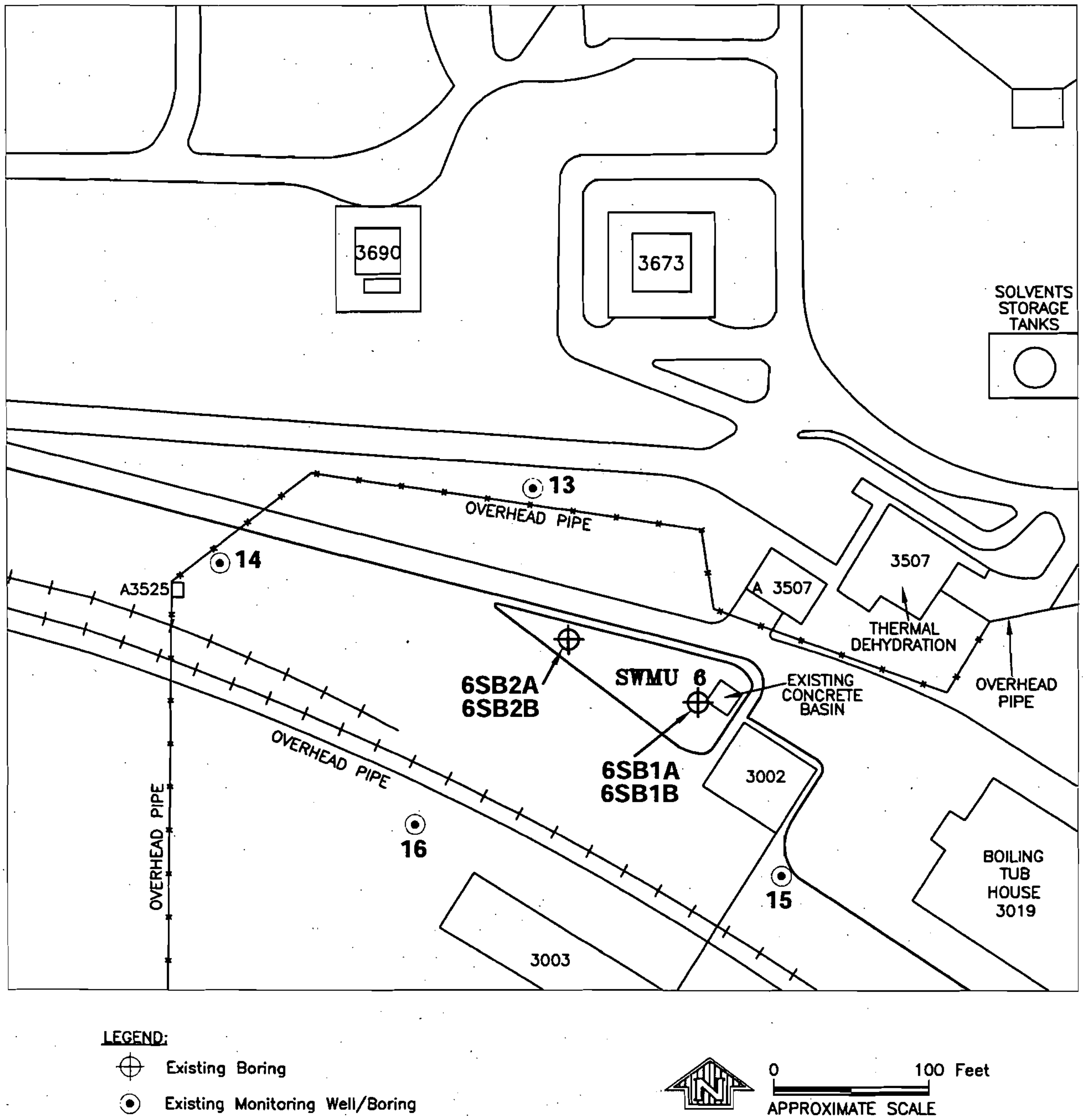

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| Radford Army Ammunition Plant (RFAAP) | |
|---|---|
| Figure 1-4 | Date/Drawing. No. |
| Location of Borings<br>6SB1 and 6SB2 | Scale: |
| URS<br>Dames & Moore | 5540 Falmouth Street, Suite 201<br>Richmond, Virginia 23230 |

In total, 19 metals were detected in the four soil samples collected from the former wastewater lagoon. The sample data were compared to Health Based Numbers (HBNs), which were set forth in the installation's first RCRA permit, which was issued in 1989, as well as Practical Quantitation Limits (PQLs) for site evaluation. Soil sample concentrations of arsenic and cobalt exceeded the HBN criteria. However, these elements were less than the apparent soil background criteria and represent concentrations expected to be in native alluvial soil. Arsenic was also detected at less than the PQL. Concentrations of other metals, such as chromium and vanadium, were greater than the alluvial soil background criteria, but the detected concentrations were below applicable HBNs. Thallium in one sample exceeded the soil HBN criterion in the duplicate analysis of 6SB1, but the concentration was less than the PQL. Thallium was detected in only one sample. No other metal concentration exceeded HBN criteria.

Six metals were detected in one groundwater sample collected from MW13. Chromium was detected in the groundwater sample collected from MW13 at a concentration below the PQL as well as below the HBN. TOC and TOX concentrations for MW13 were 1,400 μg/L and 53.7 μg/L respectively.

## 1.4 SAMPLING PROGRAM

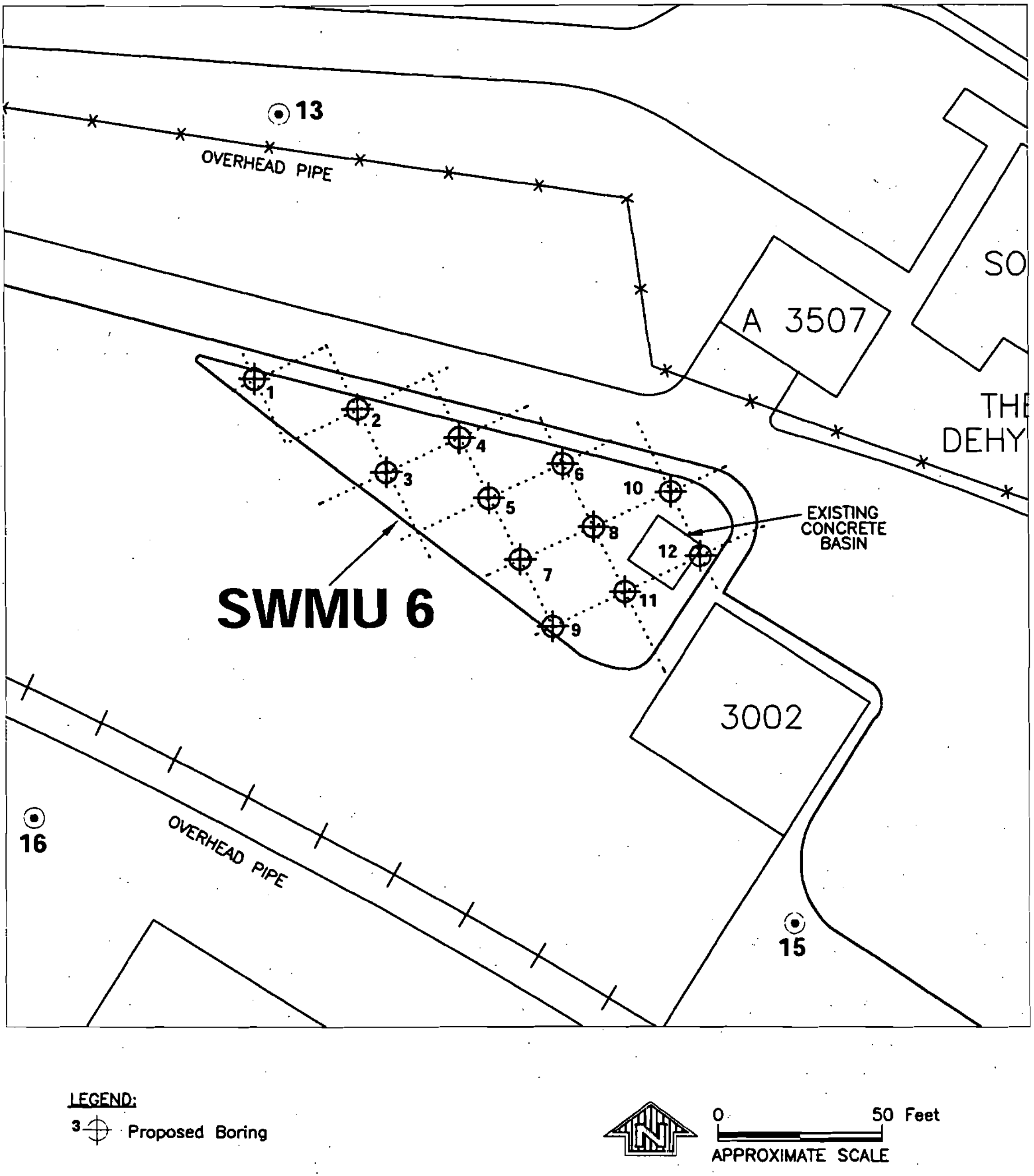
The purpose of the SWMU 6 sampling program is to collect representative composite samples of the overburden soils, as well as to collect representative discrete samples of the soil at depth (25-feet bgs or at probe refusal). Figure 1-5 shows the proposed boring locations. In selecting the locations of subsurface soil samples to be collected, consideration was given to the size and shape of SWMU 6, as well as the overall project objective of evaluating the overburden soils relative to RCRA waste characteristics and providing the information necessary for evaluating the soils at depth relative to USEPA Region III RBCs (residential and industrial) and USEPA Region III SSLs.

Reference is made to the RFAAP MWP where routine activities will be performed in accordance with the MWP specifications. Variances to the specifications will be documented in this WPA.

Components of the investigation will include subsurface soil sampling and sample collection by direct push technology (Geoprobe®) methods, boring abandonment, stratigraphic logging of the soil borings, sample management, field screening using a portable photoionization detector (PID), field documentation, laboratory analysis, quality assurance practices, and evaluation of the data relative to RCRA hazardous waste characteristics and USEPA Region III RBCs (residential and industrial) and USEPA Region III SSLs. Investigation activities will be conducted in accordance with the Standard Operating Procedures (SOPs) in the MWP and in accordance with the Health and Safety Plan. Table 1-1 identifies the applicable SOPs that will be followed as part of the investigation.

### 1.4.1 Sampling Strategy and Chemical Analyses

Several factors were considered in selecting the type and location of the soil samples to be collected from SWMU 6 including: the size and shape of SWMU 6; subsurface data collected from the SWMU during the VI; and the project objectives (see Section 1.4). The following sections discuss the specific elements and rationale of the sampling program to be conducted at SWMU 6.



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| | |
|---|---|
| Radford Army Ammunition Plant (RFAAP) | |
| Figure 1-5 | Date/Drawing. No. |
| SWMU-6 Proposed Borings | Scale: |
| URS<br>Dames & Moore | 5540 Falmouth Street, Suite 201<br>Richmond, Virginia 23230 |

### *1.4.1.1 Composite Sampling*

One objective of the sampling program at SWMU 6 is to evaluate subsurface soil with respect to hazardous waste characteristics. The RCRA hazardous waste characterization data will be used to assess appropriate disposal method(s) for soils excavated during the planned construction. This evaluation will be for soils to be excavated from SWMU 6 during the PBS project; the construction plan will require the excavation of soil to a depth of 25 feet bgs. At locations where bedrock is less than 25 feet bgs, then the depth of soil removal will likely be limited to the depth of bedrock.

Composite samples rather than discrete samples will be used to characterize in-place soils to a depth up to 25 feet bgs. The rationale for using composite sampling is that it will provide a more appropriate characterization of a given volume of soil than discrete sampling; particularly when that volume of soil will be excavated and handled as fill, cover or waste depending on analytical results.

Information on the location, number of composite samples, and chemical analyses to be performed is presented in the Section 1.4.1.4.

### *1.4.1.2 Discrete Sampling*

A second objective of the sampling program at SWMU 6 is to evaluate the residual risk of soils that will remain in the SWMU at depth after excavation of the soil overburden for purposes of construction. Residual soil would be defined as the soil remaining in-place below the depth of the excavation, which in this case, would be those soils present at a minimal depth of 25 feet.

Discrete samples will be used to characterize soils that will remain in place in SWMU 6 after the construction project is completed. The rationale for using discrete sampling is that point concentrations from specific locations and depths will be required to conduct the residual risk analysis.

Information on the location, number of discrete samples, and chemical analyses to be performed is presented in Section 1.4.1.5.

### *1.4.1.3 Boring Locations*

Given the project objectives, which will require the collection of soil samples at depth, soil borings will be advanced at SWMU 6 to obtain the required data. Existing data from the soil borings drilled at SWMU 6 for the VI indicated unconsolidated soils present to a depth of 21 to 23 feet bgs overlying bedrock. Review of the subsurface data from SWMU 6 indicates that direct push technology (Geoprobe®) is appropriate for advancing the soil borings and collecting the soil samples. Therefore, soil borings will be advanced using the direct push technology, in accordance with the procedures outlined in Section 5.2.4 of the MWP. A four-foot Macro-Core® device will be used to collect the samples. Stratigraphic logs will be prepared for each boring location in accordance with the procedures outlined in SOP 20 in the MWP. During drilling, subsurface soil samples will be screened for the presence of organic compounds using a PID in accordance with SOP 90.1 in the MWP.

The number of boring locations should be sufficient to provide an appropriate number of samples to (1) characterize the volume of soil that will be excavated from SWMU 6; and (2) evaluate the residual risk, if any, of soil that will remain at depth. Given the objectives of the sampling program and the planned excavation of a significant portion of SWMU 6 area, an evenly spaced distribution of 12 soil borings has been selected within the SWMU. This distribution will provide complete coverage of the SWMU area and allow for the collection of an appropriate number of samples to characterize soils within the SWMU 6. Figure 1-5 shows the locations of the 12 soil borings, which have been selected to provide samples at intervals of 20 feet or less along the length of the SWMU and 20 feet or less across the SWMU. Table 1-2 presents sample identification to be used for this project. Figure 1-6 shows the proposed location of the NC settling tanks relative to SWMU 6.

The number and type of samples to be collected from each boring are discussed in the following sections along with a summary of the associated analytical program.

### *1.4.1.4 Composite Sampling and Analysis for Hazardous Waste Characteristics*

The stratigraphic data from the VI borings indicate that two different types of overburden material may be present at SWMU 6 and thus, both of these materials may be encountered in the one or more of the twelve soil borings. One type of material that will be encountered in the borings is soil, which was reported to be present in one VI boring (6B1) to the depth explored. Soil was also encountered in the other VI boring (6B2) from the ground surface to a depth of 14 feet bgs and at a depth below 20 feet bgs. A second type of material that may be encountered in one or more borings is a layer of sludge/waste type of material. The second of two VI borings completed at SWMU 6 (6SB2) was reported to have a layer of sludge/waste type of material present at a depth of 14 to 20 feet bgs.

Considering that two different types of material may be present in SWMU 6, the strategy for composite sampling will be to collect representative samples of each material. At boring locations where only soil material is encountered to the depths explored, only one composite sample will be collected. This sample will be a composite of the entire interval of overburden soil penetrated in the boring; sub-composites from each of the four foot Macro-Core samples will be used to assemble a composite of the entire boring. Each sub-composite sample will be assembled in a stainless steel bowl from discrete six inch segments at each end of the core and one six inch segment from the middle of the core. After placement of the materials in a stainless steel bowl, each sub-composite sample will be thoroughly homogenized with stainless steel utensils to provide for a representative composite sample. Aliquots of each interval sub-composited will be placed into a large stainless bowl or pan and thoroughly homogenized to create a representative composite sample of the entire boring interval.

At boring locations where both soil material and sludge/waste type of material is encountered, then two composite samples will be collected. One composite sample of the entire interval of soil material present above the sludge or waste type of material (i.e., fill) will be collected. A second composite sample will be collected from the entire interval(s) of sludge or waste material encountered. The method of composite sampling for each of these composite samples will be the same as that described above; this recognizes that the composite samples (and associated sub-composites) will be collected only from the interval(s) containing the targeted material. In the case where the targeted material is four feet or less in thickness, then the composite sample will be collected from the entire interval of material.

## Table 1-2
## Sample Identification Convention
## SWMU 6 Soil Investigation
## Radford Army Ammunition Plant, Radford, Virginia

| Boring Location # | Sample Designation * | Overburden Characterization | Residual Risk Screening |
|---|---|---|---|
| 1 | 6SB3A | X | |
| | 6SB3B | | X |
| 2 | 6SB4A | X | |
| | 6SB4B | | X |
| 3 | 6SB5A | X | |
| | 6SB5B | | X |
| 4 | 6SB6A | X | |
| | 6SB6B | | X |
| 5 | 6SB7A | X | |
| | 6SB7B | | X |
| 6 | 6SB8A | X | |
| | 6SB8B | | X |
| 7 | 6SB9A | X | |
| | 6SB9B | | X |
| 8 | 6SB10A | X | |
| | 6SB10B | | X |
| 9 | 6SB11A | X | |
| | 6SB11B | | X |
| 10 | 6SB12A | X | |
| | 6SB12B | | X |
| 11 | 6SB13A | X | |
| | 6SB13B | | X |
| 12 | 6SB14A | X | |
| | 6SB14B | | X |

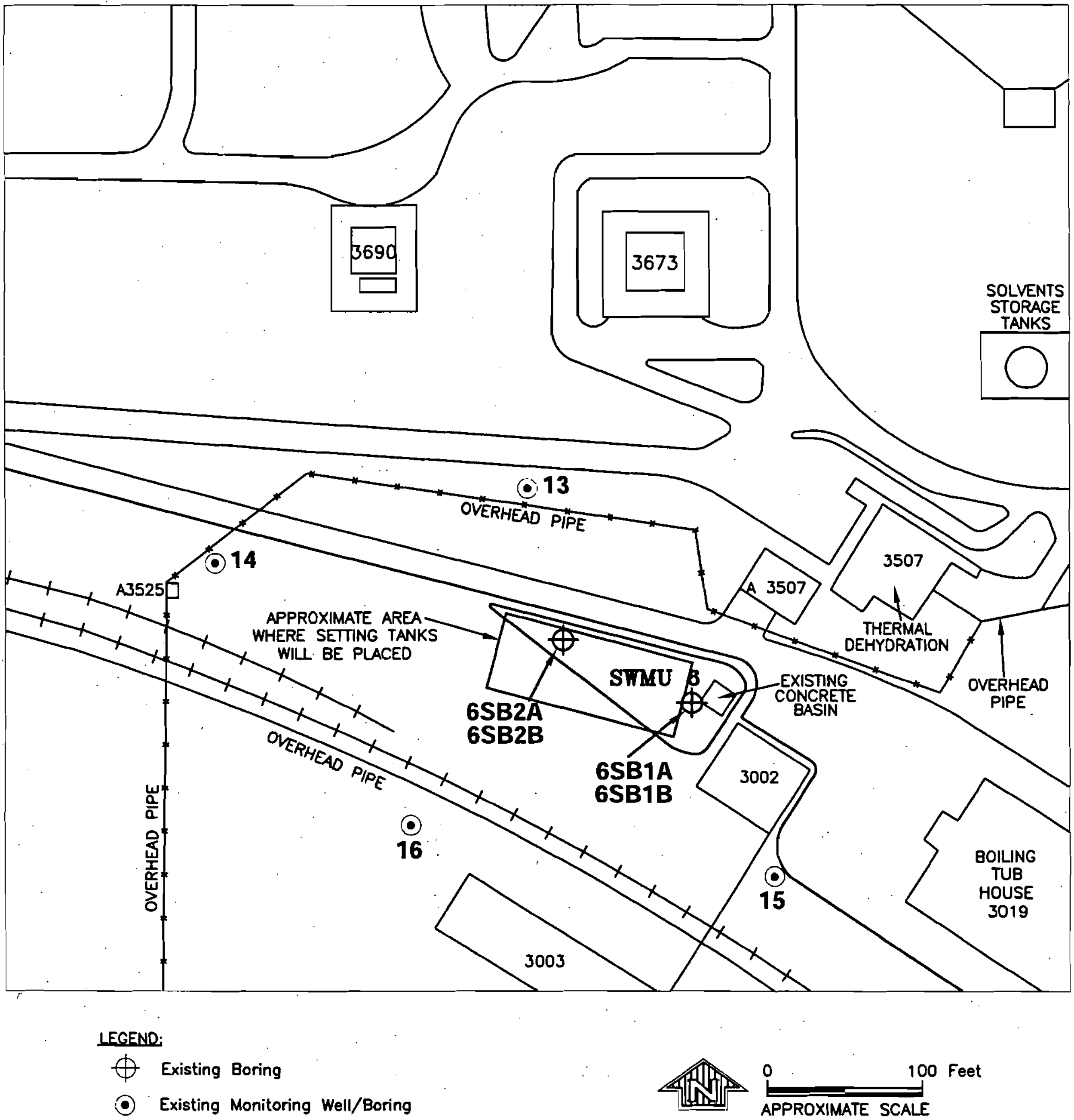
| | |
|---|---|
| Number of Overburden Characterization Samples (Composite) | 12 |
| Number of Residual Risk Samples (Discrete) | 12 |
| Total Number of Samples | 24 |

Sample Designation <u>Convention</u>
SB: Soil Boring
A: Composite overburden sample
B: Discrete residual risk sample at depth

Overburden Characterization <u>Analytes</u>
Full TCLP
Ignitability
Corrosivity
Reactivity (percent of explosive material)
Paint Filter

Residual Risk <u>Screening</u>
TAL Metals
TCL SVOCs
TCL VOCs
TCL Pesticides/ Aroclors
Explosives

* Continuation of Sample Designation convention from the Verification Investigation (VI) Report, Dames & Moore, 1992.



Radford Army Ammunition Plant (RFAAP)

Figure 1–6

Approximate Area Where
Setting Tanks Will Be Placed

Date/Drawing. No.

Scale:

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Richmond, Virginia 23230

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Given the expected depth and thickness of any sludge or waste layer(s) and the planned discrete sampling at the boring termination depth, a composite sample will not be collected of any soil interval present below a sludge/waste layer. Recognizing the difficulty in separating excavation materials at depth, any soil material present below the sludge material will be managed in the same manner as the overlying sludge/waste. Discrete sampling data from a boring may be used to help characterize soils at depth below the sludge layer; particularly if the bottom of the sludge/waste layer(s) is within four vertical feet (length of a single sample core) of the discrete sample.

Each of the "composite" samples submitted to the laboratory will require a full TCLP analysis including volatile organic compounds (VOCs). Since VOC samples may not be composited, a discrete sample for VOC samples will be collected for each composite sample. A discrete sample for potential VOC analysis will be collected from each of the four-foot core intervals associated with a given composite sample. PID screening will be used to select the VOC sample from a given four-foot interval, with the discrete sample collected from the point having the highest reading. The discrete sample that is associated with the highest PID reading for a given series of four-foot intervals composited will be submitted for VOC analysis. VOC samples subjected to TCLP analysis will not be collected using disposable Encore® sampler. The TCLPs method does not specify use of Encore® sample; rather a leaching procedure (method 1311) is used to create a liquid extract, which is in turn is analyzed for VOCs. The method of sampling to be used for TCLP VOC analysis consists of placing the sample in appropriate sample containers with zero headspace (SOP 30.1).

Twelve representative composite samples, which have been collected from the borings, will be submitted for analysis of hazardous waste characteristics per RCRA standards. Each of these samples will be analyzed for complete TCLP analysis and ignitability, corrosivity, and paint filter tests according to SW 846 Method protocols. Reactivity tests will not be required for cyanide or sulfide based on the material characteristics. Instead of these types of reactivity tests, RFAAP will determine the reactivity of the overburden soils using its own visual screening method, which determines the percentage of explosive material. In general, the material will be classified as non-reactive if its percentage of explosive material is 10 percent or less. Two composite samples of overburden material will be provided to RFAAP for evaluation of reactivity.

Table 1-3 presents a summary of the analytical methods used for hazardous waste characterization. Two duplicate samples will also be collected for analysis per the QA/QC requirements of the MWP. Table 1-4 presents a summary of the field QC samples that will be collected for the SWMU 6 investigation and the QA/QC requirements of the MWP. Table 1-5 presents a summary of the appropriate sample containment, preservation, and holding times.

Of the twelve composite samples to be submitted for analysis, up to six of these samples will be of the sludge/waste material (rate of one per boring up to six borings). If sludge/waste material is encountered in more than six borings, then six samples will be submitted from boring locations that provide the most complete geographic coverage of SWMU 6. The remaining composite samples submitted for analysis will be those that are associated with soil material. This includes up two composite samples from the interval above the sludge/waste layer(s); the remaining composite samples for analysis will be submitted from the borings where only soil material was encountered. Each of the composite samples of soil material will be selected from different borings to provide the most complete geographic coverage of SWMU 6.

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#### *1.4.1.5 Discrete Sampling and Analysis for Evaluation of Residual Risk*

In addition to a composite sample, one discrete soil sample will be collected from each of the 12 soil borings for chemical analysis. Each discrete sample will be collected from the termination depth of the associated boring. The planned depth for sample collection is 25 feet bgs; however, the actual depth may vary if bedrock is encountered at a depth less than 25 feet bgs. In the case where bedrock is encountered at a shallower depth, the discrete sample at a given location will be collected from a depth immediately above the depth of bedrock.

If the proposed depth of excavation associated with PBS project is increased from the current proposed maximum of 25 feet bgs, then additional discrete soil samples will be collected from below the 25 foot depth, providing that the additional excavated material would consist of soil.

Each of the 12 discrete samples will be analyzed for the following compounds by SW 846 Methods: (1) target compound list (TCL) VOCs; (2) TCL semivolatile organic compounds; (3) TCL pesticides/aroclors; (4) target analyte list (TAL), metals and (5) explosives. Table 1-3 presents a summary of these analytical methods. The rationale for selecting this expanded list of parameters for analysis is to provide for a more complete evaluation of potential residual risks at SWMU 6, as discussed in Section 1.7. Field QA/QC samples including two duplicate samples, three trip blank samples, and three rinse blank (equipment blank samples) will also be collected per the requirements of the MWP. Table 1-4 presents a summary of the field QC samples that will be collected for the SWMU 6 investigation and the QA/QC requirements of the MWP. Table 1-5 presents a summary of the appropriate sample containment, preservation and holding times.

Samples for TCL VOCs will be collected at the targeted depth using a disposable Encore® sampling device following SOP #V003 provided in Appendix A. The sample for VOC analyses will be collected from the portion of the targeted sample interval having the highest PID reading as measured during initial sample screening (SOP 30.1).

### 1.4.2 Drilling Program

The direct push method of drilling will be used to obtain the subsurface soil samples at SWMU 6. When subsurface conditions allow for the use of direct push technology, the Geoprobe® method of drilling and sample acquisition can result in quicker mobilization and set-up, less decontamination time, generation of less Investigative-Derived Material (IDM) (soil cuttings and decontamination water), faster drilling/higher productivity, greater accessibility in areas where overhead hazards are a concern, and less costly boring abandonment procedures.

Based on existing information obtained from previous drilling within SWMU 6, the overburden soils are silty clays; a significant amount of gravel or other conditions, which could potentially limit the effectiveness of the direct push technology, were not reported. Geoprobe® sampling will be conducted by URS/Dames & Moore's subcontractor, Marshall Miller & Associates (MM&A), who has previously conducted successful Geoprobe® sampling at RFAAP. In the event that the Geoprobe® can not penetrate to the necessary depth, the drilling subcontractor will have a hollow-stem auger drill available for use within 48 hours.

## Table 1-3
## Summary of Analytical Methods for Soil and Water Samples
## SWMU 6 Soil Investigation
## Radford Army Ammunition Plant, Radford, Virginia

| **Parameter** | **Media** | |
|---|---|---|
| | **Soil** | **Water** |
| **Overburden Composite Samples - RCRA Hazardous Waste Characterization** | | |
| TCLP Metals | 3010A | N/A |
| TCLP VOCs* | 1311/5030/8260B | N/A |
| TCLP SVOCs | 1311/3520/8270C | N/A |
| TCLP Pesticides/PCBs | 1311/3520/8081A/8082 | N/A |
| TCLP Herbicides | 1311/3520/8151A | N/A |
| Ignitability | ASTM-D93-90; 1010 | N/A |
| Corrositivity | 1110 | N/A |
| Reactivity (percent explosive material) | RFAAP Visual Method | N/A |
| Paint Filter | 9095 | N/A |
| **Evaluation of Residual Soil Risk** | | |
| TAL Metals (ICP Scan) | 3050/6010B/7471A | 3010/6010B/7470A |
| TCL VOCs (GC/MS) | 5035/8260B | 5030/8260B |
| TCL SVOCs (GC/MS) | 3550/8270C | 3520/8270C |
| TCL Pesticides/Aroclors (GC) | 3550/8081A/8082 | 3520/8081A/8082 |
| Explosives | 8330 | 8330 |
| **Investigative-Derived Material (IDM) RCRA Hazardous Waste Characterization** | | |
| TCLP Metals | 1311/3010/6010B/7471A | 1311/3010/6010B/7470A |
| TCLP VOCs* | 1311/5030/8260B | 1311/5030/8260B |
| TCLP SVOCs | 1311/3520/8270C | 1311/3520/8270C |
| Ignitability | ASTM-D93-90; 1010 | 1010 |
| Corrosivity | 1110 | 9040B |
| Reactivity (percent explosive material) | RFAAP Visual Method | -- |
| Paint Filter | 9095 | N/A |

* VOC samples will not be composited.

## Table 1-4
## Field Quality Control Samples
## SWMU 6 Soil Investigation
## Radford Army Ammunition Plant, Radford, Virginia

| TYPE OF CONTROL | COLLECTION FREQUENCY | OVERBURDEN CHARACTERIZATION | RESIDUAL RISK | CRITERIA REQUIREMENTS |
|---|---|---|---|---|
| Matrix Spike | 1 per 20 samples | 1 | 1 | See Table 8-1 MWP |
| Matrix Spike Duplicate | 1 per 20 samples | 1 | 1 | See Table 8-1 MWP |
| Field Duplicate | 1 per 10 samples | 2 | 2 | RPD $\leq$ 35% |
| Rinse Blank (Equipment Blank) | 1 per 20 samples or 1 per day | ** | 3 | No target analytes |
| Trip Blank* | 1 per cooler | ** | 3 | No target analytes |

* VOCs only

** Trip Blank and Rinse Blank for Residual Risk used for Overburden TCLP

2,

## Table 1-5
## Summary of Sample Containment and Sample Preservation
## SWMU 6 Soil Investigation
## Radford Army Ammunition Plant, Radford, Virginia

| PARAMETER | SAMPLE CONTAINER | | PRESERVATION METHODS | HOLDING TIMES |
|---|---|---|---|---|
| | Quantity | Type | | |
| ***SOLID SAMPLES*** | | | | |
| Volatile Organic Compounds | 2 | 120-mL amber glass vials, Teflon®-lined cap | Cool to 4 ±2°C | 7 days |
| Volatile Organic Compounds – Methanol Extraction | 1 | 60-mL amber glass vial, Teflon®-lined cap | Cool to 4 ±2°C | 4 days |
| Semivolatile Organic Compounds | 1 | 500-mL amber glass bottle, Teflon®-lined cap | Cool to 4 ±2°C | Extraction: 7 days<br>Analysis: 40 days |
| Pesticides/Aroclors | 2 | 500-mL amber glass bottle, Teflon®-lined cap | Cool to 4 ±2°C | Extraction: 7 days<br>Analysis: 40 days |
| Explosives | 1 | 500-mL amber glass bottle, Teflon®-lined cap | Cool to 4 ±2°C | Extraction: 7 days<br>Analysis: 40 days |
| Metals* | 1 | 500-mL amber glass bottle, Teflon®-lined cap | Cool to 4 ±2°C | 6 months |
| Mercury* | 1 | 500-mL amber glass bottle, Teflon®-lined cap | Cool to 4 ±2°C | 28 days |
| Reactivity (percent explosive material) | 1 | 500-mL amber glass bottle, Teflon®-lined cap | -- | -- |
| ***SOLID WASTE CHARACTERIZATION*** | | | | |
| TCLP VOCs | 1 | 500-mL wide-mouth amber glass, Teflon®-lined cap | Cool to 4 ±2°C | Leaching: 14 days<br>Analysis: 14 days |
| TCLP SVOCs | 1 | 500-mL wide-mouth amber glass, Teflon®-lined cap | Cool to 4 ±2°C | Leaching: 14 days<br>Extraction: 7 days<br>Analysis: 40 days |
| TCLP Pesticides | 1 | 500-mL wide-mouth amber glass, Teflon®-lined cap | Cool to 4 ±2°C | Leaching: 14 days<br>Extraction: 7 days<br>Analysis: 40 days |

## Table 1-5 (Continued)

### Summary of Sample Containment and Sample Preservation
### SWMU 6 Soil Investigation
### Radford Army Ammunition Plant, Radford, Virginia

| PARAMETER | SAMPLE CONTAINER | | PRESERVATION METHODS | HOLDING TIMES |
|---|---|---|---|---|
| | Quantity | Type | | |
| ***SOLID WASTE CHARACTERIZATION (continued)*** | | | | |
| TCLP Herbicides | 1 | 500-mL wide-mouth amber glass, Teflon®-lined cap | Cool to 4 ±2°C | Leaching: 14 days<br>Extraction: 7 days<br>Analysis: 40 days |
| TCLP Metals | 1 | 500-mL wide-mouth amber glass, Teflon®-lined cap | Cool to 4 ±2°C | Leaching: 14 days<br>Analysis: 6 months<br>Mercury analysis: 28 days |
| Corrosivity, Paint Filter | 1 | 500-mL wide-mouth amber glass, Teflon®-lined cap | Cool to 4 ±2°C | Corrosivity: 7 days<br>Reactivity: 7 days |
| Reactivity (percent explosive material) | 1 | 500-mL amber glass bottle, Teflon®-lined cap | -- | -- |
| ***AQUEOUS SAMPLES*** | | | | |
| Volatile Organic Compounds | 3 | 40-mL, amber glass vials, Teflon®-lined septum cap | HC1 to pH<2<br>Cool to 4 ±2°C | 14 days |
| Semivolatile Organic Compounds | 2 | 1-liter, narrow-mouth amber glass, Teflon®-lined cap | Cool to 4 ±2°C | Extraction: 7 days<br>Analysis: 40 days |
| Pesticides/Aroclors | 4 | 1-liter, narrow-mouth amber glass, Teflon®-lined cap | Cool to 4 ±2°C | Extraction: 7 days<br>Analysis: 40 days |
| Explosives | 1 | 1-liter, narrow-mouth amber glass, Teflon®-lined cap | Cool to 4 ±2°C | Extraction: 7 days<br>Analysis: 40 days |
| Metals | 1 | 1-liter, polyethylene bottle | $HNO_3$ to pH<2<br>Cool to 4 ±2°C | 6 months |
| Mercury | 1 | 1-liter, polyethylene bottle | $HNO_3$ to pH<2<br>Cool to 4 ±2°C | 28 days |

* = Metals and mercury sample for soil will be combined into one 500 mL bottle.

An experienced geologist will supervise the drilling of each borehole and will maintain continuous detailed subsurface logs by examining drill cuttings, recording samples, and recording PID screening results. In addition, a daily field log will be maintained to include such information as the progress of drilling operations, problems encountered, and other data as included in the SOPs.

### *1.4.2.1 Geoprobe® Sampling*

Twelve soil borings (6SB3 through SB14) will be advanced using the Geoprobe®. Proposed locations are presented in Figure 1-5. Summaries of the soil boring sample identifications are presented in Table 1-2.

Soil boring locations will be marked prior to drilling and RFAAP personnel will clear each location for utilities. If buried or aboveground utilities interfere with the safe operation of equipment, alternate locations will be selected in the field and documented in the field notes.

The Geoprobe® is a "direct push" technique, which incorporates a hydraulically powered percussion/probing machine designed specifically for use in the Environmental Industry. MM&A's Geoprobe® is mounted on the back of a Ford F-250 pickup truck. The Geoprobe® uses static force (the truck's weight) and a percussion hammer to advance small diameter sampling tools into the subsurface to collect soil cores. The macro soil core sample will be collected inside a dedicated, pre-cleaned acetate liner; each acetate liner will be used once then discarded (handled as IDM).

### *1.4.2.2 Decontamination*

The Geoprobe® and other down hole equipment and tools will be steam cleaned daily prior to use at the site. The down-hole equipment and tools will be decontaminated on site between each boring location. One location will be designated for steam-cleaning that is as close to the SWMU 6 as possible to minimize the distance the rig must travel for decontamination. A sample from the water source to be used for drilling, rinsing, and steam cleaning will be analyzed and reviewed prior to fieldwork to ensure it is contaminant-free.

After each soil-sampling interval the Macro-Core®-cutting shoe (the end of the Macro-Core® that comes in contact with the soil) will be decontaminated. Besides the Macro-Core® shoe, the only item that comes in contact with the sample is the four-foot acetate liner, of which a new one is used for every sample, minimizing the chance of cross-contamination. Field decontamination will consist of the following steps:

- A laboratory grade, non-phosphate detergent wash;
- Followed by a tap water rinse;
- Followed by a distilled water rinse; and
- A final rise with de-ionized ultra filtered (DIUF) water.

For the purposes of quality control, three lidded five-gallon plastic buckets will be used to contain the cleaning solutions and rinses. In addition, a dedicated garden sprayer will contain the DIUF water to maintain its purity. Decontamination water produced will be containerized in 55-gallon DOT approved steel drums and managed in accordance with Section 1.6 of this document.

#### *1.4.2.3 Boring Abandonment*

Soil borings must be abandoned (sealed) upon completion by pouring bentonite chips or pellets into the borehole. Borings will be abandoned in accordance with Section 5.2.6 and SOP 20.2 of the MWP.

### 1.4.3 Sample Location Position Information

Sample location coordinates will be obtained using a Global Positioning System (GPS) unit capable of obtaining real-time position information with horizontal resolution of one meter. Position information will be recorded in the U.S. State Plane Coordinate System (measured in U.S. survey feet) using the North American Datum 1927. Position information will be prepared for entry into the Environmental Restoration Information System (ERIS) database.

### 1.4.4 Required Materials and Equipment

Table 1-6 lists materials and equipment required to complete project activities, including calibration and maintenance schedules.

**Table 1-6**

**Equipment List and Maintenance Schedules**

**SWMU 6 Soil Investigation**

**Radford Army Ammunition Plant, Radford, Virginia**

| Materials and Equipment | Calibration and Maintenance Schedules |
|---|---|
| ***Provided by Subcontractors*** | |
| Geoprobe® | Decontamination before/after each use<br>Maintenance before coming to site, as needed on site |
| Acetate liners | Dedicated item |
| Steam cleaning apparatus | Maintenance before coming to site, as needed on site |
| IDM Drums | Replace as needed |
| Lab materials | Dedicated items |
| Pre-labeled sample jars | Certified pre-cleaned |
| Bubble wrap | Dedicated item |
| Preservatives | Dedicated items |
| ***Provided by URS/Dames & Moore*** | |
| Soil Sampling equipment | |
| Bowls, trowels | Decontamination before/after each use |
| Decontamination equipment | |
| Liquinox | Replace as needed |
| Brushes | Replace as needed |

| Materials and Equipment | Calibration and Maintenance Schedules |
|---|---|
| Buckets | Replace as needed |
| Water | Replace as needed |
| PPE (Modified Level D) | |
| Tyvek | Disposed of after each use |
| Gloves | Disposed of after each use |
| Rubber booties | Disposed of after each use |
| Air Monitoring Equipment | |
| PID | Daily calibration |

## 1.5 SAMPLE MANAGEMENT

Sample Management objectives will be met through adherence to the sample identification procedures (identification convention); documentation requirements; and chain-of-custody procedures defined in the MWP.

### 1.5.1 Number and Type

The estimated number and type of environmental samples proposed during the sampling event is included in Table 1-2.

### 1.5.2 Sample Containers, Preservation, and Holding Times

Parameter, container and preservation requirements, and holding times shall follow SOP 50.3 (Appendix A, MWP) and Table 1-5.

### 1.5.3 Sample Identification

The sample identification number will be similar in manner with past nomenclature at SWMU 6 at RFAAP. The sample identification will consist of an alphanumeric designation related to the sampling location, media type, and sequential order according to the sampling event. The sample identification number will not exceed eight characters for subsequent entry into ERIS. Samples will be coded in the following order to ensure a unique identification.

- **Site Location Code:** The first character will be the site SWMU number (i.e., 6 for SWMU 6).
- **Sample/Media Type:** The second two characters will be the sample/media type. In this case, the characters will be SB (for soil boring).
- **Sampling Location Number:** The next one or two characters will be the number of the sampling location (e.g., 3, 4, 5, ..., 9, 10, 11, ...). The sample numbering will start at "3" since two previous samples from SWMU 6 have been recorded as "1" and "2".
- **Sample Depth:** The sample representing the composite of the soils above the termination depth of the boring will be designated with an "A" after the boring number. The samples with the "A" designation will be those samples that will be analyzed for parameters pertaining to the RCRA hazardous waste characterization. The sample collected from the bottom of the boring will be designated with a "B"

following the boring number. The samples with the "B" designation will be analyzed for the parameters pertaining to the evaluation of the residual risk of the remaining soils.

- **Duplicate:** Duplicate samples will be identified with a "D" designation. A record of the samples that correspond to the duplicates will be kept in the field logbook.

**Sample Identification Examples:**

1. A subsurface soil sample that is a composite of the soils above the termination depth of boring location 4 at SWMU 6 would be identified as sample 6SB4A (for SWMU 6, soil boring 4, and "A" which stands for the composite of the overburden soils at that location).

2. A subsurface soil sample collected at the bottom of soil boring 5 at SWMU 6 would be identified as 6SB5B (for SWMU 6, soil boring 5, and "B" which stands for the bottom sample at that borehole). The duplicate for that sample would be 6SB5BD.

- Quality Control Samples: QC samples will be identified by date (mo, day, yr), followed by QC sample type, and sequential order number at one digit. The QC sample types include:

| | | |
|---|---|---|
| R = Rinse Blank | MS = Matrix Spike | FD = Field Duplicate |
| T = Trip Blank | MSD = Matrix Spike Duplicate | |

For example, the second rinse blank collected on September 7, 2000, would be identified as 090700R2.

### 1.5.4 Documentation

Documentation that will be maintained in support of project activities include:

- **Field logbooks**: documentation in the field logbooks should be of sufficient detail to allow the re-creation of investigative conditions. Sample collection will be documented in field logbooks for site/media and will be sufficient enough to enable cross-reference with other investigative records. Entries will be made in indelible ink and corrections will consist of line-out deletions that are initialed and dated. The person making the correction will provide a brief explanation for the change. There should be no blank lines on a page. A single blank line or a partial blank line (such as at the end of a paragraph) should be lined to the end of the page. If only part of the page is used, the remainder of the page should be crossed out.

- **Chain-of-Custody Forms**: evidence of sample custody will be traceable from the time of collection to receipt of analytical results. Only one chain-of custody will be used per cooler. Copies will be kept on file to document field activities.

- **Phone logs**: telephone communication will be documented for scope of work changes and/or conditions that impact task deliverables. Related records include e-mail and facsimiles.

- **Field Parameter Form**: A Field Parameter Form (FPF) is designed to collect the sample information used for IRDMIS data entry. One FPF will be filled out for each sample collection.

- **Investigation records**: specific records related to investigative activities including: boring logs, laboratory data, subcontractor permits and qualifications, utility clearance, and abandonment records.

## 1.6 INVESTIGATIVE-DERIVED MATERIAL HANDLING AND DISPOSAL

Activities conducted during this investigation will comply with the relevant Occupational Safety and Health Administration (OSHA) and USEPA regulations regarding the identification, handling, and disposal of nonhazardous IDM and hazardous materials. In addition, activities will be performed in accordance with installation safety rules, protocols, and MWP Section 5.1.4.1 and SOP 70.1. Disposal of IDM generated during this effort will be documented in the field logbook. A decontamination pad will be constructed within SWMU 6 for decontamination of equipment used to complete the soil borings. Decontamination water will be collected and drummed for subsequent proper disposal. Residual IDM will be removed from the decontamination pad at the end of each field day. IDM, such as soil, decontamination water, and personal protective equipment (PPE) will be drummed and labeled for subsequent proper offsite disposal in accordance with the applicable Federal, state and local regulations, including, but not limited to, RCRA, DOT, and Army Regulation (AR) 200-1. IDM drums awaiting disposal characterization will be properly sealed, labeled and covered, and staged at SWMU 17, Scrap Burning Area. Every attempt will be made to transport IDM drums offsite by day 14 following generation at the end of the field activities, but in no case will IDM remain on site longer than 90 days.

- **Material Characterization:** Materials will be sampled prior to disposal to establish waste characteristics, in accordance with 40 Code of Federal Regulations (CFR) 264 and Virginia Hazardous Waste Management Regulations. Material characterization analyses will be performed per RCRA standards by CompuChem Laboratory using USEPA-approved SW-846 Methods (USEPA Level IV data) and in accordance with the MWP.

- **Handling and disposal of nonhazardous materials:** Following analysis, nonhazardous materials will be segregated by material and disposed off-site.

- **Handling and disposal of hazardous materials or waste:** In the event that IDM are determined to be hazardous, following analysis, the IDM will be disposed of in accordance with Virginia Administrative Code (VAC) Regulation 9VAC20-50-370 and other Federal, state and local regulations, including, but not limited to, RCRA, DOT and AR200-1.

- **Miscellaneous IDM** – Miscellaneous IDM will include decontamination sludge and used PPE. IDM will be disposed of in accordance with the MWP and Federal, state and installation requirements.

- **Accumulation and storage:** IDM will not be stored at RFAAP for greater than 90 days. Containerized material will be properly labeled and stored in an Alliant Techsystems, Inc., (ATK) approved area (SWMU 17, Scrap Burning Area).

- **General Disposal:** Analytical results, including analytical methods and detection limits, will generally be submitted to Alliant Techsystems, Inc., (ATK) seven (7) working days prior to submitting a material profile for approval unless directed otherwise. The material profile will be submitted to ATK ten (10) working days prior to material disposal. ATK will be contacted again seven (7) working days prior to material disposal.

- **Transportation, storage and disposal facility (TSDF):** A list of TSDFs previously used for RFAAP disposal activities will be obtained from ATK at the beginning of the project. Previously used TSDFs will have priority over TSDFs that have no work history with the Installation. A copy of the proposed TSDF's most recent state or federal inspection will be provided to ATK upon selection for Installation approval. In the event ATK determines that the proposed TSDF is unsuitable, a new TSDF will be selected for approval.

- **Manifest:** A hazardous waste manifest will be prepared as requested. In the event that the IDM is a hazardous waste, VAC Regulation 9VAC20-50-370 will be compiled with. ATK will provide an authorized signature prior to shipment.

### 1.6.1 Nonhazardous Materials

Specific information on nonhazardous materials that are expected to be encountered at the site, including description, estimated quantity, and final disposition. Handling and disposal of nonhazardous materials associated with investigation activities include the following:

- Soil cuttings from soil borings;
- Decontamination sludge, containing water and sludge collected from drilling and sampling equipment;
- Miscellaneous PPE items (e.g., Tyvek, nitrile/latex gloves, booties, etc.).

### 1.6.2 Hazardous Materials

In the event that IDM are determined to be hazardous, following analysis, the IDM will be disposed of in accordance with VAC Regulation 9VAC20-50-370 and other Federal, state and local regulations, including, but not limited to, RCRA, DOT and AR200-1.

## 1.7 DATA EVALUATION AND COMPARISON TO RBCs

Data generated by the field investigation and sample analysis tasks will be evaluated to assess the presence of hazardous constituents at sampled locations, the presence of a potential sludge layer, the characteristics of subsurface materials, and the potential risk of exposure to the soils at depth. Data evaluation will include data reduction and tabulation, development of maps and figures, and a comparison to USEPA Region III RBCs and SSLs.

Data on subsurface geology will be compiled from logs of the soil borings and observations made during field sampling. These will allow for the general determination of the area and vertical distribution of a sludge layer(s), the bedrock surface, and the depth of overburden material at SWMU 6.

To evaluate the potential risk of exposure to soils remaining at SWMU 6 after construction activities are completed, the discrete soil sampling data will be compared to USEPA Region III RBCs for residential soil (at the request of USEPA Region III) and industrial soil. In addition, these data will be compared to USEPA Region III SSLs to evaluate potential migration of constituents from soil to groundwater.

The RBCs and SSLs were developed by EPA Region III toxicologists as a risk-based screening tool for evaluating site investigation data. The RBCs will be used to identify constituent concentrations that may require additional evaluation during a site specific baseline risk assessment. The RBCs were calculated using current chemical specific toxicity data and "standard" exposure scenarios to calculate chemical concentrations corresponding to fixed levels of risk in residential and industrial soils (ingestion). At the request of USEPA Region III, a Hazard Quotient (HQ) of 0.1 or lifetime cancer risk of $1\times10^{-6}$ (whichever occurs at a lower concentration) will be used for risk screening with RBCs. SSLs for migration to groundwater will use a default dilution-attenuation factor (DAF) of 1 as provided in the USEPA Region III RBC tables.

The RBCs will be used along with available background data to identify constituent concentrations of potential concern. RFAAP is currently conducting a soils background study under a separate contract. Constituent concentrations that exceed the RBCs will be compared to the available background concentrations. Constituent concentrations less than background will be considered to be in the range of naturally occurring inorganics and, thereby, do not present additional risk greater than that from exposure to naturally occurring concentrations in background soils at the installation.

# 2.0 QUALITY ASSURANCE PLAN ADDENDUM

## 2.1 INTRODUCTION

This QAPA establishes function-specific responsibilities and authorities to ensure data quality for investigative activities at RFAAP. The project objectives will be met through the execution of the SOPs included in the MWP and appended to this document. The applicable SOPs are referenced below. Specific QC requirements include data quality objectives (DQOs), internal QC checks, and analytical procedures during investigative activities. This QAPA is designed to be used in conjunction with the Master Quality Assurance Plan (MQAP). Table 2-1 provides a list of general quality assurance (QA) measures that will be implemented as specified in the MQAP.

**Table 2-1**
**Quality Assurance Measures Discussed in the MWP**
**SWMU 6 Soil Investigation**
**Radford Army Ammunition Plant, Radford, Virginia**

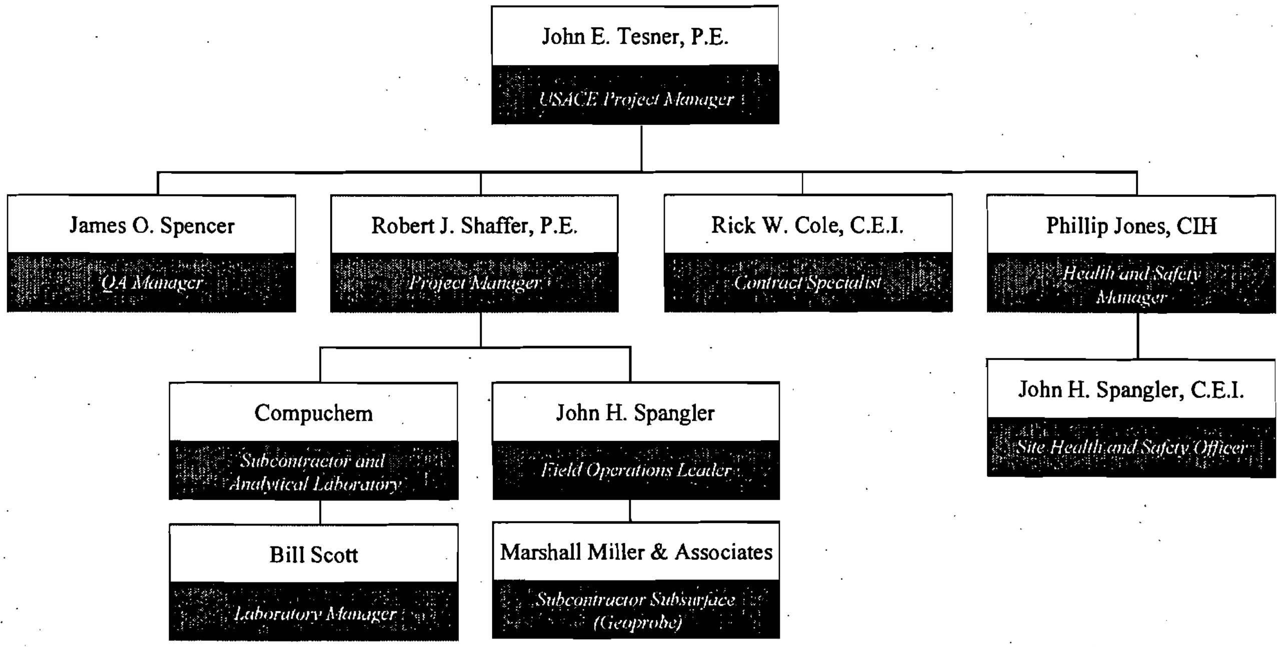
| Quality Assurance Measure | Section in MQAP (Volume II) | SOP No. (MWP Appendix A) |
|---|---|---|
| Project Organization and Responsibilities | 2.0 | -- |
| Lines of Authority | 2.2 | -- |
| Chemical Data Measurements | 3.2 | -- |
| Applicable or Relevant and Appropriate Requirements (ARARs) | 3.3 | -- |
| Site Investigation | 5.0 | 2.0, 20.6, 30.1, 30.7, 30.8, 50.3, 70.1, 80.1 |
| Documentation Requirements | 5.6 | 10.1, 10.2, 10.3, 50.1 |
| Chain-of-Custody | 5.7 | 10.4, 50.2 |
| Calibration Procedures | 7.0 | 90.1 PID |
| Data Reduction, Validation, Reporting and Management | 9.0 | 60.1 |
| Corrective Action | 10.0 | -- |
| Quality Assessments | 11.0 | -- |

### 2.1.1 Contractor and Subcontractor Responsibilities

Contractor and subcontractor personnel requirements for implementing the technical, quality and health and safety programs are described in Section 2.1 of the MQAP. Figure 2-1 presents the identification and the organization of URS project management personnel.

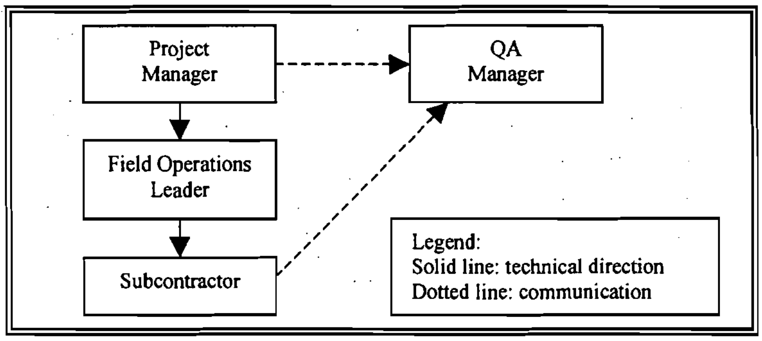
**Figure 2-1**

**Project Organizational Chart**



### 2.1.2 Lines of Authority

The URS Project Manager is the central point of contact and is responsible for ensuring implementation of project quality and health and safety programs. Communication of project objectives is provided to project staff through meetings, reporting, and reviews.



### 2.1.3 Key Points of Contact

The names and points of contact for URS Corporation personnel and subcontractors are provided in Table 2-2.

Mr. Rick Cole, C.E.I., will serve as Contract Specialist for this assignment and will have the overall responsibility of the efforts of the URS Team for project deliverables and coordination with both USACE and subcontractors. Mr. Cole has more than 16 years of environmental consulting experience and serves as Manager of the URS Richmond Environmental Services Group. His technical experience includes project management and administration, environmental assessments, permitting, and regulatory assistance, hazardous waste management, environmental site assessments, technical and report writing, marketing, and business development.

Mr. Cole has worked closely with federal, state, and local regulatory and review agencies on a range of environmental issues, particularly with environmental impact review processes, coordination of permits and project plans, and determination of regulatory requirements.

Mr. Robert Shaffer, P.E., will serve as the Project Manager. He has 12 years of environmental experience relative to environmental engineering and studies in Virginia. His experience includes hazardous and solid waste management, civil, geotechnical industrial wastewater, storage tanks, and storm water. Mr. Shaffer has managed multiple, simultaneous delivery orders under multi-million dollar indefinite quantity contract for the U.S. Navy and Army. In addition, his experience includes managing RCRA Corrective Measures Studies, hazardous waste management unit (HWMU) closures, and numerous other environmental studies. He as also served as lead engineer on several CERCLA Feasibility Studies and Remedial Designs.

Mr. John Spangler, C.E.I., will serve as the Field Operations Manager. Mr. Spangler has over ten years of experience conducting subsurface investigations for private and federal clients throughout the Mid-Atlantic region. Mr. Spangler participated extensively in the VI and RCRA Facility Investigations conducted at RFAAP by URS (then Dames & Moore) in 1991 and 1992.

Mr. James O. Spencer will serve as the QA Manager. Mr. Spencer has thirteen years of experience directing and conducting environmental, geological, hydrological and geotechnical engineering investigations. Projects have included CERCLA and RCRA investigations, closure plans and permitting, petroleum storage tank management, investigations and corrective action, geotechnical engineering investigations, environmental site investigations/remedial action plans and groundwater and geochemical modeling. Mr. Spencer has extensive experience conducting RCRA investigations at RFAAP (including the VI and RCRA Facility Investigations conducted by URS (then Dames & Moore) in 1991 and 1992. He worked as a project geologist on these investigations conducting field investigations, managing IRDMIS data entry and preparing reports.

## Table 2-2
## Contractor and Subcontractor Key Points of Contact
## SWMU 6 Soil Investigation
## Radford Army Ammunition Plant, Radford, Virginia

| Contractor | Key Point of Contact |
|---|---|
| Project Manager, Robert J. Shaffer, P.E.<br>e-mail: bob_shaffer@urscorp.com | URS Corporation<br>5540 Falmouth Street, Suite 201<br>Richmond, Virginia 23230<br>Tel: 804.965.9000; Fax: 804.965.9764 |
| Quality Assurance Manager, James O. Spencer<br>e-mail: james_o_spencer@urscorp.com | URS Corporation<br>5540 Falmouth Street, Suite 201<br>Richmond, Virginia 23230<br>Tel: 804.965.9000; Fax: 804.965.9764 |
| Field Operations Leader, John Spangler<br>e-mail: john_spangler@urscorp.com | URS Corporation<br>5540 Falmouth Street, Suite 201<br>Richmond, Virginia 23230<br>Tel: 804.965.9000; Fax: 804.965.9764 |
| Project Contract Specialist, Rick Cole<br>e-mail: rick_cole@urscorp.com | URS Corporation<br>5540 Falmouth Street, Suite 201<br>Richmond, Virginia 23230<br>Tel: 804.965.9000; Fax: 804.965.9764 |
| Health and Safety Manager, Phillip Jones<br>e-mail: phillip_jones@urscorp.com | URS Corporation<br>1400 Union Meeting Road, Suite 202<br>Blue Bell, Pennsylvania 19422-1972<br>Tel: 215.619.4160; Fax: 215.542.3888 |
| Site Health and Safety Officer, John Spangler<br>e-mail: john_spangler@urscorp.com | URS Corporation<br>5540 Falmouth Street, Suite 201<br>Richmond, Virginia 23230<br>Tel: 804.965.9000; Fax: 804.965.9764 |
| **Subcontractor** | **Key Point of Contact** |
| Analytical Laboratory<br>Compuchem<br>e-mail: bscott@compuchemlabs.com | Bill Scott<br>Cary, NC<br>Tel: 919.679.4024; Fax: 919.379.4050 |
| Subsurface (Geoprobe®)<br>Marshall Miller & Associates | Chuck Cline<br>Bluefield, VA<br>Tel: 540.322.5467; Fax: 540.322.1510 |

## 2.2 QUALITY ASSURANCE OBJECTIVES

Quality Assurance (QA) is defined as the overall system of activities for assuring the reliability of data produced. QA objectives are specified for investigation, chemical and regulatory issues, associated with this project, and are referenced in Section 2.1. QA objectives will be met through the conformance of appended SOPs. The system integrates the quality planning, assessment, and corrective actions of various groups in the organization to provide the independent QA program necessary to establish and maintain an effective system for collection and analysis of environmental samples and related activities. The program encompasses the generation of complete data with its subsequent review, validation (if required at a later date) and documentation.

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. The DQO process used for developing RFAAP data quality criteria and performance specifications for decision making is consistent with the Guidance For the Data Quality Objectives Process, EPA QA/G-4, September 1994.

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 investigation activities.

**Table 2-3**
**Summary of Project Data Quality Objectives**
**SWMU 6 Soil Investigation**
**Radford Army Ammunition Plant, Radford, Virginia**

| DQO Element | Project DQO Summary |
|---|---|
| Problem Statement | RFAAP plans to construct settling tanks in an area that includes SWMU 6. This Work Plan seeks to:<br>• Assist RFAAP in planning for proper management of material excavated from SWMU 6; and<br>• Screen for residual risk once excavation is complete. |
| Identify Decision/Study Question | • Characterize material to be excavated for hazardous characteristics; and<br>• Screen soils at depth (25 feet bgs or refusal) against compounds with published risk-based concentrations. |
| Decision Inputs | • Field Investigation: Collection of appropriate soil samples in material targeted for excavation and from material that may remain following construction. Boring logs resulting from field investigation.;<br>• Boring logs developed, noting observable lithologic differentiation of backfill and potential waste material (e.g., sludge-like material).;<br>• Chemical analyses: Submit soil samples to USACE-approved off-site analytical laboratory for analyses; and<br>• Chemical analytical suite for soils to be excavated include full TCLP, ignitability, corrosivity, reactivity, and paint filter test. Chemical analytical suite for soil at depth include TCL SVOCs and VOCs, TAL Metals. |
| Study Boundaries | • Previously defined SWMU 6 area.;<br>• Targeted depth of construction excavation of 25-feet bgs;<br>• Subsurface obstructions precluding achievement of the 25 foot horizon; and<br>• SMWU 6 boundary best fit of equally spaced sample locations. |

10

| DQO Element | Project DQO Summary |
|---|---|
| Decision Rule | - Comparison between 40 CFR 261, Subpart C RCRA Waste Hazardous Waste Criteria and data from samples of material targeted for excavation;<br>- Use noted lithologic differentiations to ensure proper delineation of excavated material characterization; and<br>- Comparison between USEPA Region III Industrial Soil Risk Based Concentrations (October 2000) and data from samples of soils at depth. |
| Acceptable Decision Error Limits | - Analytical methods CLP report limits. CLP-like raw data package (Level IV) suitable for future validation. |
| Optimize Data Design | - Equally spaced sampling interval will be established within SWMU 6 boundary; and<br>- Visual interpretation of lithology encountered in each boring will dictate the composite sample collection. Based on lithology, up to six of the 12 sample locations, may be used to collect composite samples of potential waste material (e.g., layer of sludge-like material). |

The DQO process consists of the seven steps specified below.

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

   (1) *The planning team consists of the RFAAP, USACE, USEPA, Alliant Techsystems, and URS Corporation.*

   (2) *Relative to the implementation of this Work Plan, the primary decision-maker is RFAAP, in consultation with URS Corporation, USACE, USEPA, and VA DEQ.*

   (3) *Assist RFAAP in properly managing material excavated from SWMU 6 and screen for residual risk prior to the construction of settling tanks in an area that includes SWMU 6. This Work Plan includes the collection subsurface soil samples of SWMU 6 for evaluation of the excavated material for hazardous waste characteristics and the remaining material for residual risk.*

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

   (1) *At the time of settling tanks construction, define the anticipated disposal needs of material removed from SWMU 6 to facilitate the settling tanks construction. The disposal needs will be defined by a hazardous waste characterization of the material per 40 CFR 261, Subpart C. Estimate the volume of material that would be removed from within the SWMU 6 spatial boundary to facilitate the settling tanks construction.*

(2) *Screen the exposed at-depth surface of SWMU 6 following overburden removal for residual risk. Screening for residual risk will be accomplished through the comparison of data against USEPA, Region III Soil Industrial Risk Based Concentrations (RBCs) dated October 2000.*

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

(1) *Collection of field soil data from SWMU 6:*

a) *Collect a composite soil sample from the vertical column in each of 12 boring locations within the SWMU 6 boundary. Continuous undisturbed cores will be collected from each boring. Boring logs will be developed from information gathered during core collection. Considering information available from previous investigation and based on lithologic description of each boring, the appropriate intermediate locations will be identified, from which a composite sample will be collected.*

b) *Construction activities will require excavation to 25 feet bgs. Collect a discrete sample of material that would represent material at the bottom of the excavation. Sample will be collected at 25 feet bgs, or at bedrock refusal depth.*

c) *Construct boring logs from each boring.*

(2) *Conduct field sampling in accordance with the MWP, attached SOPs, and approved deviation presented herein. Following proper sample collection and handling defined herein, submit samples to an USACE-approved analytical laboratory for evaluation of analytes defined herein using USEPA SW-846 methodologies. Selected laboratory is within the CLP network.*

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

(1) *Physical horizontal boundary of SWMU 6 will be defined using input from RFAAP personnel and available existing information (e.g., report figures, site maps and existing site features). Vertical boundary for this project is 25 feet bgs, or bedrock refusal.*

(2) *Sample points are laid out within the SWMU boundary to ensure equally spaced sample locations.*

(3) *Subsurface obstructions pose a constraint. Should the direct push technique prove to be inadequate for reaching the target depth of 25-feet bgs or refusal (i.e., bedrock), a field decision will be made to change out direct push equipment with a hollow stem auger rig. Significant horizontal sample collection constraints are not anticipated.*

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

   (1) *Parameters of interest include the parameter analysis for RCRA hazardous waste characteristics, and residual risk data.*

      a) *RCRA hazardous waste characteristics parameters include full TCLP, ignitability, corrosivity, reactivity (visual method for percent explosive material), and paint filter test.*

      b) *Residual risk parameters include Target Analyte List Metals (TAL metals), Target Compound List Semi-Volatile Organic Compounds (TCL SVOCs), Target Compound List Volatile Organic Compounds (TCL VOCs), Target Compound List Pesticides/Aroclors, and Explosives.*

   (2) *Action levels for RCRA hazardous waste characteristics will be per 40 CFR 261, Subpart C. Residual risk screening will occur against USEPA Region III soil RBCs (residential and industrial) and SSLs (dated October 2000). PQLs, as defined in Table 2.4, will ensure that data quality is sufficient for intended data use. Selected laboratory is within the CLP network and therefore it is assumed that sources of analytical errors are small and known.*

   (3) *Decision rules include:*

      a) *The composite sample analytical results will be used to estimate the extent and approximate volume of overburden that may require handling as a hazardous waste.*

      b) *The discrete sample analytical results will be compared to USEPA Region III Soil RBCs and SSLs. This will provide an indication of the potential residual risk that may exist once excavation has been completed.*

   (4) *Boring logs will be used to estimate a volume and present a description of the soil physical characteristics.*

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

   (1) *Practical Quantitation Limits (PQLs) are established for each analyte within the suites of parameter sought. This will ensure that data quality is appropriate. The Contract Laboratory will provide a CLP-like raw data package (Level IV). Data validation will not be conducted under this Work Plan effort.*

   (2) *Decision error includes the accuracy of SMWU 6 boundary delineation and heterogeneous nature of soils.*

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(3) *Information from previous studies and physical features of the areas surrounding SWMU 6 allows for a low probability of decision error.*

7. **Optimize Data Design:** Identify data collection activities commensurate with data quality specifications. This final step in the process consists of (1) reviewing DQO outputs and existing environmental data, (2) developing data collection design alternatives, and (3) documentation of operational details and theoretical assumptions.

(1) *DQO outputs will be reviewed based on the data collection activities; the validity of the data could be verified if necessary based on the review.*

(2) *Data collection is based upon site specific characteristics and the ultimate use of the data.*

(3) *This addendum contains the proposed sampling design program based on the DQOs. Project documentation will be implemented in accordance with the MWP.*

## 2.3 ANALYTICAL PROCEDURES

### 2.3.1 Laboratory Procedures for Chemical Analysis

CompChem Laboratory, Inc., will perform offsite analytical activities. URS personnel will perform on-site sampling activities. Analytical methods and quantitation limits to be used are given in Table 2-4. For the residual risk data, laboratory analysis will be in accordance with USEPA SW 846 approved methods for the analysis of Target Analtye List (TAL) metals, TCL VOCs, SVOCs, pesticides/aroclors, and explosives. For the composite overburden characterization samples, analysis will be in accordance with USEPA SW 846 protocols for the analysis of complete Toxic Characteristic Leaching Procedures (TCLP), ignitability, corrosivity, and reactivity (visual method by RFAAP).

Aqueous samples (decontamination water) to be analyzed for disposal characterization will be analyzed for TCLP metals, TCLP VOCs, TCLP SVOCs, ignitability, corrosivity, and reactivity. Solid samples (soil cuttings) to be analyzed for disposal characterization will be analyzed for TCLP VOCs, TCLP SVOCs, ignitability, corrosivity, reactivity, and paint filter test. The following sections briefly describe the analytical methodologies to be used in the RFAAP site investigation.

### 2.3.2 Inorganics

Samples will be analyzed for USEPA TAL metals using a combination of the following methodologies to achieve project DQOs: inductively coupled plasma (ICP) and cold vapor atomic absorption (CVAA).

Trace metals will be analyzed using EPA SW-846 Method 3010A/6010B for aqueous samples and Method 3050B/6010B for solid samples. The ICP method involves the simultaneous or sequential multi-element determination of trace elements in solution. The basis of the method is the measurement of atomic emission by optical spectrometry. Samples are nebulized and the aerosol that is produced is transported to the plasma torch where excitation occurs. Characteristic atomic-line emission spectra are produced by a radio-frequency inductively

## Table 2-4
## Summary of Analyte Quantitation Limits
## SWMU 6 Soil Investigation
## Radford Army Ammunition Plant, Radford, Virginia

| VOC TCL | Cas Number | Quantitation Limits[a] | | Risk Screening (ug/g) | | |
|---|---|---|---|---|---|---|
| | | Low Soil (ug/g) | Low Water (ug/L) | Residential RBCs | Industrial RBCs | SSLs (DAF 1) |
| Chloromethane | 74-87-3 | 10 | 1 | 49 | 440 | 0.00052 |
| Bromomethane | 74-83-9 | 10 | 1 | 11 | 290 | 0.0021 |
| Vinyl Chloride | 75-01-4 | 10[b] | 1 | 0.43 | 3.8 | 0.000017 |
| Chloroethane | 75-00-3 | 10 | 1 | 220 | 2000 | 0.00096 |
| Methylene Chloride | 75-09-2 | 10 | 1 | 85 | 760 | 0.00095 |
| Acetone | 67-64-1 | 10 | 1 | 780 | 20000 | 0.12 |
| Carbon Disulfide | 75-15-0 | 10 | 1 | 780 | 20000 | 0.95 |
| 1,1-Dichloroethene | 75-35-4 | 10[b] | 1 | 1.1 | 9.5 | 0.000018 |
| 1,1-Dichloroethane | 75-34-3 | 10 | 1 | 780 | 20000 | 0.23 |
| 1,2-Dichloroethene (total) | 540-59-0 | 10 | 1 | 70 | 1800 | 0.019 |
| Chloroform | 67-66-3 | 10 | 1 | 100 | 940 | 0.000045 |
| 1,2-Dichloroethane | 107-06-2 | 10 | 1 | 7 | 63 | 0.000052 |
| 2-Butanone | 78-93-3 | 10 | 1 | 4700 | 120000 | 0.4 |
| 1,1,1-Trichloroethane | 71-55-6 | 10 | 1 | 2200 | 57000 | 3 |
| Carbon Tetrachloride | 56-23-5 | 10 | 1 | 4.9 | 44 | 0.00011 |
| Bromodichloromethane | 75-27-4 | 10 | 1 | 10 | 92 | 0.000054 |
| 1,2-Dichloropropane | 78-87-5 | 10 | 1 | 9.4 | 84 | 0.0001 |
| cis-1,3-Dichloropropene | 10061-01-5 | 10 | 1 | 6.4 | 57 | 0.00016 |
| Trichloroethene | 79-01-6 | 10 | 1 | 58 | 520 | 0.00077 |
| Dibromochloromethane | 124-48-1 | 10 | 1 | 7.6 | 68 | 0.000045 |
| 1,1,2-Trichloroethane | 79-00-5 | 10 | 1 | 11 | 100 | 0.000039 |
| Benzene | 71-43-2 | 10 | 1 | 12 | 100 | 0.00009 |
| trans-1,3-Dichloropropene | 10061-02-6 | 10 | 1 | 6.4 | 57 | 0.00016 |
| Bromoform | 75-25-2 | 10 | 1 | 81 | 720 | 0.0033 |
| 4-Methyl-2-pentanone | 108-10-1 | 10 | 1 | 630 | 16000 | 0.065 |
| 2-Hexanone | 591-78-6 | 10 | 1 | 310 | 8200 | -- |
| Tetrachloroethene | 127-18-4 | 10 | 1 | 12 | 110 | 0.0024 |
| 1,1,2,2-Tetrachloroethane | 79-34-5 | 10 | 1 | 3.2 | 29 | 0.000034 |
| Toluene | 108-88-3 | 10 | 1 | 1600 | 41000 | 0.44 |
| Chlorobenzene | 108-90-7 | 10 | 1 | 160 | 4100 | 0.04 |
| Ethylbenzene | 100-41-4 | 10 | 1 | 780 | 20000 | 0.75 |
| Styrene | 100-42-5 | 10 | 1 | 1600 | 41000 | 2.9 |
| Xylenes (total) | 1330-20-7 | 10 | 1 | 16000 | 410000 | 8.5 |

## Table 2-4 (Continued)
## Summary of Analyte Quantitation Limits
## SWMU 6 Soil Investigation
## Radford Army Ammunition Plant, Radford, Virginia

| SVOC TCL | Cas Number | Quantitation Limits[a] | | Risk Screening (ug/g) | | |
|---|---|---|---|---|---|---|
| | | Low Soil (ug/g) | Low Water (ug/L) | Residential RBCs | Industrial RBCs | SSLs (DAF 1) |
| Phenol | 108-95-2 | 0.330 | 10 | 4700 | 120000 | 6.7 |
| Bis(2-chloroethyl)ether | 111-44-4 | 0.330 | 10 | 0.58 | 5.2 | 0.0000022 |
| 2-Chlorophenol | 95-57-8 | 0.330 | 10 | 39 | 1000 | -- |
| 1,3-Dichlorobenzene | 541-73-1 | 0.330 | 10 | 7 | 180 | 0.0044 |
| 1,4-Dichlorobenzene | 106-46-7 | 0.330 | 10 | 27 | 240 | 0.00036 |
| 1,2-Dichlorobenzene | 95-50-1 | 0.330 | 10 | 700 | 18000 | 0.22 |
| 2-Methylphenol | 95-48-7 | 0.330 | 10 | 390 | 10000 | 0.0043 |
| 2,2'-oxybis(1-Chloropropane) | 108-60-1 | 0.330 | 10 | 9.1 | 82 | 0.000084 |
| N-Nitrosodi-n-propylamine | 621-64-7 | 0.330 | 10 | 0.091 | 0.82 | 0.0000024 |
| 4-Methylphenol | 106-44-5 | 0.330 | 10 | 390 | 1000 | -- |
| Hexachloroethane | 67-72-1 | 0.330 | 10 | 46 | 410 | 0.018 |
| Nitrobenzene | 98-95-3 | 0.330 | 10 | 3.9 | 100 | 0.0012 |
| Isophorone | 78-59-1 | 0.330 | 10 | 670 | 6000 | 0.0021 |
| 2-Nitrophenol | 88-75-5 | 0.330 | 10 | -- | -- | -- |
| 2,4-Dimethylphenol | 105-67-9 | 0.330 | 10 | 160 | 4100 | 0.34 |
| Bis(2-chloroethoxy)methane | 111-91-1 | 0.330 | 10 | -- | -- | -- |
| 2,4-Dichlorophenol | 120-83-2 | 0.330 | 10 | 23 | 610 | 0.019 |
| 1,2,4-Trichlorobenzene | 120-82-1 | 0.330 | 10 | 78 | 2000 | 0.38 |
| Naphthalene | 91-20-3 | 0.330 | 10 | 160 | 4100 | 0.0077 |
| 4-Chloroaniline | 106-47-8 | 0.330 | 10 | 31 | 820 | 0.048 |
| Hexachlorobutadiene | 87-68-3 | 0.330 | 10 | 8.2 | 73 | 0.0092 |
| 4-Chloro-3-Methylphenol | 59-50-7 | 0.330 | 10 | -- | -- | -- |
| 2-Methylnaphthalene | 91-57-6 | 0.330 | 10 | 160 | 4100 | 1.1 |
| Hexachlorocyclopentadiene | 77-47-4 | 0.330 | 10 | 55 | 1400 | 100 |
| 2,4,6-Trichlorophenol | 88-06-2 | 0.330 | 10 | 58 | 520 | -- |
| 2,4,5-Trichlorophenol | 95-95-4 | 0.800 | 25 | 780 | 20000 | -- |
| 2-Chloronaphthalene | 91-58-7 | 0.330 | 10 | 630 | 16000 | 1.6 |
| 2-Nitroaniline | 88-74-4 | 0.800 | 25 | -- | -- | -- |
| Dimethylphthalate | 131-11-3 | 0.330 | 10 | 7.8 | 2000000 | -- |
| Acenaphthylene | 208-96-8 | 0.330 | 10 | -- | -- | -- |
| 2,6-Dinitrotoluene | 606-20-2 | 0.330 | 10 | 16 | 200 | 0.029 |
| 3-Nitroaniline | 99-09-2 | 0.800 | 25 | -- | -- | -- |

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# Table 2-4 (Continued)
# Summary of Analyte Quantitation Limits
# SWMU 6 Soil Investigation
# Radford Army Ammunition Plant, Radford, Virginia

| SVOC TCL | Cas Number | Quantitation Limits[a] | | Risk Screening (ug/g) | | |
|---|---|---|---|---|---|---|
| | | Low Soil (ug/g) | Low Water (ug/L) | Residential RBCs | Industrial RBCs | SSLs (DAF 1) |
| Acenaphthene | 83-32-9 | 0.330 | 10 | 470 | 12000 | 5.2 |
| 2,4-Dinitrophenol | 51-28-5 | 0.800 | 25 | 16 | 410 | -- |
| 4-Nitrophenol | 100-02-7 | 0.800 | 25 | 63 | 1600 | 0.087 |
| Dibenzofuran | 132-64-9 | 0.330 | 10 | 31 | 820 | 0.38 |
| 2,4-Dinitrotoluene | 121-14-2 | 0.330 | 10 | 16 | 410 | 0.029 |
| Diethylphthalate | 84-66-2 | 0.330 | 10 | 6300 | 160000 | 23 |
| 4-Chlorophenyl-phenylether | 7005-72-3 | 0.330 | 10 | -- | -- | -- |
| Fluorene | 86-73-7 | 0.330 | 10 | 310 | 8200 | 6.8 |
| 4-Nitroaniline | 100-01-6 | 0.800 | 25 | -- | -- | -- |
| 4,6-Dinitro-2-methylphenol | 534-52-1 | 0.800 | 25 | 0.78 | 20 | -- |
| N-Nitrosodiphenylamine | 86-30-6 | 0.330 | 10 | 130 | 1200 | 0.038 |
| 4-Bromophenyl-phenylether | 101-55-3 | 0.330 | 10 | -- | -- | -- |
| Hexachlorobenzene | 118-74-1 | 0.330 | 10 | 0.4 | 3.6 | 0.0026 |
| Pentachlorophenol | 87-86-5 | 0.800 | 25 | 5.3 | 48 | -- |
| Phenanthrene | 85-01-8 | 0.330 | 10 | -- | -- | -- |
| Anthracene | 120-12-7 | 0.330 | 10 | 2300 | 61000 | 23 |
| Carbazole | 86-74-8 | 0.330 | 10 | 32 | 290 | 0.023 |
| Di-n-butylphthalate | 84-74-2 | 0.330 | 10 | -- | -- | -- |
| Fluoranthene | 206-44-0 | 0.330 | 10 | 310 | 8200 | 0.38 |
| Pyrene | 129-00-0 | 0.330 | 10 | 230 | 6100 | 3.4 |
| Butylbenzylphthalate | 85-68-7 | 0.330 | 10 | 1600 | 41000 | 840 |
| 3,3'-Dichlorobenzidine | 91-94-1 | 0.330 | 10 | 1.4 | 13 | 0.00025 |
| Benzo(a)anthracene | 56-55-3 | 0.330 | 10 | 0.87 | 7.8 | 0.073 |
| Chrysene | 218-01-9 | 0.330 | 10 | 87 | 780 | 7.3 |
| Bis(2-ethylhexyl)phthalate | 117-81-7 | 0.330 | 10 | 46 | 410 | 140 |
| Di-n-octylphthalate | 117-84-0 | 0.330 | 10 | 160 | 4100 | 120000 |
| Benzo(b)fluoranthene | 205-99-2 | 0.330 | 10 | 0.87 | 7.8 | 0.23 |
| Benzo(k)fluoranthene | 207-08-9 | 0.330 | 10 | 8.7 | 78 | 2.3 |
| Benzo(a)pyrene | 50-32-8 | 0.330 | 10 | 0.087 | 0.78 | 0.019 |
| Indeno(1,2,3-cd)pyrene | 193-39-5 | 0.330 | 10 | 0.87 | 7.8 | 0.64 |
| Dibenz(a,h)anthracene | 53-70-3 | 0.330 | 10 | 0.087 | 0.78 | 0.07 |
| Benzo(g,h,I)perylene | 191-24-2 | 0.330 | 10 | -- | -- | -- |

## Table 2-4 (Continued)
## Summary of Analyte Quantitation Limits
## SWMU 6 Soil Investigation
## Radford Army Ammunition Plant, Radford, Virginia

| Pesticides/Aroclors TCL | Cas Number | Quantitation Limits[a] |  | Risk Screening (ug/g) |  |  |
|---|---|---|---|---|---|---|
|  |  | Low Soil (ug/g) | Low Water (ug/L) | Residential RBCs | Industrial RBCs | SSLs (DAF 1) |
| alpha-BHC | 319-84-6 | 0.0017 | 0.05 | 0.10 | 0.91 | 0.000045 |
| beta-BHC | 319-85-7 | 0.0017 | 0.05 | 0.35 | 3.2 | 0.00016 |
| delta-BHC | 319-86-8 | 0.0017 | 0.05 | -- | -- | -- |
| gamma-BHC | 58-89-9 | 0.0017 | 0.05 | 0.49 | 4.4 | 0.00022 |
| Heptachlor | 76-44-8 | 0.0017 | 0.05 | 0.14 | 1.3 | 0.042 |
| Aldrin | 309-00-2 | 0.0017 | 0.05 | 0.038 | 0.34 | 0.00038 |
| Heptachlor epoxide | 1024-57-3 | 0.0017 | 0.05 | 0.07 | 0.63 | 0.0012 |
| Endosulfan I | 959-98-8 | 0.0017 | 0.05 | 47 | 1200 | 0.98 |
| Dieldrin | 60-57-1 | 0.0033 | 0.10 | 0.04 | 0.36 | 0.00011 |
| 4,4'-DDE | 72-55-9 | 0.0033 | 0.10 | 1.9 | 17 | 1.8 |
| Endrin | 72-20-8 | 0.0033 | 0.10 | 65 | 580 | 0.27 |
| Endosulfan II | 33213-65-9 | 0.0033 | 0.10 | -- | -- | -- |
| 4,4'-DDD | 72-54-8 | 0.0033 | 0.10 | 2.7 | 24 | 0.56 |
| Endosulfan sulfate | 1031-07-8 | 0.0033 | 0.10 | -- | -- | -- |
| 4,4'-DDT | 50-29-3 | 0.0033 | 0.10 | 1.9 | 17 | 0.058 |
| Methoxychlor | 72-43-5 | 0.0170 | 0.50 | 200000 | 39 | 1.2 |
| Endrin Ketone | 53494-70-5 | 0.0033 | 0.10 | -- | -- | -- |
| Endrin Aldehyde | 7421-36-3 | 0.0033 | 0.10 | -- | -- | -- |
| alpha- Chlordane | 5103-71-9 | 0.0017 | 0.05 | -- | -- | -- |
| gamma- Chlordane | 5103-74-2 | 0.0017 | 0.05 | -- | -- | -- |
| Toxaphene | 8001-35-2 | 0.1700 | 5.0 | 0.58 | 5.2 | 0.031 |
| Aroclor-1016 | 12674-11-2 | 0.0330 | 1.0 | 0.55 | 82 | 0.21 |
| Aroclor-1221 | 11104-28-2 | 0.0670 | 2.0 | -- | -- | -- |
| Aroclor-1232 | 11141-16-5 | 0.033 | 1.0 | -- | -- | -- |
| Aroclor-1242 | 53469-21-9 | 0.067 | 1.0 | -- | -- | -- |
| Aroclor-1248 | 12672-29-6 | 0.033 | 1.0 | -- | -- | -- |
| Aroclor-1254 | 11097-69-1 | 0.067 | 1.0 | 0.32 | 2.9 | 0.054 |
| Aroclor-1260 | 11096-82-5 | 0.033 | 1.0 | 0.14 | 1.3 |  |

# Table 2-4 (Continued)
# Summary of Analyte Quantitation Limits
# SWMU 6 Soil Investigation
# Radford Army Ammunition Plant, Radford, Virginia

| Metal TAL | Cas Number | Quantitation Limits[a] | | Risk Screening (ug/g) | | |
|---|---|---|---|---|---|---|
| | | Low Soil (ug/g) | Low Water (ug/L) | Residential RBCs | Industrial RBCs | SSLs (DAF 1) |
| Aluminum | 7429-90-5 | 20 | 200 | 7800 | 200000 | -- |
| Antimony | 7440-36-0 | 6 | 60 | 31 | 82 | 0.66 |
| Arsenic | 7440-38-2 | 1 | 10 | 0.43 | 3.8 | -- |
| Barium | 7440-39-3 | 20 | 200 | 550 | 14000 | 110 |
| Beryllium | 7440-41-7 | 0.5 | 5 | 16 | 410 | 58 |
| Cadmium | 7440-43-9 | 0.5 | 5 | 7.8 | 200 | 2.7 |
| Calcium | 7440-70-2 | 500 | 5000 | -- | -- | -- |
| Chromium (VI) | 7440-47-3 | 1 | 10 | 23 | 610 | 2.1 |
| Cobalt | 7440-48-4 | 5 | 50 | 470 | 12000 | -- |
| Copper | 7440-50-8 | 2.5 | 25 | 310 | 8200 | 530 |
| Iron | 7439-89-6 | 10 | 100 | 2300 | 61000 | -- |
| Lead | 7439-92-1 | 0.3 | 3 | -- | -- | -- |
| Magnesium | 7439-95-4 | 500 | 5000 | -- | -- | -- |
| Manganese | 7439-96-5 | 1.5 | 15 | 160 | 4100 | 48 |
| Mercury | 7439-97-6 | 0.02 | 0.2 | -- | -- | -- |
| Nickel | 7440-02-0 | 4 | 40 | 160 | 4100 | -- |
| Potassium | 7440-09-7 | 500 | 5000 | -- | -- | -- |
| Selenium | 7782-49-2 | 0.5 | 5 | 39 | 1000 | 0.95 |
| Silver | 7440-22-4 | 1 | 10 | 39 | 1000 | 1.6 |
| Sodium | 7440-23-5 | 500 | 5000 | -- | -- | -- |
| Thallium | 7440-28-0 | 1 | 10 | 0.55 | 14 | 0.18 |
| Vanadium | 7440-62-2 | 5 | 50 | 55 | 1400 | 260 |
| Zinc | 7440-66-6 | 2 | 20 | 2300 | 61000 | 680 |

Notes:

[a] = Quantitation limits for soil are estimated quantitation limits based on wet weight. Actual data will be reported on a dry weight basis; therefore, the quantitation limit reported will be higher, based on the percent dry weight in each sample.

[b] = Laboratory will be requested to report estimated values for these constituents and data will be flagged with a "J". Detection limits lower than the RBC should be obtainable provided there are no matrix interferences.
RBC = USEPA Region III Risk Based Concentration (October 5, 2000);
A hazard quotient (HQ) of 0.1 is used for non carcinogens and a target risk level of 1E10-6 is used for carcinogens
(except when HQ of 0.1 is lower).
SSL = USEPA Region III Soil Screening Level (October 5, 2000). A dilution-attenuation factor (DAF) of 1 is used for SSLs.
g/g = micrograms per gram
g/L = micrograms per liter.

coupled plasma. A background correction technique is utilized to compensate for variable background contribution the determination of trace elements.

Mercury will be analyzed using CVAA according to USEPA SW-846 Method 7470A for aqueous samples and Method 7471A for solid samples. A sample aliquot is initially digested with nitric acid to free combined mercury. The mercury is then reduced to its elemental state and aerated from the solution into a closed system. The mercury vapor is passed through a cell positioned in the path of the mercury light source and the measured abundance is proportional to the concentration of mercury in the sample.

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

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

### 2.3.3 Organics

Samples will be analyzed for volatiles using USEPA SW-846 Method 5030/8260B for aqueous samples and USEPA SW-846 5035/8260B for solid matrices using purge and trap technology. Samples are to be collected using an EnCore sampling device and subsequently sent to the laboratory for analysis. Initially, the extract should be screened on a gas chromatograph/flame ionization detector (GC/FID) to assess the appropriate analytical level. Gel Permeation Chromatography will be used to clean the samples. The extract is injected into a gas chromatograph programmed to separate the compounds, which are then detected with a mass spectrometer.

Samples will be analyzed for semi-volatiles using USEPA SW-846 Method 3520/8270C for aqueous samples and USEPA SW-846 Method 3550/8270C for solid matrices using capillary column technique coupled with gas chromatography and mass spectrometry (GC/MS). Samples will be analyzed for pesticides using USEPA SW-846 Method 3550/8081A for solid matrices using capillary column technique coupled with gas chromatography (GC). Samples will be analyzed for aroclors using USEPA SW-846 Method 3550/8082 for solid matrices using capillary column technique coupled with gas chromatography.

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

See Table 1-3 for a summary of analytical methods for soil and water samples.

## 2.4 INTERNAL QUALITY CONTROL CHECK

This section discusses the internal QC components that will be used by URS during operations at RFAAP. The internal quality components include the field QC samples and the laboratory QC elements to be followed.

### 2.4.1 Field Quality Control Samples

Rinse blanks, trip blanks, and field duplicates will be collected during the acquisition of environmental samples at RFAAP. Table 1-4 presents guidelines for the collection of QC samples that will be taken in conjunction with environmental sampling at SWMU 6.

## 2.5 DATA COLLECTION , VALIDATION, AND REPORTING

Analyses will be conducted by a USACE-certified analytical laboratory. Level IV CLP-like raw data will be provided along with the Form 1. Formal data validation is beyond the scope this Work Plan, however, a data package sufficient to allow for future data validation will be provided.

URS will direct the overall data management. Data activity for the sampling program will be divided between URS and CompuChem Laboratories. Each firm has the equipment needed to perform the required data management functions. The laboratory will perform data entry and manipulation operations associated with the analysis of raw analytical data and provisions of chemical analysis results by sampling location. These data will be transmitted to URS for evaluation and interpretation. URS will also code and review boring logs and sample location maps

The laboratory will provide analytical results in Microsoft Excel software, for subsequent translation to Microsoft Access database format. In addition, ERIS data input support will be provided.

The Sampling and Analyses Report will contain data obtained during the investigation, organized in a logical sequence and presented in a technical format. It will include summaries of findings, problems encountered during the investigation and actions taken to correct those problems. It will also include laboratory data, boring logs, and sampling locations. Conclusions and recommendations based on the entirety of data will be presented.

A draft and final version of the Soil Sampling Report will be prepared. The submittal of each will include the original and 19 copies.

The proposed schedule for project implementation is presented in Appendix C. As is presented in the schedule, the results of the fieldwork are anticipated in mid-December 2000, with a draft findings report slated for completion in early February 2001.

## 3.0 HEALTH AND SAFETY PLAN ADDENDUM

### 3.1 OBJECTIVE

This site specific Health and Safety Plan Addendum (HSPA) was developed to provide the requirements for protection of site personnel, including government employees, URS Corporation, regulators, subcontractors, and visitors, who are expected to be involved with soil boring advancement/sampling at SWMU 6.

This HSPA addresses project-specific hazards, which include physical hazards, biological hazards, and chemical hazards, as identified in Section 3.2.2, below. Of these hazards, the potential exposure to concentrated acids or acid fumes is of primary concern. The project location has active overhead piping that is transporting highly acidic and explosive material. In addition, concentrated acid is stored in aboveground storage tanks immediately adjacent to the project work area. If a nearby acid tank or pressurized overhead acid line were to rupture, the potential exists that acid could spray on site personnel causing serious burns, or create fumes which could hinder breathing. This potential emergency situation will be covered in detail prior to starting the work.

This addendum addresses site-specific training, personal protective equipment (PPE), and air monitoring requirements. General health and safety issues that are also applicable to this scope of work are addressed in Volume III of the MWP, as shown in Table 3-1.

**Table 3-1**
**Health and Safety Issues Discussed in the MWP**
**SWMU 6 Soil Sampling**
**Radford Army Ammunition Plant, Radford, Virginia**

| Health and Safety Issue | Section in MHSP |
|---|---|
| Site Safety and Health Documentation | 1.4 |
| Safety Statement | 1.5 |
| Personnel H&S Responsibilities | 2.1 |
| Hazard Assessment and Control | 3.0 |
| Training Plan, General | 4.0 |
| Medical Surveillance Plan | 5.0 |
| Site Safety and Control | 6.0 |
| Personal Protective Equipment | 7.0 |
| Personnel and Equipment Decontamination | 8.0 |
| Monitoring Plan | 9.0 |
| Emergency Response and Contingency Plan | 10.0 |

URS and subcontractor personnel performing field activities and site visitors will read this HSPA and will be required to follow its protocols as minimum standards. This HSPA is written for the site-specific conditions at SWMU 6 and must be amended if conditions change. A copy of this HSPA will be available at each work site.

### 3.2 TRAINING PLAN

Training will be used to review important topics outlined in this addendum and to inform URS personnel and subcontractor personnel of the hazards and control techniques associated with facility-wide background locations.

Site personnel will be informed of the specific personal protective equipment that will be worn during all field activities. This includes at a minimum steel-toed boots, safety glasses with side shields, gloves, acid-resistant suits (the same type as used by RFAAP employees in this area), and hardhat with acid-resistant neck-flaps. Each field person will also have a respirator onsite, in the event that an emergency occurs and a respirator is necessary for site evacuation, or if the use of a respirator is necessary based on air monitoring results. Prior to beginning fieldwork, all staff will be required to review the manual "Safety Rules for Contractors and Subcontractors". Additional training, which will be conducted during daily safety "tailgate" meetings, will include emergency and evacuation procedures, general safety rules, and use of automobiles.

Written documentation will be kept onsite of safety briefings.

#### 3.2.1 Hazard Information Training

Hazard information training will be presented to URS and subcontractor personnel to provide a description of the Hazardous, Toxic, Radioactive Waste (HTRW) with the potential to be found at SWMU 6. Training will also be provided on the potential biological, chemical, and physical hazards to be found at the installation. This training will be conducted by the URS site safety and health officer based on information provided by the operating contractor.

#### 3.2.2 Project-Specific Hazard Analysis

The following hazards must be recognized and controlled during applicable investigation activities:

*(1)* *Physical Hazards*

- *Cold stress – refer to Section 3.2.2 of the MWP;*
- *Manual lifting – refer to Section 3.2.4 of the MWP;*
- *Slips, trips and falls associated with walking through heavily vegetated areas – refer to Section 6.1.1 of the MWP;*
- *Heavy equipment – refer to Section 6.1.2.1 of the MWP; and*
- *Manufacturing Area – overhead acid lines.*

*(2)* *Biological Hazards (refer to Section 3.3 of the MWP)*

- *Insect bites and stings;*
- *Tick bites;*

- *Snake bites; and*
- *Plants.*

(3) *Chemical Hazards*

- *Potential exposure to carcinogenic chemicals; and*
- *Potential exposure to corrosive chemical including strong acids; and*
- *Potential exposure to dangerous fumes in the event of a nearby release or spill of acids, resulting in the creation of a fume cloud.*

### 3.2.3 Hearing and Conservation Training

Site personnel involved in heavy equipment operation in addition to other operations involving exposure to noise levels exceeding 85 dBA 8-hour time-weighted average (TWA), shall be trained according to 29 CFR 1910.95. This training shall address the effects of noise on hearing, the purpose, advantages, disadvantages, and selection of hearing protection devices, and the purpose and explanation of audiometric test procedures.

### 3.2.4 Hazard Communication Training

In order to comply with the requirements of the OSHA Hazard Communication (HAZCOM) Standard, 29 CFR 1910.1200, URS will have a written HAZCOM Program in place. The written hazard communication program addresses training (including potential safety and health effects from exposure), labeling, current inventory of hazardous chemicals on site, and the location and use of Material Safety Data Sheets (MSDSs). The SHSO will arrange HAZCOM training for site personnel at the time of initial site assignment. Whenever a new hazardous substance is introduced into the work area or an employee changes job locations where new chemicals are encountered, supplemental HAZCOM training shall be scheduled and presented. HAZCOM training shall be documented by the SHSO using a HAZCOM Employee Training Record. This documentation and URS' HAZCOM program will be maintained onsite for the duration of the project, and later incorporated in the employees' personal training file.

### 3.2.5 Confined Space Entry Training

Confined space entry training will not be required for fieldwork, as there will be no confined spaces encountered during this investigation.

## 3.3 SITE SAFETY AND CONTROL

Site safety is the responsibility of site personnel. Personnel on site will be required to follow safe work practices contained in this section, and immediately notify the SHSO of conditions that do not comply with the Master Health and Safety Plan (MHSP). These provisions are intended to be the minimum safe practices that site personnel will follow.

## 3.4 PERSONAL PROTECTIVE EQUIPMENT AND CLOTHING

Acid resistant PPE will be required during fieldwork. The minimum and initial level of PPE for these activities will be Modified Level D. The initial selection of PPE is based on a hazard assessment, including the review of existing analytical data and related toxicological information with respect to the proposed field activities. PPE assignments are subject to change based upon site conditions and task variation. The SHSO will review the required level of protection and safety equipment for each task with the sampling crew. The decisions on which protective level is most appropriate will be made by the SHSO.

In accordance with 29 CFR 1910.134, URS personnel working on site will be required to participate in URS Corporation's written respiratory protection program. Personnel slated for fieldwork will have a qualitative fit test performed at least once per year or more frequently as required by law. Site personnel will be trained on the use, limitations, maintenance, inspection, and cleaning of respirators.

## 3.5 MONITORING PLAN

During sampling activities, the SHSO will monitor the site initially and periodically for potentially hazardous airborne contaminants or physical hazards. A Photoionization Detector (PID) will be used to detect organic vapors. The PID will be calibrated on a daily basis in accordance with the manufacturer's calibration instructions. The action levels for volatile organics at sustained concentrations in the breathing zone are as follows:

| **PID Readings** | **Action** |
|---|---|
| Background + 5 ppm | Investigate |
| 5 ppm to 25 ppm | Upgrade to Level C (full face air-purifying respirator with organic vapor/acid gas cartridge), investigate |
| Greater than 25 ppm | Suspend work, depart area, investigate |

# APPENDIX A

## APPLICABLE STANDARD OPERATING PROCEDURES (SOPs)

# STANDARD OPERATING PROCEDURE 10.1
# FIELD LOGBOOK

## 1.0 SCOPE AND APPLICATION

The purpose of this standard operating procedure (SOP) is to delineate protocols for recording daily site investigation activities.

Records should contain sufficient information so that anyone can reconstruct the sampling activity without relying on the collector's memory.

## 2.0 MATERIALS

- Field Logbook
- Indelible ink pen
- Clear tape

## 3.0 PROCEDURE

Information pertinent to site investigations will be recorded in a bound logbook. Each page/form will be consecutively numbered, dated, and signed. All entries will be made in indelible ink and all corrections will consist of line-out deletions that are initialed and dated. If only part of a page is used, the remainder of the page should have an "X" drawn across it. At a minimum, entries in the logbook will include but not be limited to the following:

- Project name (cover)
- Name and affiliation of personnel on site
- Weather conditions
- General description of the field activity
- Sample location
- Sample identification number
- Time and date of sample collection.
- Specific sample attributes (e.g. sample collection depth flow conditions, or matrix)
- Sampling methodology (grab or composite sample)
- Sample preservation, as applicable
- Analytical request/methods
- Associated QA/QC samples
- Field measurements/observations, as applicable
- Signature and date of personnel responsible for documentation

## 4.0 MAINTENANCE

Not applicable.

## 5.0 PRECAUTIONS

None.

## 6.0 REFERENCES

USEPA. 1990. *Sampler's Guide to the Contract Laboratory Program*. EPA/540/P-90/006, Directive 9240.0-06, Office of Emergency and Remedial Response, Washington, D.C., December 1990.

USEPA. 1991. *User's Guide to the Contract Laboratory Program*. EPA/540/O-91/002, Directive 9240.0-01D, Office of Emergency and Remedial Response, January 1991.

USEPA. 1980. *Interim Guidelines and Specifications for Preparing Quality Assurance Project Plans*. QAMS-005/80.

# STANDARD OPERATING PROCEDURE 10.2
# SURFACE WATER, GROUNDWATER, AND SOIL/SEDIMENT FIELD LOGBOOKS

## 1.0 SCOPE AND APPLICATION

The purpose of this standard operating procedure (SOP) is to delineate protocols for recording surface water, groundwater, soil/sediment sampling information, as well as instrument calibration data in field logbooks.

## 2.0 MATERIAL

- Applicable field logbook (see attached forms)
- Indelible ink pen

## 3.0 PROCEDURE

All information pertinent to surface water, groundwater, or soil/sediment sampling will be recorded in the appropriate logbook. Each page/form of the logbook will be consecutively numbered. All entries will be made with an indelible ink pen. All corrections will consist of line-out deletions that are initialed and dated.

### 3.1 SOIL/SEDIMENT

#### 3.1.1 Field Parameters/Logbook (Form 10.2-a)

1. HIGH CONCENTRATION EXPECTED?: answer "Yes" or "No."
2. HIGH HAZARD?: answer "Yes" or "No."
3. INSTALLATION/SITE: record the complete name of the installation or site.
4. AREA: record the area designation of the sample site.
5. INST CODE: record the 2 letter installation code appropriate for the installation or site. Correct abbreviations can be found on pages 3-6 of the IRDMIS User's Guide for chemical data entry. Radford is "RD".
6. FILE NAME: record "CSO" for a soil sample, "CSE" for a sediment sample, or "GW" for groundwater sample.
7. SITE TYPE: record the abbreviation appropriate for where the sample was taken. Correct abbreviations can be found on pages 18-21 of the IRDMIS User's Guide for chemical data entry. This entry must match the Site Type on the map file form.
8. SITE ID: record a code up to 10 characters or numbers which is unique to the site.
9. FIELD SAMPLE NUMBER: record a code specific for the sample.
10. DATE: enter the date the sample was taken.
11. TIME: enter the time (12 hour or 24 hour clock acceptable as long as internally consistent) the sample was taken.
12. AM PM: circle "AM" or "PM" to designate morning or afternoon (12 hour clock).
13. SAMPLE PROG: record "GQA" (Groundwater Quality Assessment) or other appropriate sample program.
14. DEPTH (TOP): record the total depth sampled.
15. DEPTH INTERVAL: record the intervals at which the plug will be sampled.
16. UNITS: record the units of depth (feet, meters)
17. SAMPLE MEASUREMENTS: check the appropriate sampling method.
18. CHK: check off each container released to a laboratory.
19. ANALYSIS: record the type of analysis to be performed on each sample container.
20. SAMPLE CONTAINER: record the sample container type and size.
21. NO.: record the number of containers.
22. REMARKS: record any remarks about the sample
23. TOTAL NUMBER OF CONTAINERS FOR SAMPLE: record the total number of containers.
24. SITE DESCRIPTION: describe the location where the sample was collected.
25. SAMPLE FORM: record the form of the sample (i.e., clay, loam, etc.) using The Unified Soil Classification System (USCS).
26. COLOR: record the color of the sample as determined from standard Munsell Color Charts.
27. ODOR: record the odor of the sample or "none".
28. PID (HNu): record the measured PID (HNu™) values.
29. UNUSUAL FEATURES: record anything unusual about the site or sample.
30. WEATHER/ TEMPERATURE: record the weather and temperature.
31. SAMPLER: record your name.

#### 3.1.2 Map File Form (refer to form 10.2-c)

1. SITE ID: record the Site ID from the field parameter form.

2. POINTER: record the field sample number for the sample being pointed to.
3. DESCRIPTION/ MEASUREMENTS: describe the location where the sample was taken, along with distances to landmarks.
4. SKETCH/ DIMENSIONS: diagram the surroundings and record the distances to landmarks.
5. MAP REFERENCE: record which U.S.G.S. Quad Map references the site.
6. COORDINATE DEFINITION: write the compass directions the X- and Y-Coordinates of the map run.
7. COORDINATE SYSTEM: write "UTM" (Universal Transverse Mercator).
8. SOURCE: record the 1 digit code representing the Map Reference.
9. ACCURACY: give units (e.g.write "1-M" for 1 meter).
10. X-COORDINATE: record the X-Coordinate of the sample site location.
11. Y-COORDINATE: record the Y-Coordinate of the sample site location.
12. UNITS: record the units map sections are measured in.
13. ELEVATION REFERENCE: record whether topography was determined from a map or a topographical survey.
14. ELEVATION SOURCE: record the 1 digit code representing the elevation reference.
15. ACCURACY: record the accuracy of the map or survey providing the topographical information.
16. ELEVATION: record the elevation of the sampling site.
17. UNITS: write the units in which the elevation is recorded.
18. SAMPLER: write your name.

## 3.2 SURFACE WATER

### 3.2.1 Field Parameter Logbook (Forms 10.2-b and 10.2-c)

1. CAL REF: record the calibration reference for the pH meter.
2. pH: record the pH of the sample.
3. TEMP: record the temperature of the sample in degrees Celsius.
4. COND: record the conductivity of the water.
5. Description of site and sample conditions (refer to 10.2-b).
6. Map File Form (refer to Section 3.1.2)

## 3.3 GROUNDWATER (FORMS 10.2- D)

### 3.3.1 Field Parameter Logbook (Form 10.2.b)

Refer to Section 3.2.1.

### 3.3.2 Map File and Purging Forms

1. WELL NO. OR ID: record the abbreviation appropriate for where the sample was taken. Correct abbreviations can be found on pages 18-21 of the IRDMIS User's Guide for chemical data entry.
2. SAMPLE NO.: record the reference number of the sample.
3. WELL/SITE DESCRIPTION: describe the location where the sample was taken, along with distances to landmarks.
4. X-COORD and Y-COORD: record the survey coordinates for the sampling site.
5. ELEV: record the elevation where the sample was taken.
6. UNITS: record the units the elevation was recorded in.
7. DATE: record the date in the form MM/DD/YY.
8. TIME: record the time, including a designation of AM or PM.
9. AIR TEMP.: record the air temperature, including a designation of C or F (Celsius or Fahrenheit).
10. WELL DEPTH: record the depth of the well in feet and inches.
11. CASING HT.: record the height of the casing in feet and inches.
12. WATER DEPTH: record the depth (underground) of the water in feet and inches.
13. WELL DIAMETER: record the diameter of the well in inches.
14. WATER COLUMN HEIGHT: record the height of the water column in feet and inches.
15. SANDPACK DIAM.: record the diameter of the sandpack. Generally, this will be the same as the bore diameter.
16. EQUIVALENT VOLUME OF STANDING WATER: use one of the following equations, to determine one equivalent volume (EV):

1 EV = volume in casing + volume in saturated sand pack. Or:

$$1\ \text{EV} = [\pi R_w^2 h_w + 0.30p(R_s^2 - R_w^2)h_s] * (0.0043)$$

where:

$R_s$ = radius of sandpack in inches
$R_w$ = radius of well casing in inches

$h_s$ = height of sandpack in inches
$h_w$ = water depth in inches

$$0.0043 = \text{gal/in}^3$$

and filter pack porosity is assumed as 30%, or

$$\text{Volume in casing} = (0.0043\ \text{gal/in}^3)(p)(12\ \text{in/ft})(R_c^2)(W_h)$$

where:

$R_c$ = radius of casing in inches, and
$W_h$ = water column height in feet

$$\text{Vol. in sandpack} = (0.0043\ \text{gal/in}^3)(p)(12\ \text{in/ft})(R_b^2 - R_c^2)(W_h)(0.30)$$

(if $W_h$ is less than the length of the sandpack), or

$$\text{Vol. in sandpack} = (0.0043\ \text{gal/in}^3)(p)(12\ \text{in/ft})(R_b^2 - R_c^2)(S_h)(0.30)$$

(if $W_h$ is greater than the length of the sandpack).

where:

$R_b$ = radius of the borehole, and
$S_h$ = length of the sandpack.

Show this calculation in the comments section.

1. VOLUME OF BAILER OR PUMP RATE: record bailer volume or pump rate.
2. TOTAL NUMBER OF BAILERS OR PUMP TIME: record the number of bailers required to remove 3 equivalent volumes (EV) of water from the well or the total purge time and volume as applicable.
3. WELL WENT DRY? write "YES" OR "NO."
4. NUMBER OF BAILERS OR PUMP TIME: record the number of bailers or pump time which made the well go dry.
5. VOLUME REMOVED: record the volume of water (gal) removed before the well went dry.
6. RECOVERY TIME: record the time required for the well to refill.
7. PURGE AGAIN?: answer "YES" or "NO."
8. TOTAL VOL. REMOVED: record the total volume of water (in gallons) removed from the well.
9. CAL REF.: record the calibration reference for the pH meter.
10. TIME: record time started (INITIAL T(0)), 2 times DURING the sampling and the time sampling ended (FINAL).
11. pH: record the pH at start of sampling (INITIAL), twice DURING the sampling and at the end of sampling (FINAL).
12. TEMP: record the water temperature (Celsius) at the start of sampling, twice DURING the sampling and at the end of sampling (FINAL).
13. COND: record the conductivity of the water at the start of sampling, twice DURING the sampling and at the end of sampling (FINAL).
14. D.O.: record the dissolved oxygen level in the water at the start of sampling, twice DURING the sampling and at the end of sampling (FINAL).
15. TURBIDITY: record the readings from the turbidity meter (nephelometer) and units at the start of sampling, twice DURING the sampling and at the end of sampling (FINAL).
16. ORD: record the oxidation/reduction (RedOx) potential of the water sample at the start of sampling, twice DURING the sampling and at the end of sampling (FINAL).
17. HEAD SPACE: record any positive readings from organic vapor meter reading taken in well headspace prior to sampling.
18. NAPL: Record the presence and thickness of any non aqueous phase liquids (LNAPL and DNAPL)
19. COMMENTS: record any pertinent information not already covered in the form.
20. SIGNATURE: sign the form.

### 3.4 FIELD CALIBRATION FORMS (REFER TO FORM 10.2-E)

1. Record time and date of calibration.
2. Record calibration standard reference number.
3. Record meter I.D. number
4. Record initial instrument reading, recalibration reading (if necessary), and final calibration reading on appropriate line.
5. Record value of reference standard (as required).
6. COMMENTS: Record any pertinent information not already covered on form.
7. SIGNATURE: sign form.

## 4.0 MAINTENANCE

Not Applicable.

## 5.0 PRECAUTIONS

None.

## 6.0 REFERENCE

User's Guide to the Contract Laboratory Program, USEPA, July, 1984.

## FIELD PARAMETER/LOGBOOK FORM 10.2-a
## SOIL AND SEDIMENT SAMPLES

---

HIGH CONCENTRATION EXPECTED? ____________ HIGH HAZARD?

---

INSTALLATION/SITE ______________________ AREA ____________

INST CODE ________ FILE NAME ______________________

SITE TYPE ________ SITE ID ____________
FIELD SAMPLE NUMBER ____________

DATE (MM/DD/YY) __/__/__ TIME ________ AM PM SAMPLE PROGRAM

DEPTH (TOP) _____ DEPTH INTERVAL ________ UNIT ________

SAMPLING METHOD:

SPLIT SPOON __ AUGER __ SHELBY TUBE __ SCOOP __ OTHER

---

| CHK | ANALYSIS | SAMPLE CONTAINER | NO. | REMARKS |
|---|---|---|---|---|

TOTAL NUMBER OF CONTAINERS FOR SAMPLE_____

---

### DESCRIPTION OF SITE AND SAMPLE CONDITIONS

SITE DESCRIPTION:______________________________________

______________________________________________________

______________________________________________________

SAMPLE FORM ____________ COLOR __________ ODOR ________
PID (HNu)____________ UNUSUAL FEATURES______________

---

WEATHER/TEMPERATURE

SAMPLER ____________

# FIELD PARAMETER/LOGBOOK FORM 10.2-b
# GROUNDWATER AND SURFACE WATER SAMPLES

---

HIGH CONCENTRATION EXPECTED? ________________ HIGH HAZARD?

---

INSTALLATION/SITE ____________________ AREA

INST CODE _________ FILE NAME ___________________ SITE TYPE

SITE ID _________________ FIELD SAMPLE NUMBER

DATE (MM/DD/YY) __/__/__ TIME _________ AM PM SAMPLE PROG.

DEPTH (TOP) ________ DEPTH INTERVAL __________ UNITS

---

## SAMPLING MEASUREMENTS

CAL REF. ____ pH ____ TEMPERATURE °C ____ CONDUCTIVITY ____ OTHER

---

| CHK | ANALYSIS | SAMPLE CONTAINER | NO. | REMARKS |
|---|---|---|---|---|

TOTAL NUMBER OF CONTAINERS FOR SAMPLE_____

---

## DESCRIPTION OF SITE AND SAMPLE CONDITIONS

SITE DESCRIPTION________________________________________________

SAMPLING METHOD__________________________________

SAMPLE FORM _______________ COLOR _______ ODOR _______

PID (HNu)________________________________

UNUSUAL FEATURES__________________________

WEATHER/TEMPERATURE_____________________________ SAMPLER ______________

# EXAMPLE MAP FILE LOGBOOK FORM 10.2-c
# SURFACE WATER, SOIL, AND SEDIMENT SAMPLES

---

SITE ID______________________ POINTER________________

DESCRIPTION/MEASUREMENTS______________________________________________________

SKETCH/DIMENSIONS :

MAP REFERENCE____________________________________

COORDINATE DEFINITION (X is _____________ Y is __________)

COORDINATE SYSTEM _____________ SOURCE _____________ ACCURACY________________

X-COORDINATE __________ Y-COORDINATE __________ UNITS________

ELEVATION REFERENCE______________________________

ELEVATION SOURCE _____________ ACCURACY ____________ELEVATION________________

UNITS_____________

SAMPLER________

## EXAMPLE MAP FILE AND PURGING LOGBOOK FORM 10.2-d
## GROUNDWATER SAMPLES

WELL COORD. OR ID ____________ SAMPLE NO. ________

WELL/SITE DESCRIPTION ____________________________

X-COORD. ______ Y-COORD. ________ ELEV. ______ UNITS

DATE ___/___/___ TIME ________ AIR TEMP.

WELL DEPTH ________ FT. _____ IN. CASING HT. ____ FT. ____ IN.

WATER DEPTH _____ FT. _____ IN. WELL DIAMETER ______ IN.

WATER COLUMN HEIGHT ______ FT. _____ IN. SANDPACK DIAM. ____ IN.

EQUIVALENT VOLUME OF STANDING WATER ________ (GAL) (L)

VOLUME OF BAILER ______ (GAL) (L) or PUMP RATE ______ (GPM) (LPM)

TOTAL NO. OF BAILERS (5 EV) ______ or PUMP TIME ______ MIN.

WELL WENT DRY? [Yes] [No] NUM. OF BAILERS ______ or PUMP TIME

VOL. REMOVED ________ (GAL) (L) RECOVERY TIME

PURGE AGAIN? [Yes] [No] TOTAL VOL. REMOVED ______ (GAL) (L)

| DATE & TIME | QUANTITY REMOVED | TIME REQ'D | pH | Cond | Temp | ORD | Turb | DO | Character of water (color / clarity / odor / partic.) |
|---|---|---|---|---|---|---|---|---|---|
| (before) | | | | | | | | | |
| (during) | | | | | | | | | |
| (during) | | | | | | | | | |
| (during | | | | | | | | | |
| (after) | | | | | | | | | |

COMMENTS ____________________________

SIGNATURE

# EXAMPLE FIELD CALIBRATION FORM 10.2-e
# FOR pH, CONDUCTIVITY, TEMPERATURE, TURBIDITY, ORD, AND DISSOLVED OXYGEN METERS

| INITIAL CALIBRATION | FINAL CALIBRATION |
|---|---|
| DATE: | DATE: |
| TIME: | TIME: |

## pH METER CALIBRATION

CALIBRATION STANDARD REFERENCE NO:_______________

METER ID_________________

| pH STANDARD | INITIAL READING | RECALIB. READING | FINAL READING |
|---|---|---|---|
| 7.0 | | | |
| 10.0 | | | |
| 4.0 | | | |

## CONDUCTIVITY METER CALIBRATION

CALIBRATION STANDARD REFERENCE NO:_______________

METER ID_________________

| COND. STANDARD | INITIAL READING | RECALIB. READING | FINAL READING |
|---|---|---|---|
| | | | |
| | | | |

## TEMPERATURE METER CALIBRATION

METER ID_________________

| TEMP. STANDARD | INITIAL READING | RECALIB. READING | FINAL READING |
|---|---|---|---|
| ICE WATER | | | |
| BOILING WATER | | | |
| OTHER ________ | | | |

# EXAMPLE FIELD CALIBRATION FORM 10.2-e
# FOR pH, CONDUCTIVITY, TEMPERATURE, TURBIDITY, ORD, AND DISSOLVED OXYGEN METERS

## TURBIDITY METER CALIBRATION

CALIBRATION STANDARD REFERENCE NO:________________

METER ID__________________

| STANDARD | INITIAL READING | RECALIB. READING | FINAL READING |
|---|---|---|---|
| | | | |
| | | | |
| | | | |

## ORD METER CALIBRATION

CALIBRATION STANDARD REFERENCE NO:________________

METER ID__________________

| STANDARD | INITIAL READING | RECALIB. READING | FINAL READING |
|---|---|---|---|
| | | | |
| | | | |
| | | | |

## DISSOLVED OXYGEN METER CALIBRATION

CALIBRATION STANDARD REFERENCE NO:________________

METER ID__________________

| STANDARD | INITIAL READING | RECALIB. READING | FINAL READING |
|---|---|---|---|
| | | | |
| | | | |
| | | | |

COMMENTS____________________________________________________________

SIGNATURE__________________________________

# STANDARD OPERATING PROCEDURE 10.3
# BORING LOGS

## 1.0 INTRODUCTION

The purpose of this standard operating procedure (SOP) is to describe the methods to be followed for classifying soil and rock, as well as preparing borehole logs and other types of soil reports.

## 2.0 MATERIALS

The following equipment is required for borehole logging:

- Boring log forms
- Daily inspection report forms
- Chain-of-custody forms
- Request for analysis forms
- USCS Table and Classification Chart
- Soil color chart (i.e., Munsell)
- Grain size and roundness chart
- Graph paper
- Engineer's scale
- Previous reports and boring logs
- Pocket knife or putty knife
- Hand lense
- Dilute hydrochloric acid (10% volume)
- Gloves
- Personal protective clothing and equipment, as described in the project health and safety plan
- Aluminum foil and paper towels

## 3.0 PROCEDURE

Borehole logging is the systematic observation and recording of geologic and hydrogeologic information from subsurface borings and excavations. The United Soil Classification System (USCS) is used to identify, classify, and describe soil.

The need for consistency in lithologic descriptions cannot be overstressed, especially if several individuals are involved in logging holes during a particular project. Subsequent construction of cross-sections necessary for understanding the geology and hydrogeology of a site depend upon consistent logging description.

Soil classification and borehole logging should be conducted by a geologist or other professional trained in the classification of soils. In many states, drilling, logging, and other borehole-related activities, such as building wells, must be conducted under the supervision of a professional (i.e., geologist or engineer) registered in the designated state.

Soils are typically logged in conjunction with advancing boreholes and sampling subsurface soils. Although the procedure focuses on classifying soil samples obtained from boreholes, the procedure described below also applies to soils and sediments collected using other techniques (e.g., post hole digger, scoop, Van Veen sampler, hand-augers, and backhoes.)

The USCS categorizes soils into 15 basic groups with distinct geologic and engineering properties. The following steps are required to classify a soil sample:

1. Observe basic properties and characteristics of the soil. These include grain size grading and distribution and influence of moisture on fine-grained soil.
2. Assign the soil a USCS classification and denote it by the standard group name and symbol.
3. Provide a written description to differentiate between soils in the same group if necessary.

Many soils have characteristics that are not clearly associated with a specific soil group. These soils might be near the borderline between groups, based on either grain size grading and distribution or distribution of plasticity characteristics. In such a case, assigning dual group names and symbols (e.g., GW/GC or ML/CL) might be an appropriate method of describing the soil. The two basic soils groups, coarse- and fine-grained soils, are discussed in the following sections.

### 3.1 COURSE-GRAINED CLASSIFICATION

For soils in the coarse-grained soils group, more than half of the material in the soil matrix is larger than No. 200 sieve (0.074 mm).

1. Coarse-grained soils are classified on the basis of:
   a) grain size and distribution,
   b) quantity of fine-grained material (i.e., silt and clay as a percentage), and
   c) character of fine-grained material.
2. The following symbols are used for classification:

| Basic Symbols | Modifying Symbols |
|---|---|
| G = gravel | W = well graded |
| S = sand | P = poorly graded |
| | M = with silty fines |
| | C = with clayey fines |

3. The following basic facts apply to coarse-grained soil classification.

- The basic symbol G is used if the estimated percentage of gravel is greater than that for sand. In contrast, the symbol S is used when the estimated percentage of sand is greater than the percentage of gravel.

- Gravel ranges in size from 3-inch to 1/4-inch (No. 4 sieve) diameter. Sand ranges in size from the No. 4 sieve to No. 200 sieve. The Grain Size Scale used by Engineers (ASTM Standards D 422-63 and D 643-78) is the appropriate method to further classify grain size as specified by the USCS. (Note: This grain size scale differs from the Modified Wentworth Scale used by most geologists. It introduces a distinction between sorting and grading.)
- Modifying symbol W indicates good representation of all particle sizes.
- Modifying symbol P indicates that there is an excess or absence of particular sizes.
- The symbol W or P is used only when there is less than 15 percent fines in a sample.
- Modifying symbol M is used if fines have little or no plasticity (silty).
- Modifying symbol C is used if fines have low to high plasticity (clayey).
- The following rules apply for the written description of the soil group name:

| Types of Soil | Rule |
|---|---|
| Sand and gravel | Less than 5 percent fines |
| Sand (or gravel) | 5 to 15 percent fines with fines |
| Silty (or clayey) | Greater than 15 percent fines sand or gravel |

## 3.2 OTHER PARAMETERS

Designate relative density for sand and gravel using blow count data recording the number of blows for each 6 inches in field log, but only the number of blows for the last 1 foot in the final log (or the number of blows for the amount of penetration obtained). The following are some "rule-of-thumb" guidelines:

| Blow Count | Relative Density for Sand and Silt |
|---|---|
| 0 - 4 | Very loose |
| 4 - 10 | Loose |
| 10 - 30 | Medium dense |
| 30 - 50 | Dense |
| >50 | Very Dense |

Record the color/discoloration of the sample. Name it according to the Munsell Soil Color Chart for soil or the GSA Rock Color Chart for rock. Do not describe soil color using the rock chart, or vice versa. If you have only one of the color charts, indicate so on the log. Write the color identification in parenthesis following the color name: (10 YR, 3/2).

Record the approximate percentage of gravel, sand, and fines (use a percentage estimation chart).

| Modifiers | Descriptions |
|---|---|
| Trace | Less than 5 percent |
| Few | 5 to 10 percent |
| Little | 15 to 25 percent |
| Some | 30 to 45 percent |
| Mostly | 50 to 100 percent |

Other parameters to record include maximum grain size, mineralogic composition of grains, mineralogy, grain shape (round, subround, angular, subangular), in-place moisture content (dry, moist, or wet), structure, presence of organic material, cementation by carbonates or silicates, free calcium carbonate (check for effervescence with HCl), and odor.

## 3.3 FINE-GRAINED CLASSIFICATION

If one-half or more of the material is smaller than No. 200 sieve (0.074 mm) the soil is classified as fine-grained.

1. Fine-grained soils are classified on the basis of liquid limit and plasticity.
2. Classification of fine-grained soils uses the following symbols:

| Basic Symbols | Modifying Symbols |
|---|---|
| M = silt (non plastic) | L = low liquid limit (Lean) |
| C = clay (plastic) | H = high liquid limit (Fat) |
| O = organic | |
| Pt = peat | |

3. The following basic facts apply to fine-grained soil classification:
    - The basic symbol M is used if the soil is mostly silt, while the symbol C applies if it consists mostly of clay.
4. Use of symbol O indicates that organic matter is present in an amount sufficient to influence soil properties. The symbol Pt indicates soil that consists mostly of organic material.

- Modifying symbols (L and H) are based on the following hand tests conducted on a soil sample.
    - Dry strength (crushing resistance)
    - Dilatency (reaction to shaking)
    - Toughness (consistency near plastic limit)
- Soil designated ML has little or no plasticity and can be recognized by slight dry strength, quick dilatency, and slight toughness.
- CL indicates soil with slight to medium plasticity, which can be recognized by medium to high dry strength, very slow dilatency, and medium toughness.
- OL is used to describe a soil that is less plastic than CL soil and can be recognized by slight to medium dry

strength, medium to slow dilatency, organic content, color, odor, and slight toughness.

- MH soil has slight to medium plasticity and can be recognized by low dry strength, slow dilatency, and slight to medium toughness.
- Soil designated CH has high plasticity and is recognizable by its high dry strength, no dilatency, and high toughness.
- OH soil is less plastic than CH soil and can be recognized by medium to high dry strength, slow dilatency, and slight to medium toughness.

Record consistency for clayey silt and clay using blow count data, recording the number of blows for each 6 inches in the log, (or the number of blows for the amount of penetration obtained). The following are some "rule-of-thumb" guidelines:

| Blow Count | Consistency for Clays | Description |
|---|---|---|
| 0-2 | Very Soft | Sample sags or slumps under its own weight |
| 2-4 | Soft | Sample can be pinched in two between the thumb and forefinger |
| 4-8 | Firm | Sample can be easily imprinted with fingers |
| 8-16 | Stiff | Sample can be imprinted only with considerable pressure of fingers |
| 16-32 | Very Stiff | Sample can be imprinted very slightly with fingers |
| >32 | Hard | Sample cannot be imprinted with fingers; can be pierced with pencil |

Other descriptive information to be included is color, moisture content, structure compactness (loose, dense) for silt, results of a pocket torvane test in tons per square foot (in clayey soil only), results of a pocket penetrometer test in tons per square foot, and odor.

## 3.4 PROCEDURES FOR ROCK CLASSIFICATION

For rock classification record mineralogy, texture, and structural features (e.g.: biotite and quartz fine grains, foliated parallel to relict bedding oriented 15 to 20 degrees to core axis, joints coated with iron oxide). Describe the physical characteristics of the rock which are important for engineering considerations such as fracturing (including minimum, maximum and most common and degree of spacing), hardness, and weathering.

1. The following is to be used as a guide for assessing fracturing:

| AEG Fracturing | Spacing |
|---|---|
| Crushed | up to 0.1 foot |
| Intense | 0.1 foot - 0.5 foot |
| Moderate | 0.5 foot - 10. foot |
| Slight | 1.0 foot - 3.0 foot |
| Massive | > 3.0 foot |

2. Record hardness using the following guidelines:

| Hardness | Criteria |
|---|---|
| Soft | Reserved for plastic material |
| Friable | Easily crumbled by finger pressure |
| Low | Deeply gouged or carved with pocket knife |
| Moderate | Readily scratched with knife; scratch leaves heavy trace of dust |
| Hard | Difficult to scratch with knife; scratch produces little powder and is often faintly visible |
| Very Hard | Cannot be scratched with knife |

3. Describe weathering using the following guidelines:

| Weathering | Decomposition | Discoloration | Fracture Condition |
|---|---|---|---|
| Deep | Moderate to complete alteration of minerals feldspars altered to clay, etc. | Deep and thorough | All fractures extensively coated with oxides, carbonates, or clay |
| Moderate | Slight alteration of minerals, cleavage surface lusterless and stained | Moderate or localized and intense | Thin coatings or stains |
| Weak | No megascopic alteration of minerals | Slight and intermittent and localized | Few strains on fracture surfaces |
| Fresh | Unaltered, cleavage, surface glistening | | |

### 3.5 PROCEDURE FOR LOGGING REFUSE

The following procedure applies to the logging of subsurface samples composed of various materials in addition to soil as may be collected from a landfill or other waste disposal site.

1. Observe refuse as it is brought up by the hollow stem auger, bucket auger, or backhoe.
2. If necessary, place the refuse in a plastic bag to examine the sample.
3. Record observations according to the following criteria:
    - Composition (by relative volume), e.g., paper, wood, plastic, cloth, cement, or construction debris. Use such terms as "mostly" or "at least half". Do not use percentages.
    - Moisture content: dry, damp, moist, wet.
    - State of decomposition: highly decomposed, moderately decomposed, slightly decomposed, etc.
    - Color: obvious mottling and/or degree of mottling.
    - Texture: spongy, plastic (cohesive), friable.
    - Odor.
    - Combustible gas readings (measure downhole and at surface).
    - Miscellaneous: dates of periodicals and newspapers, ability to read printed materials, degree of drilling effort (easy, difficult, very difficult).

## 4.0 MAINTENANCE

Not applicable.

## 5.0 PRECAUTIONS

Not applicable.

## 6.0 REFERENCES

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

Compton, R. R. 1962. *Manual of Field Geology.* John Wiley & Sons, Inc., New York, New York.

U.S. Department of the Interior. 1989. *Earth Manual.* Water and Power Resources Service, Washington, D.C.

# STANDARD OPERATING PROCEDURE 10.4
# CHAIN-OF-CUSTODY FORM

## 1.0 SCOPE AND APPLICATION

The purpose of this standard operating procedure (SOP) is to delineate protocols for use of the chain-of-custody form. An example is provided as part of this SOP. Other formats with similar levels of detail are acceptable.

## 2.0 MATERIALS

- Chain-of-custody form
- Indelible ink pen

## 3.0 PROCEDURE

1. Record the project name and number.
2. Record the project contact's name and phone number.
3. Print sampler's names in "Samplers" block.
4. Enter the Field Sample No.
5. Record the sampling dates for all samples.
6. List the sampling times (military format) for all samples.
7. Indicate "grab" or "composite" sample with an "X."
8. Record matrix (e.g., aqueous, soil).
9. List the analyses/container volume across top.
10. Enter the total number of containers per Field Sample No. in the "Subtotal" column.
11. Enter total number of containers submitted per analysis requested.
12. State the carrier service and airbill number, analytical laboratory, and custody seal numbers.
13. List any comments or special requests in the "Remarks" section.
14. Sign, date, and time the "Relinquished By" section when the cooler is relinquished to the next party.
15. Upon completion of the form, retain the shipper copy, and place the forms and the other copies in a zip seal bag to protect from moisture. Affix the zip seal bag to the inside lid of the sample cooler to be sent to the designated laboratory.

## 4.0 MAINTENANCE

Not applicable.

## 5.0 PRECAUTIONS

None.

## 6.0 REFERENCES

USEPA. 1990. *Sampler's Guide to the Contract Laboratory Program.* EPA/540/P-90/006, Directive 9240.0-06, Office of Emergency and Remedial Response, Washington, D.C., December 1990.

USEPA. 1991. *User's Guide to the Contract Laboratory Program.*. EPA/540/O-91/002, Directive 9240.0-01D, Office of Emergency and Remedial Response, January 1991.

USEPA. 1980. *Interim Guidelines and Specifications for Preparing Quality Assurance Project Plans,* QAMS-005/80.

## FIGURE 10.4-a
## EXAMPLE CHAIN-OF-CUSTODY FORM

<table>
<tr><td>Project Number</td><td colspan="4">Project Name</td><td rowspan="4">Matrix</td><td colspan="8">ANALYSES</td><td rowspan="4">Subtotal</td><td>LAB :</td></tr>
<tr><td colspan="5">Project Contact (Name and Phone Number)</td><td rowspan="3"></td><td rowspan="3"></td><td rowspan="3"></td><td rowspan="3"></td><td rowspan="3"></td><td rowspan="3"></td><td rowspan="3"></td><td rowspan="3"></td><td>AIRBILL No:</td></tr>
<tr><td colspan="5">Samplers:</td><td>Courier:</td></tr>
<tr><td>Field Sample No.</td><td>Date (MM-DD-YY)</td><td>Time</td><td>Comp</td><td>Grab</td><td>REMARKS</td></tr>
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<tr><td colspan="5">TOTAL</td><td></td><td colspan="10"></td></tr>
</table>

| | | | | | |
|---|---|---|---|---|---|
| Relinquished by: | Date/time | Received by: | Relinquished by: | Date/Time | Received by: |
| Relinquished by: | Date/time | Received by: (for lab) | Date/Time | Remarks | |

# STANDARD OPERATING PROCEDURE 20.2
# WELL AND BORING ABANDONMENT

## 1.0 SCOPE AND APPLICATION

The purpose of this standard operating procedure (SOP) is to establish the protocols by which all borings and wells will be abandoned. The primary objective of well abandonment is to ensure that the abandoned well or boring does not provide a conduit for the vertical migration of contamination between aquifers.

## 2.0 MATERIALS

- Drill Rig
- Pure Sodium Bentonite Powder With no Additives (bentonite)
- Bentonite Pellets (seal)
- Cement (Portland Type II)
- Approved Water

## 3.0 PROCEDURE

The procedures used in boring abandonment will ideally accomplish two objectives: 1) protect aquifers from cross-contamination by sealing the borehole, and 2) restore the strata in the borehole to nearly original conditions by selective placement of fill material.

### 3.1 WELLS

The following procedure applies to wells aborted prior to completion and existing wells determined to be ineffective or otherwise in need of closure.

Any casing will be pulled or drilled (totally or partially) out. In the event that it is not possible to remove the casing, the casing will be pierced prior to grouting. Using tremie pipe, grout will be placed from the bottom of the hole to within 3 feet of the ground surface, and allowed to settle for 24 hours. The remainder of the hole will be filled with concrete. The surface of the concrete will be mounded, smoothed, and inscribed with "ABD", for abandoned, any assigned well or boring designation, and the date the hole was abandoned. All boring logs, samples, completion records, and abandonment procedures will be included in the records of work on the site or cluster.

If the hole is within 15 ft of a monitoring well in the same aquifer, or a replacement well is to be installed within 15 ft of the well, any temporary casing will be pulled, drilled out, or thoroughly pierced. Using tremie pipe, the hole will then be back-filled with filter pack material opposite sand strata and bentonite or grout opposite substantial (2-feet or thicker) clay and silt strata. Where sand as backfill approaches the ground surface, two feet of bentonite will be placed above the sand and a 3-foot concrete plug will be placed at the surface. Otherwise, backfill materials will be placed from the bottom of the hole to within 3 feet of the ground surface. These materials will be allowed to settle for 24 hours. The remainder of the hole will be filled with concrete. The surface of the concrete will be mounded, smoothed, and inscribed with "ABD", for abandoned, any assigned well or boring designation, and the date the hole was abandoned. All boring logs, samples, completion records, and abandonment procedures will be included in the records of work on the site cluster.

If the well is within 15 ft of another monitoring well in the same aquifer, or a replacement well is to be installed within 15 ft of the well, casing will be pulled, drilled out, or thoroughly pierced. Using tremie pipe, the hole will then be back-filled with filter pack material opposite sand strata and bentonite or grout opposite substantial (2-feet or thicker) clay and silt strata. Where sand as backfill approaches the ground surface, two feet of bentonite will be placed above the sand and below the concrete plug near the surface. Backfill materials will be placed from the bottom of the hole to within 3 feet of the ground surface. These materials will be allowed to settle for 24 hours. The remainder of the hole will be filled with concrete. The surface of the concrete will be mounded, smoothed, and inscribed with "ABD", for abandoned, any assigned well or boring designation, and the date the hole was abandoned. All boring logs, samples, completion records, and abandonment procedures will be included in the records of work on the site cluster.

If the well is not within 15 ft of another monitoring well, and is not to be replaced by another well within 15 ft of the original location, casing will be pulled, drilled out, or thoroughly pierced. Using tremie pipe, grout will be placed from the bottom of the hole to within 3 feet of the ground surface, and allowed to settle for 24 hours. The remainder of the hole will be filled with concrete. The surface of the concrete will be mounded, smoothed, and inscribed with "ABD", for abandoned, any assigned well or boring designation, and the date the hole was abandoned. All boring logs, samples, completion records, and abandonment procedures will be included in the records of work on the site cluster.

### 3.2 NARROW BORINGS

Narrow borings, those with diameter less than 3 inches, advanced by hand auger or direct push methods, may be sealed using bentonite pellets or chips rather than a grout mixture. Often times a grout pump is not available to mix the grout when these methods have been used. Bentonite pellets or chips will be poured into the boring from the ground surface. Then bentonite will hydrate by absorbing moisture from the ground; unapproved water should not be added to the boring. After 24 hours, the abandoned boring will be checked, and any grout settlement will be topped off with more bentonite. The process will be repeated until bentonite remains at ground surface unless site condition indicate otherwise.

### 3.3 GROUT

Grout used in construction will be composed by weight of:

- 20 parts cement (Portland cement, type II or V);
- to 1 part (max.)(2-5%) bentonite; and
- 8-gallons (max.) approved water per 94-lb bag of cement.

Neither additives nor borehole cuttings will be mixed with the grout. Bentonite will be added after the required amount of cement is mixed with the water.

All grout material will be combined in an above-ground container and mechanically blended to produce a thick, lump-free mixture. The mixed grout will be recirculated through the grout pump prior to placement.

Grout placement will be performed using a commercially available grout pump and a rigid tremie pipe. Removal and grouting will be accomplished in stages, aquifer by aquifer, sealing the boring from the bottom to ground surface. This will be accomplished by placing a grout pipe to the bottom and pumping grout through the pipe until undiluted grout reaches the bottom of the next higher section of casing or, for the top-most section, until grout flows from the boring at ground surface.

After 24 hours, the abandoned drilling site will be checked for grout settlement. Any settlement will be filled with grout and rechecked 24 hours later. This process will be repeated until firm grout remains at the ground surface.

### 3.4 BORINGS

The term "Borings" as used in this SOP applies to any drilled hole made which is not completed as a well. This includes soil test borings, soil sampling borings, and deep stratigraphic borings. Whether completed to the planned depth or aborted for any reason prior to reaching that depth, borings will be grouted and will normally be closed within 12 hours.

## 4.0 PRECAUTIONS

Refer to the RFAAP HSP.

## 5.0 REFERENCES

COMAR 26.04.04 *Regulation of Water Supply, Sewage Disposal, and Solid Waste Abandonment Standards.*

USATHAMA, 1987. *Geotechnical Requirements for Drilling, Monitoring Wells, Data Acquisition, and Reports.* March 1987.

# SOP 20.6
# STRATIGRAPHIC CHARACTERIZATION

## 1.0 SCOPE AND APPLICATION

The purpose of this standard operating procedure (SOP) is to specify information that is to be documented during stratigraphic characterization.

## 2.0 MATERIALS

- Unified Soil Classification System
- Boring log

## 3.0 PROCEDURE

Stratigraphic characterizations should include the following information:

- Depths of the boring in feet and fractions thereof (tenths of feet);
- Soil descriptions, in accordance with the Unified Soil Classification System (USCS), including:
  - ⇒ Classification
  - ⇒ USCS symbol
  - ⇒ Secondary components and estimated percentage
  - ⇒ Color (using Munsell Soil Color Chart)
  - ⇒ Plasticity
  - ⇒ Consistency (cohesive soil) or density (noncohesive soil)
  - ⇒ Moisture content
  - ⇒ Texture/fabric/bedding
  - ⇒ Grain angularity
- Cutting descriptions, including basic classification, secondary components, and other apparent parameters;
- Numerical, visual estimates of secondary soil constituents (if terms such as "trace", "some", or "several" are used, their quantitative meanings will be defined in a general legend);
- Length of sample recovered in the split spoon (% recovery);
- Blow counts, hammer weight, and length of fall for split-spoon samples;
- Estimated depth interval for each sample;
- Depth to water first encountered during drilling and the method of determination (any distinct water bearing zones below the first zone will also be noted);
- General description of the drilling equipment used, including the rod size, bit type, pump type, rig manufacturer, model, and names of drilling personnel;
- Drilling sequence;
- Any unusual problems;
- Start and completion dates of borings, and a chronological time-sequence of events;
- Lithologic boundaries; and
- Fluid losses where applicable.

## 4.0 PRECAUTIONS

Not applicable.

## 5.0 REFERENCES

- USATHAMA, 1987. *Geotechnical Requirements for Drilling, Monitor Wells, Data Acquisition, and Reports.*
- American Association of Petroleum Geologists, 1983. *North American Stratigraphic Code,* AAPG Bulletin, May 1983, V. 67, No. 5, pp. 841-875.

# STANDARD OPERATING PROCEDURE 30.1
# SOIL SAMPLING

## 1.0 SCOPE AND APPLICATION

The purpose of this standard operating procedure (SOP) is to delineate protocols for sampling surface and subsurface soils.

## 2.0 MATERIALS

- Stainless steel spoon, trowel, knife, spatula, (as needed)
- Split-spoon, Shelby tube, or core barrel sampler
- Bucket auger or push tube sampler
- Drill rig and associated equipment (subsurface soil)
- Stainless steel bowl
- Air monitoring equipment (FID, PID)
- Sample containers (refer to SOP 50.3)
- Sample labels and packaging material (refer to SOPs 50.1 and 50.2)
- Site-specific PPE

## 3.0 PROCEDURE

### 3.1 SURFICIAL SOIL SAMPLES

1. Collect sample from under the vegetative mat with a stainless steel trowel, push tube sampler, or bucket auger.
2. Field screen sample with properly calibrated FID/PID. Cut a cross-sectional slice from the core or center of the sample and insert the monitoring instrument(s).
3. Samples requiring volatile organic compound (VOC) analysis will not be composited. A separate sample will be taken from the portion of the sample with the highest VOC reading or monitoring instrument(s) and transferred directly from the sampler to the sample container.
4. Homogenize the remainder of the sample thoroughly with a decontaminated stainless steel spoon, trowel or spatula.
5. If no compositing is to occur place sample directly into the sample jars.
6. Label and package in accordance with SOPs 50.1 and 50.2.
7. Return the leftover soil to the original hole. If necessary, add clean sand to bring the subsampling areas back to original grade. Replace the vegetative mat over the disturbed areas.
8. Decontaminate sampling equipment according to SOP 80.1.

### 3.2 SUBSURFACE SAMPLES

1. Collect split-spoon, core barrel, or Shelby Tube samples during drilling.
2. Upon opening sampler, or extruding sample, immediately screen soil for VOCs using either a PID or FID. If sampling for VOCs, determing the area of highest concentration, use a stainless steel knife, trowel or lab spatula to cut the sample and screen for VOCs with monitoring instrument(s).
3. Log the sample on the boring log before extracting from the sampler. Place VOC samples into appropriate sample container.
4. Peel and transfer the remaining sample in a decontaminated stainless steel bowl. Mix thoroughly with a decontaminated stainless steel spoon or trowel.
5. Place the sample into the required number of sample jars.
6. Label and package in accordance with SOPs 50.1 and 50.2.
7. Discard any remaining sample into the drums used for collection of cuttings.
8. Decontaminate sampling implements according to SOP 80.1.
9. Abandon borings according to procedures in SOP 20.2.

*NOTES: If sample recoveries are poor, it may be necessary to composite samples before placing them in jars.* In this case, the procedure will be the same, except that two split-spoon samples will be mixed together. The boring log should clearly state that the samples have been composited, which samples were composited, and why the compositing was done. In addition, VOC fraction should be collected from the first split spoon.

Samples taken for geotechnical analysis (e.g., percent moisture, density, porosity, and grain size) will be undisturbed samples, collected using a thin-walled (shelby tube) sampler, if subsurface conditions permit.

## 4.0 MAINTENANCE

Not applicable.

## 5.0 PRECAUTIONS

Refer to the Health and Safety Plan.

Soil samples will not include vegetative matter, rocks, or pebbles, unless the latter are part of the overall soil matrix.

## 6.0 REFERENCES

ASTM Method D1586-84, *Penetration Test and Split-Barrel Sampling of Soils.*

ASTM Method D1587-83, *Thin Walled Sampling of Soils.*

Department of the Army, Office of the Chief of Engineers, Engineer Manual 1110-2-1907 *Soil Sampling*, 31 March 1972.

# STANDARD OPERATING PROCEDURE 30.6
# CONTAINERIZED MATERIAL

## 1.0 SCOPE AND APPLICATION

The purpose of this standard operating procedure (SOP) is to delineate protocols for the opening and sampling of containerized liquids of potentially unknown substances.

## 2.0 MATERIALS

- Tools
- Historical data, if available
- Sampling tube
- Remote samplers, as required

## 3.0 PROCEDURE

Sealed containers with unknown contents potentially represent severe hazardous situations for sampling teams. Even when the original identity of the contents is reasonably certain, contents may be under pressure or in a decomposed state, and many materials readily react (sometimes violently) with air or water vapor in the atmosphere.

Field personnel will use extreme caution and care in opening sealed drums or cans of unknown content for purposes of inspection and sampling, using this SOP and appropriate health and safety protocols. Specific activities include:

- Efforts will be made to determine the identity of the contents, through markings, history of activities at the site, and similarity and proximity to containers of known contents. The range of possible hazards will dictate which specific procedure will be followed.
- Containers will be handled as little as possible; however, it may be necessary to reorient a drum to allow access to a bung or cap. If deemed necessary, this activity would be performed using remote-handling forklift equipment with special drum-holding attachments.
- If contents are deemed to be under pressure, highly reactive, or highly toxic (or if these possibilities cannot be disproven), initial opening of the container will be performed remotely.
- Air monitoring stations will be established as necessary, using the following procedures:
    1. Affix a Remote Bung Opener to the drum.
    2. Evacuate personnel to a safe distance and/or behind a barricade.
    3. Activate the non-sparking motor of the opener.
    4. After the bung is removed, the drum will be monitored for a length of time commensurate with potential contents for activity such as vapor emission, smoking, or audible reaction.
    5. Approach cautiously while monitoring for toxic levels of airborne contaminants.
- If the contents of the drum pose acceptable hazards, opening (or inspection if previously opened remotely) and sampling would be accomplished with one of three approved devices. The preferred method is to use a clean glass tube, with or without bottom stopper, which can be placed in the drum (breaking it if necessary) after sampling is complete. Alternately (if a bung has been removed), a well sampler such as a Kemmererbailer can be used, but would require removal and cleaning or disposal according to the nature of the waste. By opening either of these devices at a desirable depth, stratified sampling can be performed. Also, the sampling tubes can be made with a plunger rod and o-ring seals at selected intervals, allowing simultaneous collection of multiple samples in a stratified medium.
- Following sampling, the drum will be resealed and/or overpacked to prevent any possibility of leakage until analysis determines the identity of the contents.
- Drums that do not have removable bungs may be opened remotely with a solenoid-activated punch, which would require that the drum be recontainerized or overpacked after sampling is completed.

## 4.0 MAINTENANCE

Not Applicable.

## 5.0 PRECAUTIONS

Adhere to Health and Safety requirements.

## 6.0 REFERENCE

USEPA, 1989. *A Compendium of Superfund Field Operation Methods*. EPA/540/P-87/001. December 1987.

# Standard Operation Procedure For Collecting Soil Samples by EPA Method 5035 – Using Disposable EnCore® Samplers

## 1.0 Scope and Application

This standard operating procedure (SOP) outlines the recommended protocol and equipment for collection of representative soil samples to monitor potential volatile organic contamination in soil samples.

This method of sampling is appropriate for surface or subsurface soils contaminated with low to high levels of volatile organic compounds (VOCs). This sampling procedure may be used in conjunction with any appropriate determinative gas chromatographic procedure, including, but not necessarily limited to, SW-846 Method 8015, 8021, and 8260.

## 2.0 Method Summary

EnCore™ samplers are sent to the field to be used to collect soil samples. A total of three samplers must be filled for each soil sampling location. Two for the low level method (sodium bisulfate preservation) and one for the high level method (methanol preservation). After sample collection, EnCore™ samplers are immediately shipped back to the laboratory for preservation (adding soil sample into methanol and sodium bisulfate solution). The ratio of volume of methanol to weight of soil is 1:1 as specified in SW-846 Method 5035 (Section 2.2.2). The amount of preservative in the solution corresponds to approximately 0.2 g of preservative for each 1 g of sample. Enough sodium bisulfate should be present to ensure a sample pH of $\leq 2$. If QA/QC samples are needed, a total of seven samplers will be needed for the original, MS, and MSD analyses. Soil samples are collected in the field using the EnCore™ samplers, sealed and returned to the laboratory. A separate aliquot of soil is collected in a 125 mL jar for dry weight determination.

## 3.0 Sample Containers, Preservation, Handling, and Storage

After sample collection, the samples and the EnCore™ samplers must be cooled to and maintained at 4°C. The contents of the samplers will be analyzed using EPA methods 8015, 8021, and/or 8260. The EnCore™ sampler is a single use device. It cannot be cleaned and/or reused.

***EnCore™ samplers have a 48 hour holding time from sample collection to sample preparation in the laboratory. Return to the laboratory immediately after sampling.***

## 4.0 Equipment

4.1 Disposable EnCore™ sampler. (see attached)
4.2 EnCore™ T-handle and/or EnCore™ Extrusion Tool. (see attached)
4.3 Disposable surgical gloves.

## 5.0 Procedures

5.1 Unpack the cooler/sampling kit received from the laboratory. EnCore™ samplers are packed in sealed aluminized bags. These should be overpacked in plastic zip lock bags. A T-Handle will also be needed to collect samples with the EnCore™ sampler.

5.2 Hold coring body and push plunger rod down until small 0-ring rests against tabs. This will assure that plunger moves freely.

5.3 Depress locking lever on EnCore™ T-Handle. Place coring body, plunger end first, into the open end of the T-Handle, aligning the two slots on the coring body with the two locking pins in the T-Handle. Twist the coring body clockwise to lock the pins in the slots. Check to ensure the sampler is locked in place. Sampler is ready for use.

5.4 Orient the T-Handle with the T-up and the coring body down. This positions the plunger bottom flush with bottom of coring body (ensure that plunger bottom is in position). Using T-Handle, push sampler into soil until the coring body in completely full. When full, the small o-ring will be centered in the T-Handle viewing hole. Remove sampler from soil. Wipe excess soil from coring body exterior.

5.5 Cap coring body while it is still on the T-Handle. ***<u>Push</u>*** cap over flat area of ridge ***<u>and twist</u>*** to lock cap in place. ***Cap must be seated to seal sampler.***

5.6 Remove the capped sampler by depressing locking lever on T-Handle while twisting and pulling sampler from T-Handle.

5.6 Lock plunger by rotating extended plunger rod fully counterclockwise until wings rest firmly against tabs.

5.8 Fill the 125 mL wide mouth jar for the nonpreserved portion of the sample to be used for a moisture determination. These may be in a carboard box. Retain all packaging to return the samples.

5.9 The EnCore™ sampler should collect approximately 5 grams of soil (not necessary to weigh in the field). After a sample has been collected and capped, tear off the ID tag found at the bottom of the label on the aluminized bag. This tag is added to the sampler on the cap used to seal the sampler.

5.10 Place the sampler back in the aluminized bag and seal the top (a zip-lock seal). Make sure all the appropriate information is on the label. Record the sampler ID number on the chain-of-custody. Make sure each EnCore™ sampler and 125 mL jar are labeled with the same location identification. The EnCore™ sampler should be placed inside the plastic zip-lock bags.

5.11 Place the 125 mL wide mouth jars in the cooler with the EnCore™ sampler on top. These should be sandwiched between bags of ice to maintain the correct temperature. If sent with the jars and samplers, a temperature bottle (used to evaluate the temperature on receipt) should be placed in the middle of the jars. The sample temperature should be 4°C during shipment.

5.12 Ship the samples so that they will be received within 24 hours of sampling. The Encore™ sampler ***must*** be received by the laboratory within ***40 hours*** of the collection so that they can be correctly preserved.

## 6.0 Quality Assurance/Quality Control

6.1 All data must be documented on standard chain of custody forms, field data sheets or in the project logbook.

6.2 An equipment blank is a QA/QC sample which will determine potential contamination from sampling equipment used to collect and transfer samples from the point of collection to the sample container. An equipment blank is performed by pouring demonstrated analyte free water from one sample container, over a EnCore™ sampler, and into a separate set of identical sample containers. The equipment blank is optional when sampling with the methanol preservation technique. It may be required on a site-specific basis if elevated analytical results are suspected to be due to cross contamination from sampling equipment.

6.3 A trip blank is a QA/QC sample, which will determine additional sources of contamination that may potentially influence the samples. The sources of the contamination may be from the laboratory, sample containers, or during shipment. A trip blank is prepared at the same time and in the same manner as the sample containers by the laboratory. The trip blank must accompany the sample containers to the field and back to the laboratory along with the collected samples for analysis. It must remain sealed at all times until it is analyzed at the laboratory. The frequency of collection for the trip blank must be at a rate of one per sample shipment.

# STANDARD OPERATING PROCEDURE 50.1
# SAMPLE LABELS

## 1.0 SCOPE AND APPLICATION

Every sample will have a sample label uniquely identifying the sampling point and analysis parameters. The purpose of this standard operating procedure (SOP) is to delineate protocols for the use of sample labels. An example label is included as Figure 50.1-A. Other formats with similar levels of detail are acceptable.

## 2.0 MATERIALS

- Sample label
- Indelible marker

## 3.0 PROCEDURE

The use of preprinted sample labels is encouraged and should be requested from the analytical support laboratory during planning activities.

As each sample is collected, fill out a sample label ensuring the following information has been collected:

- Project Name
- Sample I.D. - enter the SWMU number and other pertinent information concerning where the sample was taken. This information should be included in the site-specific addenda.
- Date of Sample Collection
- Time of Sample Collection
- Initials of Sampler(s)
- Analyses to be Performed (Note: due to number of analytes, details of analysis should be arranged with lab *a priori.*)
- Preservatives (water samples only)

Double-check the label information to make sure it is correct. Detach the label, remove the backing and apply the label to the sample container. Cover the label with clear tape, ensuring that the tape completely encircles the container.

## 4.0 MAINTENANCE

Not Applicable.

## 5.0 PRECAUTIONS

None.

## 6.0 REFERENCES

USEPA. 1980. *Interim Guidelines and Specifications for Preparing Quality Assurance Project Plans.* QAMS-005/80.

FIGURE 50.1-A
SAMPLE LABEL

PROJECT NAME ______________________

SAMPLE ID ______________________

DATE: ___/___/___ TIME: ____:____

ANALYTES: VOC SVOC P/P METALS CN
PAH D/F HERBs ANIONS TPH
ALK TSS

PRESERVATIVE: [HCl] [$HNO_3$] [NaOH] [$H_2SO_4$]

SAMPLER: ________________

# STANDARD OPERATING PROCEDURE 50.2
# SAMPLE PACKAGING

## 1.0 SCOPE AND APPLICATION

The purpose of this standard operating procedure (SOP) is to delineate protocols for the packing and shipping of samples to the laboratory for analysis.

## 2.0 MATERIALS

- Waterproof coolers (hard plastic or metal)
- Metal cans with friction-seal lids (*e.g.* paint cans)
- Chain-of-custody forms
- Chain-of-custody seals (optional)
- Packing material
- Sample documentation
- Ice
- Plastic garbage bags
- Clear Tape
- Zip seal plastic bags

## 3.0 PROCEDURE

1. Check cap tightness and verify that clear tape covers label and encircles container.
2. Wrap sample container in bubble wrap or closed cell foam sheets. Samples may be enclosed in a secondary container consisting of a clear zip-seal plastic bag.
3. Place several layers of bubble wrap, or at least 1" of vermiculite on the bottom of the cooler. Line cooler with open garbage bag, place all the samples upright inside the garbage bag and tie.
4. Double bag and seal loose ice to prevent melting ice from soaking the packing material. Place the ice outside the garbage bags containing the samples.
5. Pack shipping containers with packing material (closed-cell foam, vermiculite, or bubble wrap). Place this packing material around the sample bottles or metal cans to avoid breakage during shipment.
6. Enclose all sample documentation (i.e., Field Parameter Forms, Chain-of-Custody forms) in a waterproof plastic bag and tape the bag to the underside of the cooler lid. If more than one cooler is being used, each cooler will have its own documentation. Add the total number of shipping containers included in each shipment on the chain-of-custody form.
7. Seal the coolers with signed and dated custody seals so that if the cooler were opened, the custody seal would be broken. Place clear tape over the custody seal to prevent damage to the seal.
8. Tape the cooler shut with packing tape over the hinges and place tape over the cooler drain.
9. Ship all samples via overnight delivery on the same day they are collected if possible.

## 4.0 MAINTENANCE

Not Applicable.

## 5.0 PRECAUTIONS

### 5.1 PERMISSIBLE PACKAGING MATERIALS

- Non-absorbent
  - bubble wrap
  - closed cell foam packing sheets
- Absorbent
  - Vermiculite

### 5.2 NON-PERMISSIBLE PACKAGING MATERIALS

- Paper
- Wood shavings (excelsior)
- Cornstarch "peanuts"

## 6.0 REFERENCES

USEPA. 1990. *Sampler's Guide to the Contract Laboratory Program.* EPA/540/P-90/006, Directive 9240.0-06, Office of Emergency and Remedial Response, Washington, D.C., December 1990.

USEPA. 1991. *User's Guide to the Contract Laboratory Program.* EPA/540/O-91/002, Directive 9240.0-01D, Office of Emergency and Remedial Response. January 1991.

USEPA. 1980. *Interim Guidelines and Specifications for Preparing Quality Assurance Project Plans.* QAMS-005/80.

# STANDARD OPERATING PROCEDURE 50.3
# SAMPLE PRESERVATION AND CONTAINER REQUIREMENTS

## 1.0 SCOPE AND APPLICATION

The purpose of this standard operating procedure (SOP) is to define the preservatives and techniques to be employed in preserving environmental samples between collection and analysis.

## 2.0 MATERIALS

### 2.1 SAMPLE CONTAINERS

#### 2.1.1 40-mL Glass Vial, 24 mm Neck Finish

- **Closure:** White polypropylene or black phenolic, open top, screw cap, 15-mm opening, 24-400 size.
- **Septum:** 24-mm disc of 0.005-in PTFE bonded to 0.120-in silicon for total thickness of 0.125-in.

#### 2.1.2 1-L High Density Polyethylene, Cylinder-Round Bottle, 28-mm Neck Finish

- **Closure:** White polyethylene cap, white ribbed, 28-410 size; F217 polyethylene liner.

#### 2.1.3 120-mL Wide Mouth Glass Vial, 48-mm Neck Finish

- **Closure:** White polyethylene cap, 40-480 size; 0.015-mm PTFE liner.

#### 2.1.4 250-mL Boston Round Glass Bottle

- **Closure:** White polypropylene or black phenolic, open top, screw cap.
- **Septum:** Disc of 0.005-in PTFE bonded to 0.120-in silicon for total thickness of 0.125-in.

#### 2.1.5 8-oz Short, Wide Mouth, Straight - Sided, Flint Glass Jar, 70-mm Neck Finish

- **Closure:** White polypropylene or black phenolic, baked polyethylene cap, 48-400 size; 0.030-mm PTFE liner.

#### 2.1.6 4-oz Tall, Wide Mouth, Straight - Sided, Flint Glass Jar, 48-mm Neck Finish

- **Closure:** White polypropylene or black phenolic, baked polyethylene cap, 48-400 size; 0.015-mm PTFE liner.

#### 2.1.7 1-L amber, Boston Round, Glass Bottle, 33-mm Pour-Out Neck Finish

- **Closure:** White polypropylene or black phenolic, baked polyethylene cap, 33-430 size; 0.015-mm PTFE liner.

#### 2.1.8 500-mL High-Density Polyethylene, Cylinder Bottle, 28-mm Neck Finish

- Closure: White polypropylene, white ribbed, 28-410 size; F217 polyethylene liner.

### 2.2 SAMPLE PRESERVATIVES

- HCl
- $HNO_3$
- $H_2SO_4$
- NaOH
- Ice

## 3.0 PROCEDURE

Water samples will be collected according to procedures detailed in SOPs 30.2 and 30.3 and placed in containers appropriate to the intended analyte as given in Table 50.3-A. Preservation will be performed in the field with the noted exceptions:

- Samples taken for volatile organic compound (VOC) analysis will generally be collected in pre-preserved VOC vials. Sufficient HCl should have been added to the vial prior to the addition of the sample such that the $pH<2$.
- Samples collected for metals analysis will be acidified in the field to a $pH < 2$ by the addition of $HNO_3$. Filtered samples will be acidified after filtration. After acidifying the sample, the container should be lightly capped, then swirled to thoroughly mix the sample. The cap will then be loosened to release any excess pressure this operation may have generated.
- Samples collected for cyanide will be alkalized to a $pH > 12$ by the addition of NaOH.
- Samples not requiring chemical preservation will be placed on ice and cooled to 4°C (e.g., semivolatile organic compounds, explosives).

The pH of water samples will be verified by pouring an aliquot of water on a strip of pH paper. Appropriate preservation will be added in 1 mL increments until the appropriate pH is achieved.

Soil and sediment, samples will be collected according to procedures detailed in SOPs 30.1 and 30.4 into containers appropriate to the intended analyte as given in Table 50.3-B. No chemical preservatives will be added to soil or sediment samples. These samples will be immediately placed on ice and cooled to 4°C.

## 4.0 MAINTENANCE

Not applicable.

## 5.0 PRECAUTIONS

Note that acidifying a sample containing cyanide may liberate HCN gas.

- Avoid breathing any fumes emanating from acidified samples.
- Acidify samples only in the open, rather than in closed spaces such as a vehicle.
- See the HSP for other safety measures.

## 6.0 REFERENCES

*Test Methods for Evaluating Solid Waste,* SW-845, (USEPA, 1986).

*A Compendium of Superfund Field Operations Methods,* EPA 540-P87-001.

*A Compendium of ERT Soil Sampling and Surface Geophysics Procedures,* (USEPA, 1991).

## Table 50.3-A
## Summary of Sample Containment and Sample Preservation for Aqueous Samples

| Parameter | Sample Container | | Preservation Methods | Holding Times |
|---|---|---|---|---|
| | Quantity | Type | | |
| | | **Groundwater** | | |
| Volatile Organic Compounds | 3 | 40-mL, amber glass vials, Teflon®-lined septum cap | HCl to pH<2<br>Cool, 4±2°C | 14 ~~7~~ days |
| Semivolatile Organic Compounds | 2 | 1-liter, narrow-mouth amber glass, Teflon®-lined cap | Cool, 4±2°C | Extraction: 7 days<br>Analysis: 40 days |
| Pesticides/PCBs | 2 | 1-liter, narrow-mouth amber glass, Teflon®-lined cap | Cool, 4±2°C | Extraction: 7 days<br>Analysis: 40 days |
| Explosives | 1 | 1-liter, narrow-mouth amber glass, Teflon®-lined cap | Cool, 4±2°C | Extraction: 7 days<br>Analysis: 40 days |
| Dioxin/Furans | 1 | 1-liter, narrow-mouth amber glass, Teflon®-lined cap | Cool, 4±2°C | Extraction: 7 days<br>Analysis: 40 days |
| Herbicides | 1 | 1-liter, narrow-mouth amber glass, Teflon®-lined cap | Cool, 4±2°C | Extraction: 7 days<br>Analysis: 40 days |
| Common Anions Chloride, fluoride, bromide, sulfate | 1 | 1-liter, polyethylene bottle | Cool, 4±2°C | 28 days |
| Nitrate-Nitrite | 1 | 1-liter, polyethylene bottle | $H_2SO_4$ to pH<2<br>Cool, 4±2°C | 28 days |
| Total phosphate | 1 | 1-liter, polyethylene bottle | $H_2SO_4$ to pH<2<br>Cool, 4±2°C | 28 days |
| Total Petroleum Hydrocarbons | 1 | 250-mL, amber glass, Teflon®-lined cap | $H_2SO_4$ to pH<2<br>Cool, 4±2°C | Extraction: 7 days<br>Analysis: 40 days |
| Metals | 1 | 1-liter, polyethylene bottle | $HNO_3$ to pH<2<br>Cool, 4±2°C | 6 months |
| Mercury | | | | 28 days |
| Cyanide | 1 | 1-liter, polyethylene bottle | NaOH to pH>12<br>Cool, 4±2°C | 14 days |

## Table 50.3-B
## Summary of Sample Containment and Sample Preservation for Solid Samples

| Parameter | Sample Container | | Preservation Methods | Holding Times |
|---|---|---|---|---|
| | Quantity[a] | Type | | |
| Volatile Organic Compounds | 2 | 120-mL amber glass vials, Teflon®-lined cap | Cool to 4±2°C | 7 days |
| Volatile Organic Compounds - Methanol Extraction | 1 | 60-mL amber glass vial, Teflon®-lined cap | Cool to 4±2°C | 4 days |
| Semivolatile Organic Compounds | 1[a] | 500-mL amber glass bottle, Teflon®-lined cap | Cool to 4±2°C | Extraction: 7 days<br>Analysis: 40 days |
| Explosives | 1[a] | 500-mL amber glass bottle, Teflon®-lined cap | Cool to 4±2°C | Extraction: 7 days<br>Analysis: 40 days |
| Pesticides/PCBs | 1[a] | 500-mL amber glass bottle, Teflon®-lined cap | Cool to 4±2°C | Extraction: 7 days<br>Analysis: 40 days |
| Metals | | | | |
| Metals | 1[b] | 500-mL amber glass bottle, Teflon®-lined cap | Cool to 4±2°C | 6 months |
| Mercury | | | | 28 days |
| Cyanide | 1[b] | 500-mL amber glass bottle, Teflon®-lined cap | Cool to 4±2°C | 14 days |
| TCL Dioxin/furans | 1 | 500-mL amber glass bottle, Teflon®-lined cap | Cool to 4±2°C | Extraction: 7 days<br>Analysis: 40 days |
| Herbicides | 1[a] | 500-mL amber glass bottle, Teflon®-lined cap | Cool to 4±2°C | Extraction: 7 days<br>Analysis: 40 days |
| Total Petroleum Hydrocarbons | 1[a] | 500-mL amber glass bottle, Teflon®-lined cap | Cool to 4±2°C | 28 days |
| Petroleum Fuels[c] | 1 | Resealable container | Cool to 4±2°C | 48 hours |

[a] SVOCs, PAHs, pesticides/PCBs, herbicides, and TPH sample fractions will be combined into one 500-mL bottle.
[b] Metal and cyanide sample fractions will be combined into one 500-mL bottle.

## Table 50.3-C
## Summary of Sample Containment and Sample Preservation for Solid IDW Samples

| Parameter | Sample Container | | Preservation Methods | Holding Times |
|---|---|---|---|---|
| | Quantity | Type | | |
| TCLP VOCs | 1 | 500-mL, wide-mouth amber glass, Teflon®-lined cap | Cool, 4±2°C | Leaching: 14 days<br>Analysis: 14 days |
| TCLP SVOCs | 1 | 500-mL, wide-mouth amber glass, Teflon®-lined cap | Cool, 4±2°C | Leaching: 14 days<br>Extraction: 7 days<br>Analysis: 40 days |
| TCLP Pesticides | 1 | 500-mL, wide-mouth amber glass, Teflon®-lined cap | Cool, 4±2°C | Leaching: 14 days<br>Extraction: 7 days<br>Analysis: 40 days |
| TCLP Herbicides | 1 | 500-mL, wide-mouth amber glass, Teflon®-lined cap | Cool, 4±2°C | Leaching: 14 days<br>Extraction: 7 days<br>Analysis: 40 days |
| TCLP Metals | 1 | 500-mL, wide-mouth amber glass, Teflon®-lined cap | Cool, 4±2°C | Leaching: 14 days<br>Analysis: 6 months<br>Mercury analysis: 28 days |

| | |
|---|---|
| SVOC | Semivolatile Organic Compound |
| TCLP | Toxicity Characteristic Leachate Procedure |
| VOC | Volatile Organic Compound |

# STANDARD OPERATING PROCEDURE 70.1
# INVESTIGATIVE DERIVED WASTE

## 1.0 SCOPE AND APPLICATION

Management of investigation derived waste minimizes the potential for the spread of hazardous waste on site or off site through investigation activities. The purpose of this standard operating procedure (SOP) is to provide instructions for the proper management of contaminated materials derived from the field investigations.

## 2.0 INTRODUCTION

Materials that are known or suspected to be contaminated with hazardous substances through the actions of sample collection or personnel and equipment decontamination are said to be investigation derived wastes. These wastes include decontamination solutions, disposable equipment, drill cuttings and fluids, and groundwater monitoring well development and purge waters. To the extent possible, the site manager will attempt to minimize the generation of these wastes through careful design of decontamination schemes and groundwater sampling programs. Testing conducted on soil and water investigation derived wastes will show if they are also hazardous wastes as defined by RCRA. This will determine the proper handling and ultimate disposal requirements.

The criteria for designating a substance as hazardous waste according to RCRA is provided in 40 CFR 261.3 If investigation derived wastes meet these criteria, RCRA requirements must be followed for packaging, labeling, transporting, storing and record keeping as described in 40 CFR 262.34 Those wastes judged to potentially meet the criteria for hazardous wastes will be stored in DOT approved 55 gallon steel drums.

Investigation derived waste is assumed to be RCRA hazardous waste unless analytical evidence indicates otherwise. Nonhazardous waste will be disposed of in accordance with installation approved procedures.

## 3.0 INVESTIGATION DERIVED WASTE MANAGEMENT

Procedures that minimize potential for the spread of hazardous waste include minimizing the volume of waste generated, waste segregation, appropriate storage, and disposal according to RCRA requirements.

### 3.1 WASTE MINIMIZATION

In the development of the investigation work plan, each aspect of the investigation is to be reviewed to identify areas where excess waste generation can be eliminated. General procedures that will eliminate waste include avoidance of unnecessary exposure of materials to hazardous waste, and coordination of sampling schedules to avoid repetitious purging of wells and use of sampling equipment.

### 3.2 WASTE SEGREGATION

Waste storage and handling procedures to be used depend upon the type of waste generated. For this reason, investigation derived hazardous wastes described below are segregated into separate 55-gallon storage drums. Waste materials that are known to be free of hazardous waste contamination (such as broken sample bottles or equipment containers and wrappings) must be collected separately for disposal to municipal systems. Large plastic garbage or "lawn and leaf" bags are useful for collecting this trash. Even "clean" sample bottles or tyvek should be disposed with care. Even though they are not legally a problem, if they are discovered by the public they may cause tremendous panic. Therefore, items that are known to be free from contamination but are also known to represent "hazardous or toxic waste" to the public, must not be disposed into any public dumpster such as found at your hotel or park. Items free from contamination may be freely transported in your vehicle until an appropriate disposal site is found.

#### 3.2.1 Decontamination Solutions

Solutions considered investigation derived wastes range from detergents, organic solvents and acids used to decontaminate small hand samplers to steam cleaning rinsate used to wash drill rigs and other large equipment. These solutions are to be stored in 55-gallon drums with bolt-sealed lids.

#### 3.2.2 Soil Cuttings and Drilling Muds

Soil cuttings are solid to semisolid soils generated during trenching activities or drilling for the collection of subsurface soil samples or the installation of monitoring wells. Depending on the type of drilling, drilling fluids known as "muds" may be used to remove soil cuttings. Drilling fluids flushed from the borehole must be directed into a settling section of a mud pit. This allows reuse of the decanted fluids after removal of the settled sediments. Drill cuttings, whether generated with or without drilling fluids, are to be removed with a flat-bottomed shovel and stored in 55-gallon drums with bolt-sealed lids.

#### 3.2.3 Well Development and Purge Waters

Well development and purge waters are groundwaters removed from monitoring wells to repair damage to the aquifer following well installation, obtain characteristic aquifer groundwater samples, or measure aquifer hydraulic properties. The volume of groundwater to be generated will determine the appropriate storage procedure. Well purging and well development will generate approximately two to ten well casing volumes of groundwater. This volume can stored in 55-gallon drums. Measurement of aquifer properties through pump tests can generate significantly greater volumes of groundwater depending on the well yield and the duration of the test. Use of the large-volume portable tanks such as "Baker Tanks" should be considered for temporary storage pending results of groundwater analysis.

### 3.2.4 Disposable Equipment

Disposable equipment includes used personal protective gear such as tyvek coveralls, gloves, booties and APR cartridges and some inexpensive sampling equipment such as trowels or disposable bailers. This equipment is assumed to be contaminated if it is used at a hazardous waste site, because it is impractical to submit these items for analysis. These materials are to be stored on-site in 55-gallon drums pending final disposal.

## 3.3 WASTE STORAGE

The wastes that are accumulated through investigations must be stored on-site prior to disposal. An on-site waste staging area should be designated to provide a secure and controlled storage for the drums. Per RCRA requirements, storage cannot exceed 90 days for materials presumed or shown to be RCRA-designated hazardous wastes; waste which is known not to be RCRA-designated wastes should be promptly disposed to municipal waste systems.

### 3.3.1 Storage Containers

Containers will be DOT approved (DOT 17H 18/16GA OH unlined) open-head steel drums. The lids should lift completely off the drum, and be secured by a bolt ring. Order enough drums to store all anticipated purge water (at least five times the well casing volume), plus extra drums for solid waste and decontamination water. Solid and liquid wastes are not to be mixed in the drums. A typical decontamination line uses approximately 30 gallons of water.

Pallets are often required to allow transport of filled drums to the staging area with a forklift. Normal pallets are 3' x 4' and will hold two to three 55-gallon drums depending on the filled weight. If pallets are required for drum transport or storage, field personnel are responsible for ensuring that the empty drums are placed on pallets before they are filled and that the lids are sealed on with the bolt-tighten ring after the drums are filled. Because the weight of one drum can exceed 500 pounds, under no circumstances should personnel attempt to move the drums by hand. Removal of drums to the staging area is normally the responsibility of the client, unless other arrangements have been made.

### 3.3.2 Drum Labeling

Each drum that is used will be assigned a unique number which will remain with that drum for the life of the drum. This number will be written in permanent marker on the drum itself; do not label drum lids. Drum labels will contain the following information:

- waste accumulation start date
- well number or boring number, if applicable
- drum number
- contents matrix (soil, water, slurry, etc.)
- project name

## 4.0 WASTE DISPOSAL

Responsibility for the final disposal of investigative derived waste will be determined before field activities are begun and will be described in the investigation work plan. Disposal or long-term storage (over 90 days) of RCRA-designated hazardous wastes requires procedures which are beyond the scope of this SOP.

## 5.0 PRECAUTIONS

- Only qualified personnel are authorized to handle equipment.
- Adhere to health and safety procedures.

## 6.0 REFERENCES

*Safety Rules for Contractors and Subcontractors*, Alliant Techsystems, Incorporated, Radford Army Ammunition Plant, 1995.

# STANDARD OPERATING PROCEDURE 80.1
# DECONTAMINATION

## 1.0 SCOPE AND APPLICATION

All personnel or equipment involved in intrusive sampling, or enter a hazardous waste site during intrusive sampling must be thoroughly decontaminated prior to leaving the site to minimize the spread of contamination and prevent adverse health effects. Equipment must be decontaminated between sites to preclude cross-contamination. Decontamination water will be free of contaminants as evidenced through either chemical analyses or certificates of analysis. This standard operating procedure (SOP) describes general decontamination requirements for sampling equipment and site personnel. Decontamination procedures for contaminants requiring a more stringent procedure, e.g., dioxins/furans, will be included in site-specific addenda.

## 2.0 MATERIALS

- Plastic sheeting, buckets
- Installation-approved decontamination water source
- Deionized ultra-filtered water (DIUF)
- Non-phosphate laboratory detergent
- Aluminum foil or clean plastic sheeting
- Pressure sprayer, rinse bottles, brushes
- Plastic garbage bags

## 3.0 PROCEDURE

### 3.1 SAMPLE BOTTLES

At the completion of each sampling activity the exterior surfaces of the sample bottles must be decontaminated as follows:

- Be sure that the bottle lids are on tight.
- Wipe the outside of the bottle with a paper towel to remove gross contamination.

### 3.2 PERSONNEL DECONTAMINATION

Review the project Health and Safety Plan (HSP) for the appropriate decontamination procedures.

### 3.3 EQUIPMENT DECONTAMINATION

### 3.3.1 Water Samplers

### 3.3.1.1 Bailers

After each use, Polytetrafluoroethelyne (PTFE) double check valve bailers used for groundwater sampling will be decontaminated as follows:

1. Discard all lanyards in properly marked sealable container, or as directed by the HSP. Note: no tubing is to be used in conjunction with a bailer in collecting samples.
2. Scrub the bailer to remove gross (visible) contamination, using appropriate brush(es), approved water, and non-phosphate detergent.
3. Rinse off detergent with approved water.
4. Rinse bailer with approved decontamination water.
5. Rinse bailer with DIUF-grade water.
6. Wrap bailer in aluminum foil or clean plastic sheeting, or store in a clean, dedicated PVC or PTFE storage container.
7. Dispose of used decontamination solutions with drummed purge water.

### 3.3.1.2 Submersible Pumps

1. Scrub the exterior of the pump to remove gross (visible) contamination, using appropriate brushes, approved water, and non-phosphate detergent. (Steam cleaning may be substituted for detergent scrub).
2. Calculate the volume of pump plus any tubing which is not disposable and not dedicated to a single well. Pump 10 gallons or 3 equivalent well volumes, whichever is greater, of non-phosphate laboratory detergent solution to purge and clean the interior of the pump.
3. Rinse by pumping no less than 10 gallons of approved water to rinse.
4. Rinse pump exterior with approved decontamination water.
5. Rinse pump exterior with DIUF water.
6. Wrap pump in aluminum foil or clean plastic sheeting, or store in a clean, dedicated PVC or PTFE storage container.

### 3.3.1.3 Dip Samplers

All dip samplers, whether bucket, long-handled, or short-handled (see SOP 30.3, *Surface Water Sampling*) will be decontaminated in the same manner as bailers.

### 3.3.1.4 Field Glassware

Field glassware such as beakers used to hold samples for field measurements will be decontaminated according to the procedures listed for bailers.

### 3.3.1.5 Water Level Indicators

Electric water level indicators, weighted measuring tapes, or piezometers used in the determination of water levels, well depths, and/or non-aqueous phase liquid (NAPL) levels will be decontaminated in the same manner as bailers. Clean laboratory wipes may be substituted for brushes. Tapes, probes, and piezometers should be wiped dry with clean laboratory wipes, and coiled on spools or clean plastic sheeting.

### 3.3.2 Solid Materials Samplers

Solid materials samplers include soil sampling probes, augers, trowels, shovels, sludge samplers, and sediment samplers. Equipment will be decontaminated as follows:

1. Scrub the sampler to remove gross(visible) contamination, using appropriate brush(es), approved water, and non-phosphate laboratory detergent.
2. Rinse off detergent with approved decontamination water.
3. Rinse sampler with DIUF water.
4. Wrap sampler in aluminum foil, clean plastic sheeting, or store in a new zip-seal bag (size permitting) or clean, dedicated PVC or PTFE storage container.
5. Dispose used decontamination solutions properly according to the site HSP.

### 3.3.3 Other Sampling and Measurement Probes

Temperature, pH, conductivity, Redox, and dissolved oxygen probes will be decontaminated according to manufacturer's specifications. If no such specifications exist, remove gross contaminant and triple rinse probe with DIUF water.

### 3.3.4 Drilling Rigs

Drilling rigs and associated equipment such as augers, drill casing, rods, samplers, tools, recirculation tank, and water tank (inside and out) will be decontaminated prior to site entry after over-the-road mobilization and immediately upon departure from a site after drilling a hole. Supplementary cleaning will be performed prior to site entry. There is a likelihood that contamination has accumulated on tires and as spatter or dust enroute from one site to the next.

1. Place contaminated equipment in an enclosure designed to contain all decontamination residues (water, sludge, etc.).
2. Steam clean equipment until all dirt, mud, grease, asphaltic, bituminous, or other encrusting coating materials (with the exception of manufacturer-applied paint) have been removed.
3. Water used will be taken from an approved source.
4. Containerize, sample, characterize, and dispose of all decontamination residues properly.

## 4.0 PRECAUTIONS

- Dispose of all wash water, rinse water, rinsates, and other sampling wastes (tubing, plastic sheeting, etc.) in properly marked, sealable containers, or as directed by the HSP.
- Do not eat, smoke or drink on site.

## 5.0 REFERENCES

Site-specific HSP.

# STANDARD OPERATING PROCEDURE 90.1
# PHOTOIONIZATION DETECTOR (HNu Model PI-101 and HW-101)

## 1.0 SCOPE AND APPLICATION

The purpose of this standard operating procedure (SOP) is to delineate protocols for field operations with a photoionization detector (HNu Systems Model PI-101 or HW-101). The photoionization detector (PID) detects total ionizables, hence it is used to monitor both organic and inorganic vapors and gases to determine relative concentrations of air contaminants. This information is used to establish level of protection and other control measures such as action levels. The PID cannot effectively detect compounds having ionization potentials above the photon energy level of the lamp used; therefore, methane, which has an ionization potential of 12.98 eV, is undetectable by PIDs, whose lamps are capable of producing 9.5, 10.2, or 11.7 eV.

Use of brand names in this SOP is in not intended as an endorsement or mandate that a given brand be used. Alternate equivalent brands of detectors, sensors, meters, etc. are acceptable. If alternate equipment is to be used, the contractor shall provide applicable and comparable SOPs for the maintenance and calibration of same.

## 2.0 MATERIALS

- HNu Systems Model PI-101 or HW-101 survey probe with 9.5, 10.2, or 11.7 eV lamp
- Lead-acid gel-cell battery
- Calibration Gas (*e.g.* isobutylene - 101 ppm) w/regulator
- Tygon tubing
- Tedlar bag (optional)
- Instrument logbook

## 3.0 PROCEDURE

These procedures are to be followed when using the HNu in the field.

### 3.1 START-UP

1. Before attaching the probe, check the function switch on the control panel to ensure that it is in the off position. Attach the probe by plugging it into the interface on the top of the readout module.
2. Turn the function switch to the battery check position. The needle on the meter should read within or above the green battery arc on the scale. If not, recharge the battery. If the red indicator light comes on, the battery needs recharging or service may be indicated.
3. Turn the function switch to any range setting. Listen for the hum of the fan motor. Check meter function by holding a solvent based marker pen near the sample intake. If there is no needle deflection, look briefly into the end of the probe (no more than one or two seconds) to see if the lamp is on. If it is on, it will give a purple glow. Do not stare into the probe any longer than two seconds. Long term exposure to UV light can damage the eyes. (See also note 5.4)
4. To ZERO the instrument, turn the function switch to the standby position and rotate the zero adjustment until the meter reads zero. A calibration gas is not needed since this is an electronic zero adjustment. If the span adjustment setting is changed after the zero is set, the zero should be rechecked and adjusted, if necessary. Allow the instrument to warm up for 3-5 minutes to ensure that the zero reading is stable. If necessary, readjust the zero.

### 3.2 OPERATIONAL CHECK

Follow the start up procedure in section 3.1

With the instrument set on the 0-20 range, hold a solvent-based magic marker near the probe tip. If the meter deflects upscale, the instrument is working.

### 3.3 FIELD CALIBRATION PROCEDURE

1. Follow the start-up procedures in section 3.1 and the operational check in section 3.2.
2. Set the function switch to the range setting for the concentration of the calibration gas.
3. Attach a regulator HNu P/N 101-351 or equivalent (flow = 200 to 300 ml/min) to a disposable cylinder of isobutylene (HNu 101-351 or equivalent). Connect the regulator to the probe of the HNu with a piece of clean Tygon tubing. Turn on the valve of the regulator.
4. After five seconds, adjust the span dial until the meter reading equals the benzene concentration of the calibration gas used, corrected to its equivalence which should be marked on the canister (Isobutylene ~0.7X benzene).
5. Record in the field log: the instrument ID No.; serial number; the initial and final span settings; the date; time; location; concentration and type of calibration gas used; and the signature of the person who calibrated the instrument.
6. If the HNu does not function, check-out, or calibrate properly, the project equipment manager is to be notified as soon as possible. Under no circumstances is work requiring monitoring with a PI-101 or HW-101 to be done with a malfunctioning instrument.

### 3.4 CALIBRATION TO A GAS OTHER THAN ISOBUTYLENE

The HNu may be calibrated to any certified calibration gas. However, after calibration all subsequent instrument readings will be relative to the calibration gas used. General procedures include:

1. Calibrate according to procedure 3.3
2. Partially fill and flush to two times a gas bag (Tedlar recommended) with the certified National Institute of Standards and Technology (NIST) (formerly NBS) traceable calibration gas. Then fill the bag with one to three liters of the calibration gas. If the gas is toxic, this must be done in a fume hood.
3. Feed the calibration gas into the probe with the range set for the value of the gas. After five seconds, adjust the span control until the meter reads the value of the calibration gas.
4. Record the results of the calibration on the calibration/maintenance log and attach a new calibration sticker (if available) or correct the existing sticker to reflect the new calibration data. All subsequent readings will be relative to the new calibration gas.

### 3.5 OPERATION

1. Follow the start up procedure, operational check, and calibration check (refer to 3.1).
2. Set the function switch to the appropriate range. If the concentration of gases of vapors is unknown, set the function switch to 0-20 ppm range. Adjust if necessary.
3. While taking care not to permit the HNu to be exposed to excessive moisture, dirt, or contaminants, monitor the work activity as specified in the Site Health and Safety Plan.
4. When the activity is completed or at the end of the day, carefully clean the outside of the HNu with a damp disposable towel to remove all visible dirt. Return the HNu to a secure area and place on charge. Place the instrument on charge after each use; the lead acid batteries cannot be ruined by over charging.
5. With the exception of the probe's inlet and exhaust, the HNu can be wrapped in clear plastic to prevent it from becoming contaminated and to prevent water from getting inside in the event of precipitation. If the instrument becomes contaminated, make sure to take necessary steps to decontaminate it. Call the Equipment Administrator if necessary; under no circumstances should an instrument be returned from the field in a contaminated condition.

## 4.0 MAINTENANCE

Calibration/maintenance logs are to be filled in completely whenever a PI-101 or HW-101 receives servicing. This is true of both contractor-owned and rental instruments. The equipment manager should be called to arrange for a fresh instrument when necessary. The contractor's equipment facility is responsible for arranging all repairs which cannot be performed by the project equipment manager.

### 4.1 ROUTINE SERVICE

The PID's performance is affected by a number of factors. These include but are not limited to the decay of the UV lamp output over time and the accumulation of dust and other particulate material and contaminates on the lamp and in the ion chamber. Because of these factors, the PID should not be left in the field for a period of more than two weeks before being replaced with a fresh instrument. If a site is going to be inactive for a period of more than a week, all monitoring instruments are to be returned to the project equipment manager or his trained designee for servicing and/or reassignment. The following procedures are to be performed at the designated intervals for routine service.

| Procedure | Frequency |
|---|---|
| Operational Check | Prior to use and at instrument return |
| Field Calibration | Prior to use and at instrument return |
| Full Calibration | Bi-weekly (return instrument to equipment manager for replacement with a fresh unit) |
| Clean UV Lamp and Ion Chamber | Bi-weekly or as needed |
| Replace UV Lamp | As needed |

#### 4.1.1 UV Lamp and Ion Chamber Cleaning

During periods of analyzer operation, dust and other foreign materials are drawn into the probe forming deposits on the surface of the UV lamp and in the ion chamber. This condition is indicated by meter readings that are low, erratic, unstable, non-repeatable, drifting, and which show apparent moisture sensitivity. These deposits interfere with the ionization process and cause erroneous readings. Check for this condition regularly to insure that the HNu is functioning properly. If the instrument is malfunctioning, call your respective equipment manager to arrange to have a fresh replacement.

#### 4.1.2 Lamp eV Change

If different applications for the analyzer would require different eV lamps, separate probes, each with its own eV lamp, must be used. A single readout assembly will serve for any of the probes (9.5, 10.2 and 11.7 eV). A change in probe will require resetting of the zero control and recalibrating the instrument. The 11.7 eV lamp will detect more compounds than either of the two lower eV lamps. However, the 11.7 eV probe needs more frequent calibration, it burns out much faster than the lower eV lamps.

## 5.0 PRECAUTIONS

- The HNu PI-101 and HW-101 are designed to sample air or vapors only. DO NOT allow any liquids or low boiling vapors to get into the probe or meter assembly.
- High concentrations of any gas can cause erroneous readings. High humidity can also cause the instrument readings to vary significantly from the actual concentration of gases or vapors present. This is true even through the HNu cannot react to water vapor.
- High humidity, dust, and exposure to concentrations of low boiling vapors will contaminate the ion chamber, causing a steady decrease in sensitivity.
- Continued exposure to ultraviolet light generated by the light source can be harmful to eyesight. If a visual check of the UV lamp is performed: Do not look at the light source from a distance closer than 6 inches with unprotected eyes. Use eye protection (UV-blocking sunglasses or safety glasses). Only look briefly - never more than about 2 seconds.
- Place the instrument on charge after each use; the lead batteries cannot be ruined by over charging.
- If at any time the instrument does not check out or calibrate properly in the field, the equipment manager is to be notified immediately and a replacement provided for the malfunctioning instrument. Under no circumstances should field work requiring continuous air monitoring for organic vapors and/or gases be done with a malfunctioning HNu, without a HNu or an approved comparable instrument.

## 6.0 REFERENCES

Manufacturer's Equipment Manual.

# APPENDIX B

## AERIAL PHOTOGRAPH DOCUMENTATION SHOWING SWMU 6 BOUNDARIES

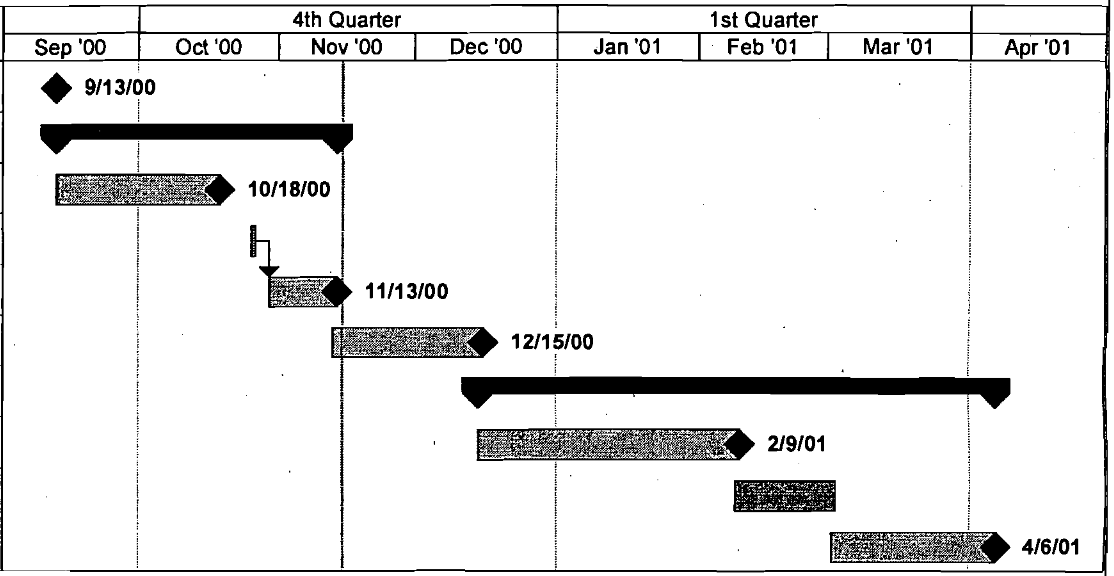
Aerial Photograph Showing Location and Boundaries of SWMU 6
Photograph Date: July 4, 1986
U.S. Environmental Protection Agency, Frame # 051:23-44
Original Scale 1: 12,000

# APPENDIX C

# SCHEDULE

# Radford Army Ammunition Plant
# SWMU 6 Sampling and Report

| ID | Task Name | Duration | Start | Finish |
|---|---|---|---|---|
| 1 | Task Award | 0 days | Wed 9/13/00 | Wed 9/13/00 |
| 2 | **Work Plan/EPA Meeting** | **44 days** | **Wed 9/13/00** | **Mon 11/13/00** |
| 3 | AO11 Draft WP Addendum | 26 days | Wed 9/13/00 | Wed 10/18/00 |
| 4 | Meeting at USEPA - Philadelphia | 1 day | Thu 10/26/00 | Thu 10/26/00 |
| 5 | AO11 Final WP Addendum | 11 days | Mon 10/30/00 | Mon 11/13/00 |
| 6 | **Field Work/Results** | **25 days** | **Mon 11/13/00** | **Fri 12/15/00** |
| 7 | **Final Report** | **81 days** | **Fri 12/15/00** | **Fri 4/6/01** |
| 8 | Draft SWMU 6 Sampling Report | 41 days | Fri 12/15/00 | Fri 2/9/01 |
| 9 | Receive Comments from RFAAP | 16 days | Fri 2/9/01 | Fri 3/2/01 |
| 10 | Final SWMU 6 Sampling Report | 26 days | Fri 3/2/01 | Fri 4/6/01 |



Project: RFAAP SWMU6
Date: Wed 11/15/00

| | | | | | |
|---|---|---|---|---|---|
| Task | ▨ | Summary | ▬ | Rolled Up Progress | ▬ |
| Split | ............... | Rolled Up Task | ▨ | External Tasks | ▨ |
| Progress | ▬ | Rolled Up Split | ............... | Project Summary | ▨ |
| Milestone | ◆ | Rolled Up Milestone | ◇ | | |

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