RAAP050506\05004

Delivery Order No. 0008
Environmental Services
Program Support
DACA31-94-D-0064

OCAW
Alliant
U.S. Army
Team Radford

RADFORD ARMY AMMUNITION PLANT, VIRGINIA

Master Work Plan
Quality Assurance Plan
Health and Safety Plan

Addendum 010:
Facility-Wide Background Study

FINAL DOCUMENT

September 2000

ALLIANT TECHSYSTEMS

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

3

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

Russell Fish, P.E., EPA Region III

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 R. Alston
TITLE: LTC, CM, Commanding
Radford AAP

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

00-815-180
JJRedder

5

COMMONWEALTH *of* VIRGINIA

James S. Gilmore, III
Governor

John Paul Woodley, Jr.
Secretary of Natural Resources

DEPARTMENT OF ENVIRONMENTAL QUALITY
Street address: 629 East Main Street, Richmond, Virginia 23219
Mailing address: P.O. Box 10009, Richmond, Virginia 23240
Fax (804) 698-4500 TDD (804) 698-4021
http://www.deq.state.va.us

Dennis H. Treacy
Director

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

October 16, 2000

Mr. Jim McKenna
Radford Army Ammunition Plant
SIORF-SE-EQ
P.O. Box 2
Radford, Virginia 24141-0089

RE: Addendum 010, Facility-Wide Background Study
Dated August 2000

Dear Mr. McKenna:

I have reviewed the above referenced work plan addendum. Given that the sampling had occurred prior to our receipt of the work plan and that EPA has already approved the plan, no comments will be provided at this time. However, please ensure that ample review time is provided for any future documents.

I look forward to reviewing the report containing the sampling results from this background study and meeting with you for a site visit on October 18th, 2000.

Very truly,

Sharon Wilcox

Sharon Wilcox
Federal Facilities Restoration Program
(804) 6987-4143
sswilcox@deq.state.va.us

cc: Durwood Willis, VDEQ
Rob Thompson, Region III, EPA
File: Radford AAP, 2000
Chronological

Aziz Farahmand, WCRO
Norm Auldridge, WCRO

copy in 439

1

McKenna, Jim

n:	McKenna, Jim
t:	Thursday, October 05, 2000 1:06 PM
To:	'durwood willis'; 'sharon wilcox'
Cc:	'john e tesner'; Redder, Jerome
Subject:	FW: Backgrnd Study Work Plan

backgrndWPapproval.wpd

Sharon,

Don't if the fax will come through clearly so I'm forwarding the email message from Rob Thomson with the review and approval letter attachment.

Jim

-----Original Message-----
From: Thomson.Bob@epamail.epa.gov [mailto:Thomson.Bob@epamail.epa.gov]
Sent: Tuesday, September 26, 2000 11:22 AM
To: Redder, Jerome; McKenna, Jim
Cc: Fish.Russell@epamail.epa.gov
Subject: Backgrnd Study Work Plan

ached, please find the EPA review letter for the Background Study Work Plan

Rob

(See attached file: backgrndWPapproval.wpd)

copy in 43q

McKenna, Jim

From: Thomson.Bob@epamail.epa.gov
Sent: Tuesday, September 26, 2000 11:22 AM
To: Redder, Jerome; McKenna, Jim
Cc: Fish.Russell@epamail.epa.gov
Subject: Backgrnd Study Work Plan

backgrndWPapproval.wpd

Attached, please find the EPA review letter for the Background Study Work Plan

Rob

(See attached file: backgrndWPapproval.wpd)

Copy in 43g

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

September 26, 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 submittals and reviews

Dear Mr. McKenna and Ms. Jake:

The U.S. Environmental Protection Agency (EPA) has reviewed the Army's draft *Facility-Wide Background Study Work Plan*, Addendum 010 for the New River Storage Depot (NRU), and the Radford Army Ammunition Plant (RAAP). Based upon our review, the *Facility-Wide Background Study Work Plan* is approved, and meets the requirements of Part II.(C)(3)(a) of RAAP's Corrective Action Permit. In accordance with Part II.(I)(2) of RAAP's Corrective Action Permit, the schedule contained within the *Facility-Wide Background Study Work Plan* is henceforth incorporated into the Permit. Thus, the complete schedule contained in Appendix B, including the deliverable date of **February 14, 2001** for the draft *Background Report* is now finalized.

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

Sincerely,

Robert Thomson

Robert Thomson, PE
Federal Facilities Branch

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

original in 43g
copy in WPA #10

ALLIANT TECHSYSTEMS

Alliant Techsystems Inc.
Radford Army Ammunition Plant
Route 114
P.O. Box 1
Radford, VA 24141-0100

August 30, 2000

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

Subject: Addendum 010: Facility Wide Background Study Radford Army Ammunition Plant
EPA ID# VA1 210020730

Dear Mr. Thomson:

Enclosed is a certified copy of the "Addendum 010: Facility Wide Background Study Radford Army Ammunition Plant". Your six additional copies and Mr. Harris' copy will be sent under separate cover. Per July 20, 2000 conversation with Mr. Harris, a copy to Ms Leslie Romanchik is no longer necessary.

The contents of this work plan were discussed in an August 10, 2000 team meeting at your office. Draft meeting minutes were provided August 16, 2000 via email. Comments on the meeting minutes received August 24, 2000 from Ms. Lynn Flowers relate to data evaluation and not to fieldwork execution. Per the email, the Army's contractor, IT Group, has begun the fieldwork on August 28, 2000.

Please coordinate with and provide any questions or comments to myself at (540) 639-8266, 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
Russell Fish, P.E., EPA Region III

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

00-815-112
JMcKenna/JJRedder

copy in 43

ALLIANT TECHSYSTEMS

Alliant Techsystems Inc.
Radford Army Ammunition Plant
Route 114
P.O. Box 1
Radford, VA 24141-0100

August 30, 2000

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

Subject: Addendum 010: Facility Wide Background Study Radford Army Ammunition Plant
EPA ID# VA1 210020730

Dear Mr. Thomson:

Enclosed is a certified copy of the "Addendum 010: Facility Wide Background Study Radford Army Ammunition Plant". Your six additional copies and Mr. Harris' copy will be sent under separate cover. Per July 20, 2000 conversation with Mr. Harris, a copy to Ms Leslie Romanchik is no longer necessary.

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Please coordinate with and provide any questions or comments to myself at (540) 639-8266, 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
Russell Fish, P.E., EPA Region III

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

bc: Administrative File
J. McKenna, ACO Staff
S. J. Barker-ACO Staff
Rob Davie-ACO Staff
C. A. Jake
J. J. Redder
Env. File

Coordination: J. McKenna
J. McKenna

00-815-112
JMcKenna/JJRedder

Concerning Addendum 010: Facility Wide Background Study Radford Army Ammunition Plant, Radford VA

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

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

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

McKenna, Jim

From: Greene, Anne
Sent: Thursday, September 07, 2000 4:13 PM
To: McKenna, Jim
Subject: FW: Online FedEx Tracking - 3010987962

For your records. This is the tracker we received letting us know Mr. Thomson's office received the Fed-X package.
ext. 7340

From: Blankenship, Herman
Sent: Thursday, September 07, 2000 12:35 PM
To: Greene, Anne
Subject: FW: Online FedEx Tracking - 3010987962

TO: MR. ROBERT THOMSON SHIPPED ON 09-06-2000

Tracking Number : 3010987962

Ship Date :
Delivered To : Recept/Frnt desk
Delivery Location : PHILADELPHIA PA
Delivery Date/Time : 09/07/2000 09:05
Signed For By : V.BOONE
Service Type : Priority Box

Scan Activity	Date/Time	Scan Exceptions
Delivered PHILADELPHIA PA	09/07/2000 09:05	
Placed on Van PHILADELPHIA PA	09/07/2000 08:24	
Arrived at FedEx Destination Location PHILADELPHIA PA	09/07/2000 07:31	
Left FedEx Sort Facility MEMPHIS TN	09/07/2000 04:14	
Left FedEx Sort Facility MEMPHIS TN	09/07/2000 00:30	
Arrived at FedEx Ramp ROANOKE VA	09/06/2000 21:56	
Left FedEx Origin Location CHRISTIANSBURG VA	09/06/2000 19:22	
Pickup Exception CHRISTIANSBURG VA	09/06/2000 15:53	Pre-routed meter pkg picked up
Pickup Exception CHRISTIANSBURG VA	09/06/2000 15:50	Pre-routed meter pkg picked up

copy ... 439

Delivery Order No. 0008
Environmental Services
Program Support
DACA31-94-D-0064

OCAW
Alliant
U.S. Army
Team Radford

RADFORD ARMY AMMUNITION PLANT, VIRGINIA

Master Work Plan
Quality Assurance Plan
Health and Safety Plan

Addendum 010:
Facility-Wide Background Study

FINAL DOCUMENT

September 2000

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

1. AGENCY USE ONLY (Leave blank)

2. REPORT DATE
September 2000

3. REPORT TYPE AND DATES COVERED
Work Plan Addendum, 2000

4. TITLE AND SUBTITLE
Radford Army Ammunition Plant, Work Plan Addendum 010

5. FUNDING NUMBERS
U.S. Army Environmental Center
Contract No. DACA31-94-0064
Delivery Order 0008

6. AUTHOR(S)
D. Kateley, E. Malarek, J. Schrader, M. Thomas, D. Trumbo, G. Zynda

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
IT Corporation
2113 Emmorton Park Road
Edgewood, MD 21040

8. PERFORMING ORGANIZATION REPORT NUMBER
ESPS 08-28

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)
U.S. Army Environmental Center
Aberdeen Proving Ground, MD 21010

10. SPONSORING/MONITORING AGENCY REPORT NUMBER

11. SUPPLEMENTARY NOTES
Report is contained in one volume.

12a. DISTRIBUTION/AVAILABILITY STATEMENT

12b. DISTRIBUTION CODE

13. ABSTRACT (Maximum 200 words)

The IT Group has been tasked to assist the Army in addressing environmental concerns at Radford Army Ammunition Plant (RFAAP). Scope of work activities include the collection of background soil samples at the Main Manufacturing Area (MMA) and the New River Unit (NRU) to establish a baseline for inorganic compounds of concern at RFAAP. This Work Plan is an addendum to the RFAAP Master Work Plan (MWP), and is to be used in conjunction with the MWP to perform facility-wide background activities at the MMA and the NRU. Definable features of work associated with this investigation includes surface and subsurface soil sampling. Corresponding QA and Health and Safety requirements are discussed for associated activities as appropriate.

14. SUBJECT TERMS
RFAAP, Site Management Plan, Master Work Plan, Background Study

15. NUMBER OF PAGES

16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT
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NSN 7540-01-280-5500

Standard Form 298 (Rev. 2-89)
Prescribed by ANSI Std 239-18
298-102

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LIST OF ACRONYMS

ATK— Alliant Techsystems, Inc.
CVAA— cold vapor atomic absorption
DOD— Department of Defense
DQOs— data quality objectives
ERIS— Environmental Restoration Information System
GC/FID— gas chromatograph/flame ionization detector
GOCO—government-owned, contractor-operated
GPS— Global Positioning System
HAZCOM— Hazard Communication
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
mL— milliliters
MQAP— Master Quality Assurance Plan
MSDSs— Material Safety Data Sheets
msl—mean sea level
MWP— Master Work Plan
OSHA— Occupational Safety and Health Administration
PPE— personal protective equipment and clothing
QA— quality assurance
QA/QC— Quality Assurance/Quality Control
QAP— Quality Assurance Plan
QAPA— Quality Assurance Plan Addendum
QC— quality control
RFAAP— Radford Army Ammunition Plant
SHSO— Site Health and Safety Officer
SOQs— Statements of Qualification
TAL— Target Analyte List
TCLP— Toxicity Characteristic Leachate Procedure
TSDF— Transporter, storage, and disposal facility
TWA— time-weighted average
USEPA—U.S. Environmental Protection Agency
VDEQ— Virginia Department of Environmental Quality
WPA— Work Plan Addendum

1.0 WORK PLAN ADDENDUM

The IT Corporation has been tasked by the U.S. Army to perform a facility-wide background study at the Main Manufacturing Area Facility and New River in accordance with Contract Number DACA31-94-D-0064, Delivery Order 0008. Task objectives are to characterize background soil inorganic concentrations within the Main Manufacturing Area and the New River Unit of Radford Army Ammunition Plant (RFAAP) (Figure 1-1).

1.1 OBJECTIVE AND SCOPE

This work plan is written as an addendum to the RFAAP Master Work Plan (MWP) (ICF KE 1998a) 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 Work Plan Addendum (WPA) presents specific activities for the Facility-Wide Background Study (Section 1.4).

The Army, U.S. Environmental Protection Agency (USEPA), and the Installation have approved the MWP as RFAAP's work plan for performing routine investigative activities. Routine investigative activities that will be performed as specified in the MWP are listed in Table 1-1.

Any changes to the approved WPA will be documented using the Work Plan Revision Form (Form 1-1). Revisions must be reviewed and approved by RFAAP prior to implementation. Project personnel will be required to read this addendum and to sign and date a Worker Acknowledgment Form (Form 1-2). The Site Health and Safety Officer (SHSO) will retain this form onsite during investigation activities.

Figure 1–1
RFAAP and Vicinity Map

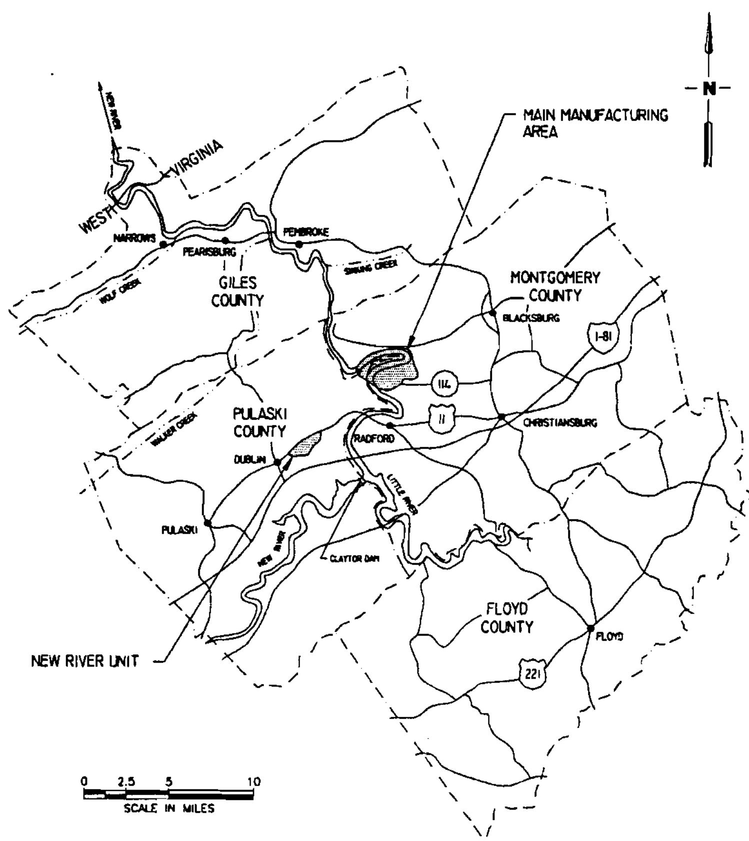


Table 1–1
Investigative Activities Discussed in the Master Work Plan

Subject	MWP Section	SOP(s) MWP Appendix A	Applicable Areas	
			Main Manufac-turing Area	NRU
Installation Description	2.0	NA	✓	✓
Environmental Setting	3.0	NA	✓	✓
Sample Management	5.1	50.1, 50.2, 50.3	✓	✓
Documentation	4.3	10.1, 10.2, 10.3, 10.4	✓	✓
Boring Abandonment	5.2.6	20.2	✓	✓
Boring Logs/Stratigraphic Characterization	5.2.3	10.3, 20.6	✓	✓
Soil Sampling/Split Spoon Samples	NA	30.1	✓	✓
Explosives Soil Screening	NA	30.13*	✓	✓
Soil Sampling	NA	30.1	✓	✓
Decontamination Requirements	5.13	80.1	✓	✓
Investigative-Derived Material	5.14	70.1	✓	✓

*Currently not contained in the MWP Appendix A but is contained in Appendix A of this Addendum.

Form 1-1

Revision Form

Work Plan – Quality Assurance Plan – Health and Safety Plan Addendum

SITE DESIGNATION/LOCATION:	Section:______________________
Radford Army Ammunition Plant	Addendum:____________________
Radford, VA	Version:______________________
	Effective Date:_________________
SUBJECT:	Approved By:
	Field Operations Leader
	______________________________
	Date __________________________
	Concurrence:
	Project Manager
	______________________________
	Date __________________________
	Sheet ____ of ____

Form 1-2

Worker Acknowledgment Form

Document:	Master Work Plan/QAP/HSP and Addendum 010
Version:	Draft
Project:	Radford Army Ammunition Plant
Location:	Main Manufacturing Area and the NRU

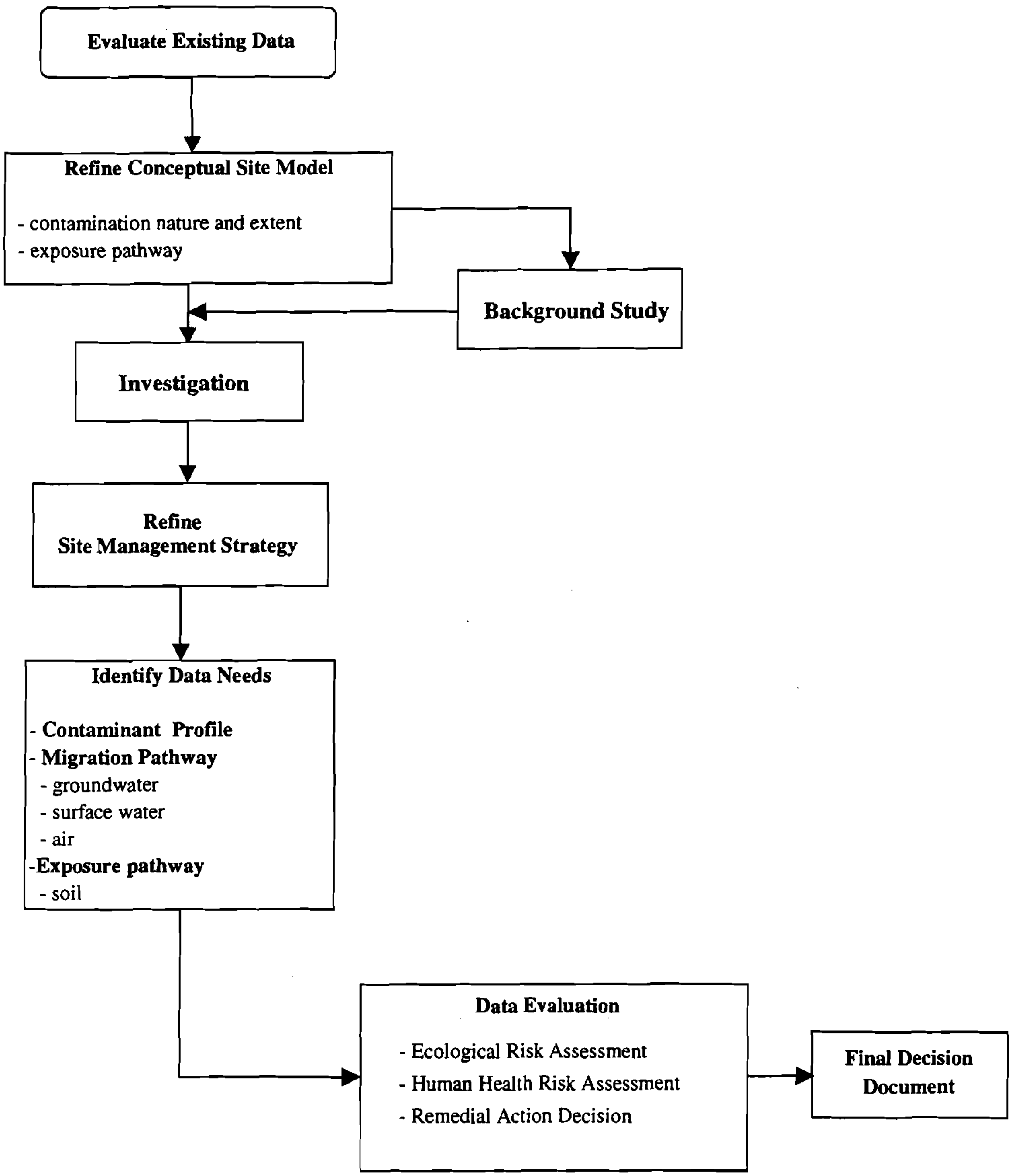
Prior to the initiation of field activities, I have been given an opportunity to read and question the contents of this Master Work Plan/QAP/HSP, this Site-Specific Addendum, and all approved revisions through the number listed above. With my signature I certify that I have read, understood, and agree to comply with the information and directions set forth in these plans. I further certify that I am in full compliance with 29 CFR 1910.120 in regard to training and medical monitoring requirements.

Site Personnel:

Name (please print)	Signature	Date

1.1.1 Investigation Overview

Investigation program activities designed to achieve site-specific data quality objectives (DQOs) are presented in the following sections. Each program systematically establishes the rationale for investigative activities through an assessment of site characteristics and associated project objectives. Supplemental chemical and physical data obtained during the sampling and analysis phase will be used to refine site profiles and enhance the accuracy of remedial action decisions. The diagram below illustrates the process.



Investigation programs focus on problems identified through existing data and have been designed to provide a comprehensive framework for establishing consistency in the decision-making process. The program clearly articulates project objectives, assumptions, and data use specifications. Program elements include:

- **Site Characteristics:** Brief site descriptions are included in the introductory paragraph for each investigation area to provide an overview of existing site conditions.
- **Preliminary Investigative Results:** Preliminary results will be integrated into remedial action decisions. Investigative activities have been conducted in each of the study areas.
- **Sampling Program:** Phase focused investigations will be performed to effectively utilize resources and achieve project DQOs. The sampling design program presented for each area has been structured to meet site-specific 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 remedial action decisions.
- **Health and Safety:** Site-specific training, personal protective equipment and clothing (PPE), and applicable monitoring requirements are presented in Section 3.0 of this addendum. These procedures were developed to provide the requirements for protection of site personnel including government employees, IT Corporation, regulators, subcontractors, and visitors, who are expected to be involved with site activities.

1.2 INSTALLATION DESCRIPTION

Radford Army Ammunition Plant (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., became the permanent contractor. The installation consists of two noncontiguous areas: the Main Manufacturing Area and the New River Unit.

The Main Manufacturing Area 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 New River Unit (NRU) was constructed in 1940 and operated as a bag-manufacturing and loading plant for artillery, cannon, and mortar projectiles. This unit currently occupies 2,800 acres and is being used for storage of explosives and powder produced at the Main Manufacturing Area.

1.2.1 Location

The Main Manufacturing Area 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 northeast region of the valley and is divided into northern and southern areas. The northern half or "Horseshoe Area" is located within the New River meander. The southern area contains the Main Manufacturing Area, which has been principally used for the manufacturing of single- and multi-base propellants and trinitrotoluene.

The NRU is located approximately six miles west of the Main Manufacturing Area of RFAAP and 70 miles southwest of Roanoke. It is located east of the town of Dublin in Pulaski County, Virginia in the southern portion of the Appalachian Mountain region. The facility is approximately 1.5 miles north of Claytor Lake and approximately 2 miles northwest of Claytor Lake Dam. The largest substantial development, Fairlawn, is approximately 2.5 miles to the northeast.

1.2.2 Environmental Setting

1.2.2.1 Climate

The climate of the area encompassing RFAAP is classified as "moderate continental," and is characterized by moderately mild winters and warm summers. Prevailing winds are from the southwest, with an average yearly wind speed between 8 to 10 miles per hour (SCS 1985). Average monthly temperature ranges from 29.6°F in January to 72°F in July, with an annual average temperature of about 52°F. Average monthly precipitation ranges from about 2.5" to 4.1" with an annual total precipitation between 36.9" and 41.5" (NCDC 1999). Lake evaporation was measured at 32" per year in the same area.

Potential evapotranspiration has been calculated at 30" per year using the Thornthwaite method (Parsons 1996). Based on these data, the net precipitation in the vicinity of RFAAP ranges between 6.9" and 11.5" annually. Snowfall in the vicinity of RFAAP averages 17" annually. Montgomery and Pulaski Counties lie in one of the areas of highest occurrence of dense fog in the United States. Dense fog can be expected to occur between 20 and 45 days per year.

1.2.2.2 Physiography

RFAAP lies within the Valley and Ridge Province of the Appalachian physiographic division. The Valley and Ridge Province is characterized by a series of long, narrow, flat-topped mountain ridges separated by valleys of varying widths. Either of these landforms may predominate; the mountains may be widely spaced and isolated or so closely spaced that the lowlands are disconnected or absent. A distinctive feature of the installation area is the absence of mountain ridges.

RFAAP exhibits prominent karstic features including sinkhole, 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.

Topography within the Main Manufacturing Area of the installation varies from a relatively flat floodplain to elevated uplands in the extreme southeast section. The New River forms the RFAAP boundary on the north, with an elevation approximately 1,675 feet above mean sea level (msl). The eastern boundary represents a transition from a floodplain elevation of 1,680 feet msl to an upland elevation of 1,900 feet msl. The southern boundary traverses terrain consisting of creek bottoms and sharply rising summits. The western boundary follows the bluff line overlooking the New River to a point where the Norfolk and Western Railroad crosses the lower arm of the Horseshoe Area.

The topography at the NRU contains some relatively flat areas but is dominated by undulating terrain and occasional sinkholes. The highest elevation is approximately 2,160 ft above mean sea level (msl) in the western portion of the site, and the lowest elevation is approximately 1,860 ft msl at Hazel Hollow located in the northeastern section of the site. One stream flows to the southeast corner of the NRU. Several intermittent streams merge into Hazel Hollow to carry surface runoff to the northeast corner of the NRU.

1.2.3 Land Use/Demographics

The Main Manufacturing Area has not been highly developed because of the steep terrain surrounding the area. Land use in the vicinity of the facility has been mostly rural; less rugged areas have been primarily used for agriculture. The majority of counties situated in the New River Valley, which includes Montgomery, Pulaski, Giles, and Floyd is forested. The Jefferson National Forest is located approximately two miles north of the facility. Only 38 percent of the area of the New River Valley is classified as nonforest land, including agricultural land, developed land, and water acreage (NRVPDC 1994). The Blacksburg, Christiansburg VPI Water Authority owns four parcels of land adjacent to the facility. There are approximately 200 private residences located adjacent to the facility (Dames & Moore 1992). The largest substantial development, Fairlawn, is located about two miles southwest of the facility boundary.

The NRU currently serves a variety of land uses. A large portion of the site was sold and acquired by Burlington Industries, which used the warehouse area for their textile operation. Burlington Industries has since closed down operations and portions of the acquired land have been sold to the Town of Dublin. Portions of the site are used by Pulaski County for a maintenance facility and by the Commonwealth of Virginia for a highway maintenance facility.

The Pulaski County School Board and County Park uses a portion of the site. Flow Laboratories owns several acres, most of which is undeveloped. The U.S. Army Reserve has a facility and some undeveloped land at the site. The majority of the site remains undeveloped with many of the former buildings still standing.

In 1990, the city of Radford, located about four miles southwest of the Main Manufacturing Area, had a population of 15,940 which is equivalent to 1,626 people per square mile and the adjacent city of Dublin had 1,156 people per square mile. Population densities for Montgomery and Pulaski Counties included 190 and 108 persons per square mile, respectively (NRVPDC 1994). According to the U.S Census Bureau, the town of Dublin in 1999 had an estimated population of 2,009 people, which is equivalent to approximately 1,155 people per square mile. The estimated population in 1999, for Montgomery and Pulaski Counties was 76,997 and 34,407 people, respectively (U.S. Census Bureau 2000). The current estimated population densities are 198 and 108 persons per square mile, respectively.

1.2.4 Geology

RFAAP is located in the New River Valley, at the northwest terminus of the southern Valley and Ridge Province. The New River crosses the Valley and Ridge Province approximately perpendicular to the regional strike of bedrock and it chiefly cuts Cambrian and Ordovician limestone and dolomite. The valley is covered by river flood plain and terrace deposits; karst topography is dominant. Deep clay-rich residuum is prevalent in areas underlain by carbonate rocks. Karst features include sinkholes, caverns and springs caused by the dissolution of calcium carbonate by naturally occurring carbonic acid in rainwater. The greatest areas of karst features are controlled by bedrock stratigraphy and structure, and by the presence of major drainages. Late Cambrian and Mid-Ordovician limestones are more soluble than Cambrian and Lower Ordovician dolomite and shaley dolomite; therefore, they have the greatest number of sinkholes and caverns. However, both rock types show increased karst development in areas of low bedrock dip, where bedding is intensely folded, cleaved or jointed, and near major drainages.

The Elbrook and Mccrady/Price Formations are the only rock outcrops at the installation. The Elbrook Formation is composed of thickly bedded, blue-gray dolomite interspersed with blue-gray to white limestone; brown, green, and red shale; argillaceous limestone; and brecciated limestone (colors range from mottled light- to dark-gray and yellow-brown). Sinkholes, solution channels, pinnacled surfaces, and springs are common to the Elbrook, which ranges from 1,400 to 2,000 feet thick. The strike of bedding in the Elbrook Formation is variable throughout the region. The general orientation of bedding is seen in the nearly east-west alignment of sinkholes at the installation and the surrounding area. Most sinkholes in the area are oval shaped and elongated with respect to the strike of the bedding; they most likely represent fractured or faulted zones within the underlying Elbrook Formation. The *Mccrady/Price Formations* outcrop in a fenster (window) east of the main plant area along Stroubles Creek. This Formation may be up to 1,500 feet thick and consists of mottled red and green shale and mudstone interspersed with brownish-green siltstone and sandstone.

Max Meadows tectonic breccia, which is evidence of the close proximity of the Pulaski fault surface, is observed within and in the vicinity of the facility. This tectonic breccia consists of poorly sorted, angular to subrounded clasts of massive dolomite, laminated dolomites, and finely-laminated greenish gray calcareous mudstones in a fine- to very fine-grained matrix of crushed dolomite. Clasts range from less than 1 inch to more than 3 feet in length. The breccias are massive to crudely layered and are well to poorly indurated. The breccia, which is most fine-grained along the fault contact (Schultz 1986), is an integral part of the highly deformed rocks along the base of the Pulaski thrust sheet. Tectonic breccia has been described along the entire strike (310 miles) of the Pulaski thrust sheet.

The installation is also underlain by unconsolidated sedimentary deposits, including: alluvial plain sediments deposited by the New River prior to entrenchment, residual deposits from in-place weathering of parent bedrock, and colluvial deposits developed by residual slope wash. Alluvial plain deposits commonly line the New River and Stroubles Creek; as either recent floodplain material or as geologically older terraces. For example, three alluvial terraces are evident on the horseshoe loop that exhibit an upward textural fining. Gravels and silty, clayey sands form the basal unit, which are overlain by finer micaceous silts and clays. Sporadic cobbles and boulders (known as river jack) occur as lenses throughout the alluvial strata. Thickness of the alluvial deposits varies from a few feet to 50 feet, with an average of 20 feet.

Residual deposits (clays and silts) are a result of chemical and physical weathering of the parent bedrock, which is composed primarily of Elbrook dolomite. Residual deposits generally underlie the alluvium along the New River and in the Horseshoe Area. The exception is where the residuum has been eroded to bedrock and replaced by alluvium. Overburden depths vary from a few to 70 feet.

Colluvial deposits are generally formed from mass-wasting of slopes and escarpments. In general, these deposits are a heterogeneous mixture of alluvium, residuum, and rock debris that has moved from its original position. These deposits are generally interbedded between the strata of alluvium and residuum; thickness is variable.

The NRU is located within the middle section of the Ridge and Valley province (Thornbury 1965). The rocks, which underlie this site, are Middle Cambrian limestones, dolomites and shales of the Elbrook formation. The thickness of the Elbrook formation in this area is approximately 1,500 feet. The uppermost portion of the Elbrook is characterized by interbedded sandy, commonly cross-bedded, fine-grained dolomite containing thin lenses of fine to medium- grained sandstone. This is followed by cyclic sequences of medium-gray, finely laminated; fine-grained dolomite with crossbedding, bioturbated fine-grained dolomite with burrowed areas filled with slightly coarser-grained dolomite. The percentage of limestone diminishes with depth. The basal unit is 25 to 50 feet of fine-grained finely laminated, light greenish-gray, phyllitic, dolomitic mudstone, and interbedded dolomite. This formation is thought to be part of the Pulaski overthrust sheet. Most of the rock units trend northeast-southwest. Southeastward dipping thrust faults and asymmetric folds overturned to the northwest are common (Dietrich 1990).

1.3 SAMPLING PROGRAM DESIGN

The primary objective of the work plan is to collect samples representative of background conditions. Investigation objectives will be accomplished through biased sampling, which will be used to evaluate areas that have been minimally impacted by previous site activities or releases.

1.3.1 Sample Location Position Information

Sample location coordinates will be obtained using a Trimble Pathfinder Pro XRS Global Positioning System (GPS). The Pathfinder Pro XRS system is capable of obtaining real-time position information with submeter accuracy. 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 entered into the Installation Restoration Data Management Information System (IRDMIS) or Environmental Restoration Information System (ERIS) database.

1.3.2 Required Materials and Equipment

Table 1-2 lists materials and equipment required to complete project activities, including calibration and maintenance schedules.

Table 1–2
Equipment List and Maintenance Schedules

Materials and Equipment	Calibration and Maintenance Schedules
Provided by Subcontractors	
Geoprobe	Decontamination before/after each use 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 IT Corporation	
Soil sampling equipment	
bowls, trowels	Decontamination before/after each use
Explosives field test kits	Replace as needed
Decontamination equipment	
Liquinox	Replace as needed
Brushes	Replace as needed
Buckets	Replace as needed
Water	Replace as needed
PPE	
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

1.4 BACKGROUND STUDY

Background, in the context of this report, refers to site areas in which facility-wide inorganic concentrations are indicative of natural conditions and have been minimally influenced by site activities or releases from HWMUs, SWMUs, or areas of concern. The background study was designed to ensure the study approach is scientifically based and statistically significant. Primary background study components associated with determining inorganic background levels include selection of background sample locations, number of samples necessary to achieve statistical performance objectives, and statistical data evaluation.

1.4.1 Data Review and Evaluation

1.4.1.1 Evaluation of General Soil Maps

Soil survey maps were evaluated to establish general soil characteristics for the Main Manufacturing Area and New River Unit. Broad soil categories were established based on county soil map units.

The Main Manufacturing Area is located in both Montgomery and Pulaski (Horseshoe Area) counties. The Montgomery County and the Pulaski County general soil maps (SCS 1985) provided an understanding of the primary soil types underlying the Main Manufacturing Area. Soil descriptions associated with the Main Manufacturing Area are predominantly nearly level to hilly and are classified as deep.

Soils in this map unit consist of clayey and loamy soils formed in material weathered from limestone and shale. Characteristic soil types associated with this area include the Unison and Braddock in Montgomery County (Figure 1-2) and the Braddock and Wheeling in Pulaski County (Figure 1-3). Braddock soils are classified as deep, undulating to hilly soils with a clayey subsoil that are formed in alluvium. The Braddock soil type comprises approximately 4 percent of the county surface area. These soils are situated on old high terraces and exhibit a dark yellowish brown loam surface layer. Subsoils are dominated by yellowish red and red clay.

The Braddock-Wheeling series is classified as deep, level to hilly soils with a clayey or loamy subsoil that has formed in the alluvium.

Wheeling soils are situated on nearly level, low terraces near streams. Surface soils are characterized by a dark brown sandy loam, and subsoils consist of a dark brown sandy clay loam.

The Unison-Braddock map unit consists of deep, well-drained, gently sloping to moderately steep soils. The clayey subsoils associated with this unit were formed in old alluvium and are generally situated on stream terraces and alluvial fans.

A parallel review was conducted at the New River Unit, located in Pulaski County (Figure 1-3). The Groseclose-Poplimento-Frederick and Carbo-Lowell-Groseclose soils are the primary soil types underlying the New River Unit. Groseclose-Poplimento-Frederick soils are described as deep, undulating to hilly soils that possess a clayey subsoil.

These soils were formed in material weathered from limestone and shale. Groseclose soils are located on smooth, broad ridge tops and convex side slopes. These soils have a surface soil layer of dark yellowish brown silt loam and a subsoil layer of strong brown silty clay and clay.

Poplimento soil consists of a dark yellowish brown silt loam surface soil with a strong brown and reddish clay subsoil. Bedrock is encountered at depths greater than 48 inches.

Frederick soils have a surface layer of yellowish brown loam and a subsoil of strong brown and yellowish red clay. Bedrock is generally encountered at depths greater than 60 inches.

Carbo-Lowell-Groseclose soils are classified as moderately deep or deep, undulating to rolling soils that have a clayey subsoil. These soils were formed in material weathered from limestone and shale.

1.4.1.2 Detailed Soil Map Development

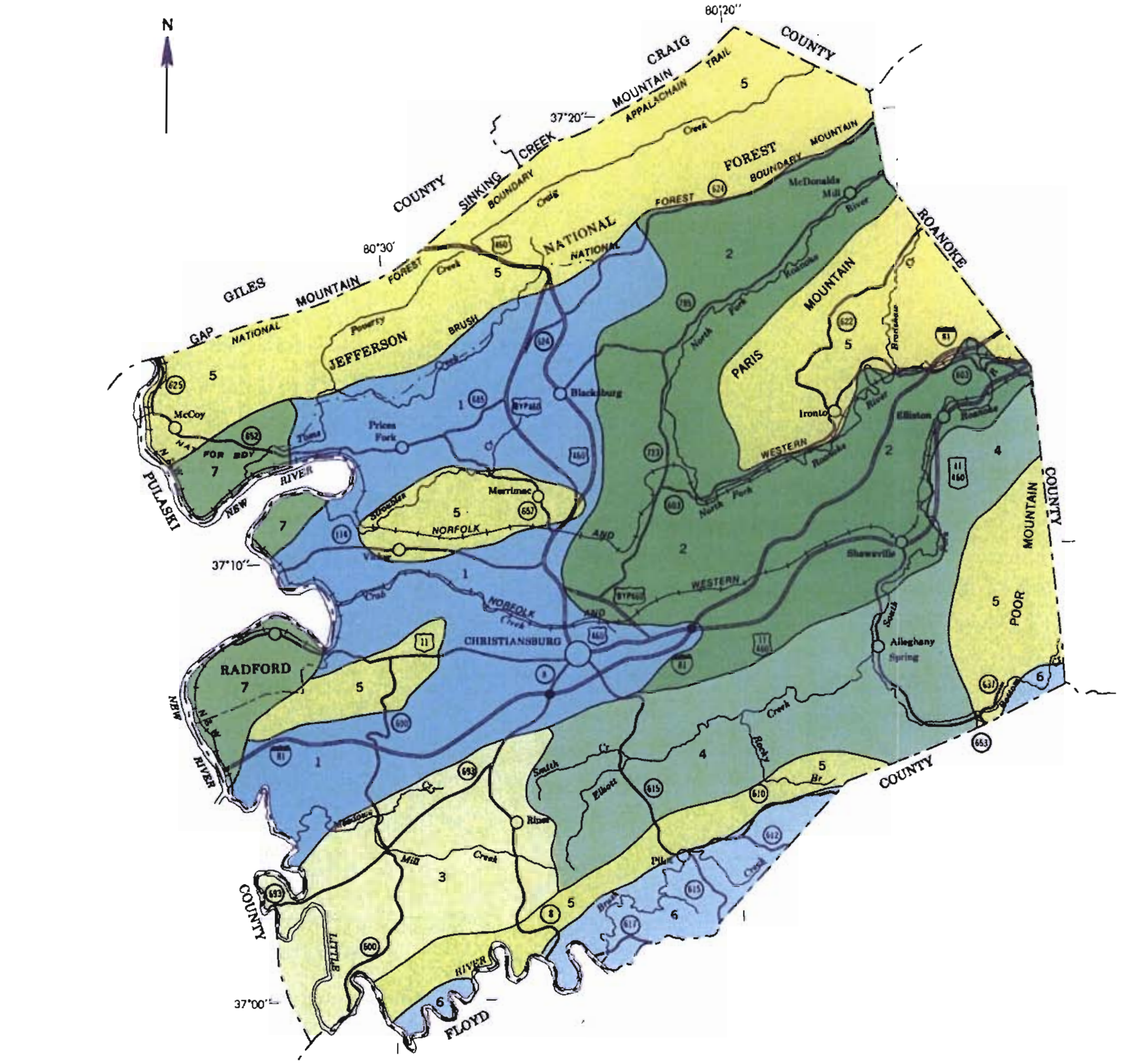
Detailed soil maps were constructed for each area using Soil Conservation Service (1985) map units (refer to Figure 1-4, Main Manufacturing Area, and Figure 1-5, New River Unit). Color-coded soil maps were developed to delineate the underlying soil types consistent with the associated study areas. Map unit descriptions were used to determine the appropriateness of the soil for consideration into the background study. Areas of concern, HWMUs, and SWMUs have been included on the maps.

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

GENERAL SOIL MAP

MONTGOMERY COUNTY, VIRGINIA

Scale 1:190,080



Each area outlined on this map consists of more than one kind of soil. The map is thus meant for general planning rather than a basis for decisions on the use of specific tracts.

LEGEND

1	Groseclose-Poplimento-Duffield: Deep, well drained, gently sloping to steep soils that have a clayey subsoil and formed in limestone, shale, and sandstone residuum and colluvium; on moderately dissected uplands
2	Caneyville-Opequon-Rock outcrop: Moderately deep and shallow, well drained, moderately steep to very steep soils that have a clayey subsoil and formed in limestone and shale residuum, and Rock outcrop; on highly dissected uplands
3	Berks-Groseclose-Lowell: Moderately deep and deep, well drained, gently sloping to very steep soils that have a loamy and clayey subsoil and formed in shale, limestone, and sandstone residuum; on moderately dissected uplands
4	Berks-Lowell-Rayne: Moderately deep and deep, well drained, moderately steep to very steep soils that have a loamy and clayey subsoil and formed in shale, limestone, and sandstone residuum; on highly dissected uplands
5	Berks-Weikert: Moderately deep and shallow, well drained, moderately steep to very steep soils that have a loamy subsoil and formed in acid shale and sandstone residuum; on mountains and highly dissected uplands
6	Glenelg-Parker: Deep, well drained and somewhat excessively drained, gently sloping to steep soils that have a loamy subsoil and formed in granite, gneiss, and schist residuum; on moderately to highly dissected uplands
7	Unison-Braddock: Deep, well drained, gently sloping to moderately steep soils that have a clayey subsoil and formed in old alluvium; on stream terraces and alluvial fans

Compiled 1982

SOILMONT.PPT

RADFORD AAP

the group

JULY 2000

FIGURE 1-2
GENERAL SOIL MAP
MONTGOMERY COUNTY, VIRGINIA

U.S. FOREST SERVICE
VIRGINIA POLYTECHNIC INSTITUTE AND STATE UNIVERSITY

GENERAL SOIL MAP
PULASKI COUNTY, VIRGINIA

Scale 1:190,080

1 0 1 2 3 Miles

1 0 3 6 Km

LEGEND

DOMINANTLY SLOPING TO STEEP SOILS THAT ARE DEEP TO SHALLOW

- 1 — Nolichucky-Berks: Deep or moderately deep, sloping to steep soils that have a loamy subsoil; formed in colluvial material weathered from sandstone or in material weathered from shale
- 2 — Berks-Gilpin: Moderately deep, moderately steep to very steep soils that have a loamy subsoil; formed in material weathered from shale
- 3 — Lack Kill-Rayne-Gilpin: Deep and moderately deep, sloping to steep soils that have a loamy subsoil; formed in material weathered from shale
- 4 — Klinesville-Berks: Shallow and moderately deep, sloping to steep soils that have a loamy subsoil; formed in material weathered from shale
- 5 — Rayne-Berks-Klinesville-Groseclose: Deep to shallow, sloping to steep soils that have a loamy or clayey subsoil; formed in material weathered from shale interbedded with limestone
- 6 — Lily-Ramsey-Berks-Gilpin: Moderately deep or shallow, moderately steep to very steep soils that have a loamy subsoil; formed in material weathered from sandstone shale, quartzite, and phyllite

DOMINANTLY UNDULATING TO STEEP SOILS THAT ARE DEEP OR MODERATELY DEEP

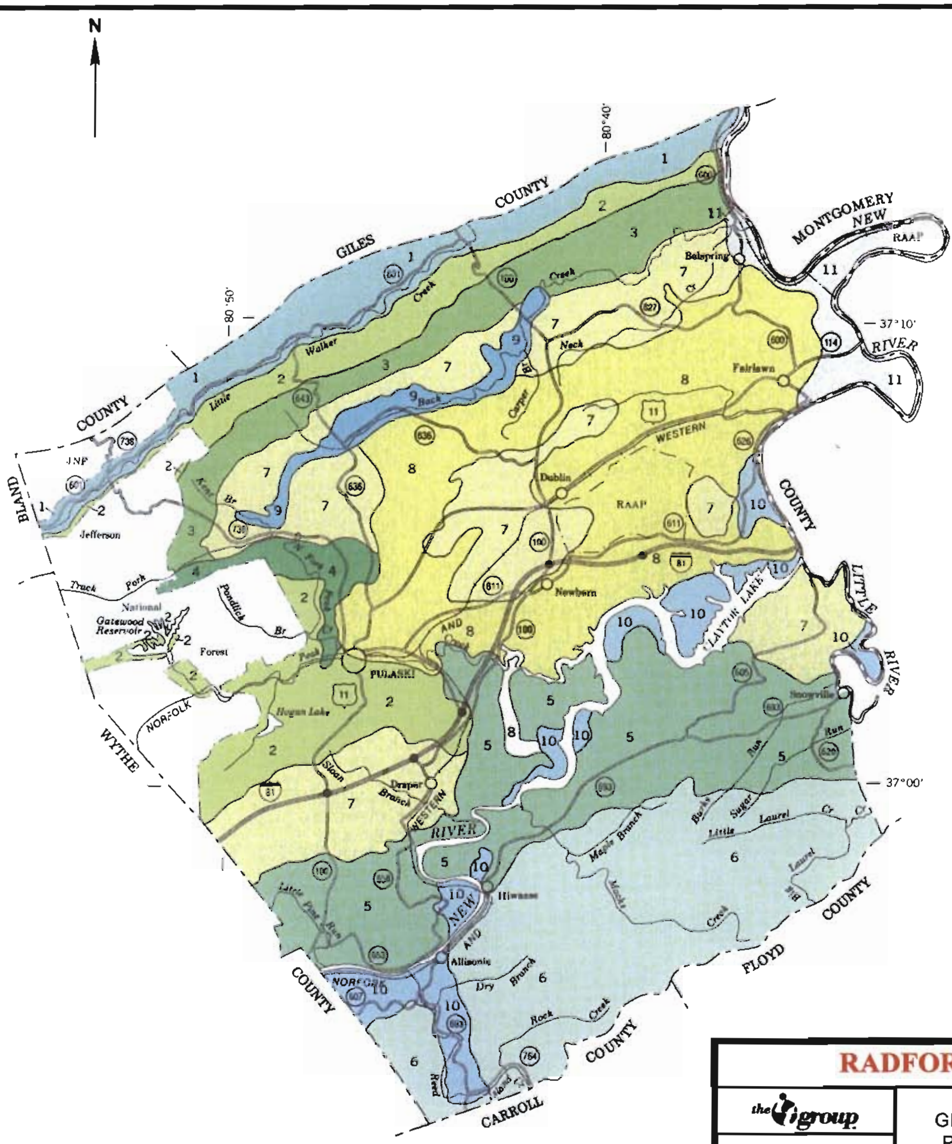
- 7 — Groseclose-Poplimento-Frederick: Deep, undulating to hilly soils that have a clayey subsoil; formed in material weathered from limestone and shale
- 8 — Carbo-Lowell-Groseclose: Moderately deep or deep, undulating to hilly soils that have a clayey subsoil; formed in material weathered from limestone and shale

DOMINANTLY NEARLY LEVEL TO HILLY SOILS THAT ARE DEEP

- 9 — Cotaco-Dunning-Groseclose: Deep, nearly level to hilly soils that have a loamy or clayey subsoil; formed in alluvium and in material weathered from limestone and shale
- 10 — Braddock: Deep, undulating to hilly soils that have a clayey subsoil; formed in alluvium
- 11 — Braddock-Wheeling: Deep, nearly level to hilly soils that have a clayey or loamy subsoil; formed in alluvium

Each area outlined on this map consists of more than one kind of soil. The map is thus meant for general planning rather than a basis for decisions on the use of specific tracts.

Compiled 1979



RADFORD AAP

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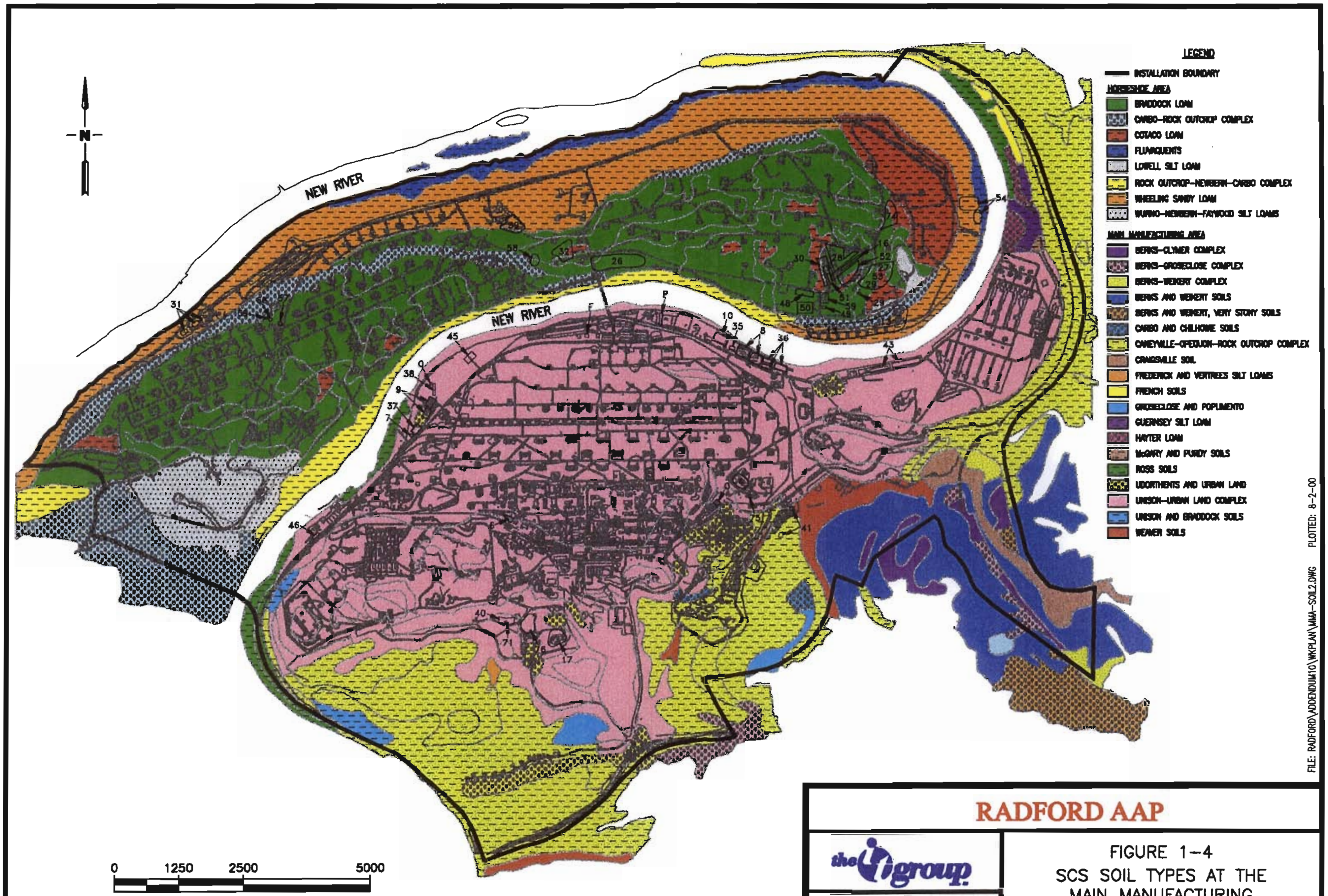
JULY 2000

FIGURE 1-3
GENERAL SOIL MAP
PULASKI COUNTY,
VIRGINIA

SOILPULASKI.PPT



RADFORD AAP

JULY 2000

FIGURE 1-4
SCS SOIL TYPES AT THE MAIN MANUFACTURING AREA

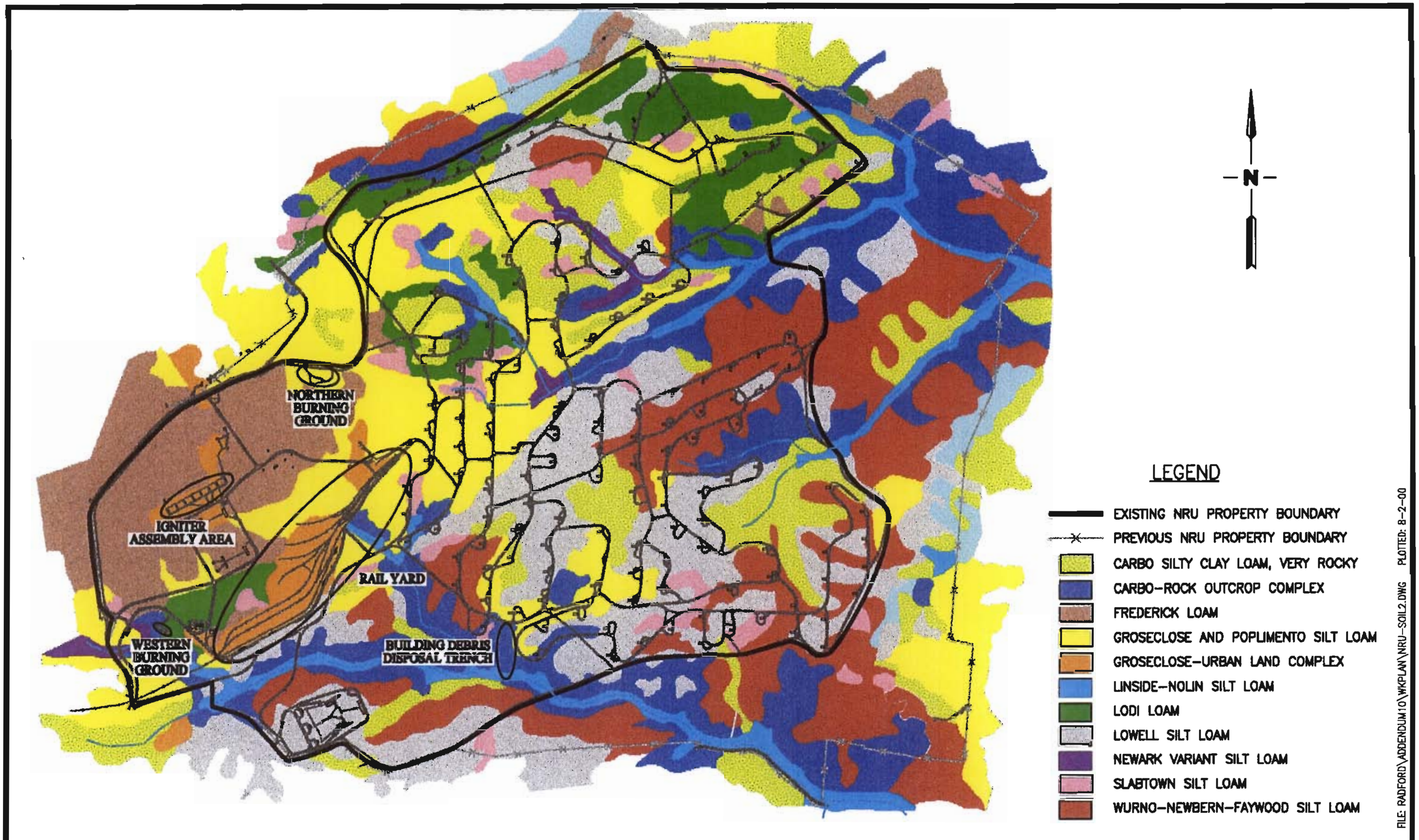


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FIGURE 1-5
SCS SOIL TYPES AT
THE NEW RIVER UNIT

Features that have not been included on the maps, but will be taken into consideration, are the associated soil horizons. Soil horizons are characteristic soil layers associated with soil forming processes. These soil layers extend from the soil surface down to material that has been slightly altered.

Most soils generally exhibit three major horizons: A, B, and C. The A horizon, or surface layer, is the layer in which maximum leaching of clay and iron has occurred. The B horizon underlays the A horizon and is termed the subsoil. This horizon is characteristic of maximum accumulation of clay, iron, aluminum, and other compounds leached from the surface layer. The C horizon is generally below the B horizon. Soil in this horizon is less altered by the soil-forming process than the A or B horizons.

1.4.1.3 Available Site Data Review

Available site data were reviewed to discern construction, HWMUs/SWMUs, areas of concern, and other associated physical features to ensure background sampling locations were representative of areas that had been minimally impacted by facility operations. These items included:

- Aerial photographs;
- Facility base and topographic maps; and
- Soil Series Classification.

Aerial photographs (EPIC 1992) were used to evaluate construction and SWMU activities occurring between 1949 and 1986 and to identify physical features potentially impacting environmental conditions at the Main Manufacturing Area and New River Unit.

EPIC interpretive results indicated specific signature features and environmental conditions. The certainty associated with these signatures were further qualified by the terms "possible" and "probable" when definite feature identification was not discernible. Because these interpretations were performed on the actual aerial photographs, the level of resolution associated with the photographic prints, in some instances, does not provide the same level of detail necessary to verify the annotation. These results were then correlated with available site data to ensure background sampling locations were positioned in areas that had not been impacted by previous installation activities.

Facility base and topographic maps were then evaluated to further refine the understanding of construction activity, land use, and associated physical features of the study area. The topographic maps used to provide information on ground elevation, land features, water bodies, and minimally impacted areas, included the Radford North (Main Manufacturing Area) and Dublin (New River Unit) quadrangles.

The USDA-NRCS Soil Series Classification Database (http://www.statlab.iastate.edu/soils/sc/) was then evaluated to further refine soil profile information including geographically associated soils, available horizons, related soils, and regional distribution. This database was selected because of its completeness, information depth, and maintenance. Additions and changes to the database are continually made to ensure the user is evaluating the most current data.

A soil series name search was performed on the database that produced specific soil characteristics that complemented the information obtained from the Montgomery and Pulaski County soil surveys. Result interpretations have been articulated into the rationale for background sampling locations discussed in Section 1.4.

1.4.2 Background Sample Selection

Soil Conservation Service (1985) map units, as described in Section 1.4.1.2, were employed to identify soil types within the current facility boundaries of the Main Manufacturing Area and the New River Unit. The detailed Montgomery and Pulaski County map units identified twenty-seven soil types at the Main Manufacturing Area and 11 at the New River Unit. Indiviudal soil type descriptions are listed alphabetically in the following subsections for each study area. This discussion also includes the rationale for soil types and groups that will be be sampled as part of the background study.

1.4.2.1 Main Manufacturing Area

The Main Manufacturing Area is underlain by 27 soil types as depicted graphically on Figure 1-4. Chemical and physical properties associated with these soil types are presented in Table 1-3. Descriptions of these soils are as follows.

Table 1–3
Physical and Chemical Properties of the Soils
Main Manufacturing Area

Soil Name	Depth (in.)	Clay (%)	Moist Bulk Density (g/cm^3)	Permeability (in./hr)	Soil pH	Organic Matter (%)
Berks	A: 0–7 B: 7–23 C: 23–33	5-32	1.20-1.60	0.6-6.0	3.6-6.5	0.5-3
Braddock	A: 0–8 B: 8–32	10–55	1.20–1.50	0.6–6.0	4.5–5.5	1–2
Caneyville	A: 0–7 B: 7–60	10-60	1.20-1.60	0.6-2.0	4.5-7.3	2-4
Carbo	A: 0–5 B: 5–31	20–80	1.20–1.50	0.06–2.0	4.5–7.8	0.5–3
Chilhowie	A: 0–2 B: 2–15 C: 15–30	40-80	1.20-1.50	0.06-0.6	6.1-8.4	0.5-1
Clymer	A: 0–9 B: 9–32 C: 32–49	15-30	1.20-1.50	0.6-2.0	3.6-5.5	1-4
Craigsville	A: 0–8 B: 8–30 C: 30–60	5-15	1.05-1.60	2.0-20	4.5-5.5	1-5
Frederick	A: 0–10 B: 10–74	13-75	1.25-1.65	0.6-6.0	4.5-6.0	1-3
French	A: 0–4 B: 4–30 C: 30–50	8-35	1.3-1.6	0.6-2.0	5.1-6.5	1-4
Groseclose	A: 0–8 B: 8–62 C: 62–67	7–60	1.25–1.60	0.06–6.0	4.5–5.5	1–2
Guernsey	A: 0–8 B: 8–62 C: 62–67	13-60	1.0-1.70	0.06-2.0	4.5-7.8	1-3
Hayter	A: 0–10 B: 10–55 C: 55–74	10-35	1.25-1.60	2.0-6.0	5.1-6.5	1-3
McGary	A: 0–9 B: 9–37 C: 37–66	22-50	1.35-1.75	< 0.2-2.0	5.6-8.4	1-4
Opequon	A: 0–4 B: 4–15	18-65	1.20-1.70	0.2-2.0	5.6-7.8	2-4
Poplimento	A: 0–7 B: 7–44 C: 44–70	17–60	1.20–1.60	0.2–2.0	4.5–6.0	0.5–2
Purdy	A: 0–11 B: 11–34 C: 34–66	18-50	1.30-1.60	< 0.2-0.6	3.6-5.5	2-4

Table 1-4 (Continued)
Physical and Chemical Properties of the Soils
Main Manufacturing Area

Soil Name	Depth (in.)	Clay (%)	Moist Bulk Density (g/cm^3)	Permeability (in./hr)	Soil pH	Organic Matter (%)
Ross	A: 0–10 B: 10–35 C: 35–70	5-32	1.20-1.60	0.6-6.0	6.1-8.4	3-5
Unison	A: 0–10 B: 10–52 C: 52–60	10–70	1.30–1.65	0.6–2.0	4.5–6.0	1–3
Vertrees	A: 0–10 B: 10–66	15-60	1.20-1.65	0.2-2.0	4.5-7.3	2-4
Weaver	A: 0–10 B: 10–49 C: 49–60	18-35	1.35-1.50	0.6-2.0	6.6-8.4	1-3
Weikert	A: 0–4 B: 4–13	5-32	1.20-1.40	2.0-6.0	4.5-5.5	1-3
Wheeling	A: 0–10 B: 10–52 C: 52–60	8–30	1.20–1.50	0.6–20	5.1–6.0	1–3

Berks and Weikert, Very Stony Soils. Berks and Weikert, very stony soils comprise less than 1 percent of the facility and consist of well drained moderately steep and steep (15 to 35 percent) soils that are located on ridgetops and side slopes. This unit consists of approximately 50 percent moderately deep Berks soils, 25 percent shallow Weikert soils, and 25 percent other soils.

Berks soils typically consist of a 5-inch thick surface layer of grayish brown and brown very stony silt loam underlain by a 17 inch subsoil of yellowish brown shaly silt loam. The substratum is a 5-inch thick, yellowish brown very shaly silt loam. Soft shale bedrock is at 27 inches, but it may range from 20 to 40 inches. Permeability is moderate, available water capacity is low, and surface runoff is rapid.

Weikert soils typically consist of a 4-inch thick surface layer of dark brown very stony silt loam and a 9-inch thick subsoil of yellowish brown, very friable shaly silt loam. Soft shale bedrock is at 13 inches, but it may range from 10 to 20 inches. Permeability is moderately rapid, available water capacity is very low, and surface runoff is rapid. Natural fertility is low, and organic matter content is low to moderate for both soils. The surface layer and subsoil for both soils in unlimed areas range from extremely to strongly acidic.

Berks and Weikert Soils. Berks and Weikert soils comprise approximately 3 percent of the facility and consist of well drained; steep and very steep (25 to 65 percent) soils that are located on side slopes. This complex consists of approximately 50 percent Berks soils, 25 percent Weikert soils, and 25 percent other soils.

Typical Berks soils consist of a 5-inch thick, very dark grayish brown and brown shaly silt loam surface layer underlain by a 17 inch thick subsoil of yellowish brown shaly silt loam. The substratum is a 5-inch thick, yellowish brown very shaly silt loam. Soft shale bedrock is at a depth of about 27 inches, but it may range from 20 to 40 inches. Permeability is moderate, available water capacity is low, and surface runoff is high. Natural fertility is low, and the organic matter content is low to moderate. The surface layer and subsoil in unlimed areas range from extremely to strongly acidic.

A typical Weikert soil profile consists of a 4-inch thick, dark brown shaly silt loam surface layer underlain by a 9-inch thick subsoil of yellowish brown shaly silt loam. Soft shale bedrock is at 13 inches, but it may range from 10 to 20 inches. Permeability is moderately rapid, available water capacity is very low, and surface runoff is very rapid. Natural fertility is low, and the organic matter content is low to moderate. The surface layer and subsoil in unlimed areas range from very strongly to strongly acidic.

Berks-Clymer Complex. The Berks-Clymer Complex comprises less than 1 percent of the facility and consists of well drained, strongly sloping soils (7 to 15 percent) that are predominately located on ridgetops and side slopes. This complex consists of approximately 50 percent moderately deep Berks soils, 30 percent deep Clymer soils, and 20 percent other soils. The rooting zone and depth to bedrock range from 20 to 40 inches in the Berks soil and from 40 to 60 inches in Clymer soils.

Typical Berks soils consist of a 5-inch thick surface layer of very dark grayish brown and brown shaly silt loam underlain by a 17-inch subsoil of yellowish brown shaly silt loam. The substratum is approximately 5 inches thick and is a yellowish brown very shaly silt loam. Soft shale bedrock is at a depth of approximately 27 inches, but it may range from 20 to 40 inches. Permeability is moderate, the available water capacity is low, and surface runoff is high in the soil. Natural fertility of these soils is low, and the organic matter content is low to moderate. The surface layer and subsoil in unlimed areas ranges from extremely to strongly acidic.

A typical Clymer soil profile consists of surface layer of yellowish brown loam approximately 9 inches thick. The upper part of the subsoil is yellowish brown clay loam and channery sandy clay loam is located in the lower part. The 17-inch thick substratum is channery sandy loam mottled in shades of brown, yellow, and red. Hard sandstone bedrock is typically at 49 inches, but may range from 40 to 60 inches. Permeability is moderate, the available water capacity is low, and surface runoff is high in the soil. Natural fertility of these soils is low, organic matter content is low to moderate. The surface layer and subsoil in unlimed areas range from extremely to strongly acidic.

Berks-Groseclose Complex. The Berks-Groseclose Complex comprises less than 1 percent of the facility. This soil complex consists of well drained, gently to strongly sloping soils (2 to 15 percent) that are located on side slopes and ridgetops. This complex consists of 40 percent moderately deep Berks soils, 35 percent deep Groseclose soils, and 25 percent other soils.

A typical Berks soil profile consists of a 5-inch thick surface layer of brown shaly silt loam underlain by a 17-inch thick subsoil of yellowish brown shaly silt loam. The 7-inch thick substratum is a very shaly silt loam mottled in shades of brown, yellow, and red. Soft shale bedrock is at 29 inches, but it may range from 20 to 40 inches. Permeability is moderate, available water capacity is low, and surface runoff is medium. Organic matter content is low to moderate, and the natural fertility is low. The surface layer and subsoil in unlimed areas range from extremely to strongly acidic.

Generally, Groseclose soil profiles consist of a 6-inch thick brown silt loam surface layer underlain by a 29-inch thick subsoil of a strong brown, sticky and plastic clay mottled in shades of brown, yellow, and red. The substratum is clay loam mottled in shades of yellow, brown, and red below a depth of approximately 35 inches. Depth to bedrock is greater than 48 inches. Permeability is slow, available water capacity is moderate, and surface runoff is medium. Organic matter content is low to moderate, and natural fertility is low. The surface layer and subsoil in unlimed areas range from extremely to strongly acidic.

Berks-Weikert Complex. The Berks-Weikert Complex comprises less than 1 percent of the facility and consists of well-drained, moderately steep soils (15 to 20 percent) that are predominately located on side slopes. This complex consists of approximately 50 percent moderately deep Berks soils, 30 percent shallow Weikert soils, and 20 percent other soils.

Berks soils typically consist of a 5-inch thick, very dark grayish brown and brown shaly silt loam surface layer underlain by a 17 inch subsoil of yellowish brown shaly silt loam. The 5-inch thick substratum is a yellowish brown very shaly silt loam. Soft shale bedrock is at a depth of approximately 27 inches, but it may range from 20 to 40 inches. Permeability is moderate, available water capacity is low, and surface runoff is high. Natural fertility is low, and the organic matter content is low to moderate. The surface layer and subsoil in unlimed areas range from extremely to strongly acidic.

A typical Weikert soil profile consists of a 4-inch thick surface layer of dark brown shaly silt loam underlain by a 9-inch subsoil of yellowish brown shaly silt loam. Soft shale bedrock is at 13 inches, but it may range from approximately 10 to 20 inches. Permeability is moderately rapid, available water capacity is very low, and surface runoff is very rapid. Natural fertility is low, and the organic matter content is low to moderate. The surface layer and subsoil in unlimed areas range from very strongly to strongly acidic.

Braddock Loam. The Braddock Loam comprises about 17 percent the Main Manufacturing Area. This soil type has a variable slope between 2 and 30 percent and does not have a seasonal high water table within 6 feet of the surface. Typically, the surface layer is dark yellowish-brown, 7 inches thick. The subsoil, which is a yellowish-red and red clay, extends to a depth of 60 inches or more. Depth to bedrock is more than 60 inches deep.

Permeability of the Braddock Loam soil is moderate, natural fertility is low, and organic matter content is moderately low. This soil type is acidic or very strongly acidic.

Caneyville-Opequon-Rock Outcrop Complex. The Caneyville-Opequon-Rock Outcrop Complex comprises about 21 percent of the Main Manufacturing Area at RFAAP and is found in undeveloped areas at the southern portion of the facility. This complex consists of about 30 percent Canyeyville soils, 25 percent Opequon soils, 20 percent rock outcrop, and 25 percent other soils.

Caneyville soils generally have an 8-inch surface layer of brown silt loam underlain by a 24-inch thick subsoil of yellowish-red plastic clay. Limestone bedrock is at a depth of about 32 inches.

A typical Opequon soil profile has a 4-inch thick surface layer of a brown plastic silty clay loam, and a 11-inch thick subsoil of yellowish-red very plastic clay. Limestone bedrock is at a depth of approximately 15 inches. The rock outcrop consists of limestone and dolomite.

Permeability is moderately slow in both the Caneyville and Opequon soils. Natural fertility and organic matter content are moderate for both soils.

Carbo and Chilhowie Soils. Carbo and Chilhowie soils comprise less than 1 percent of the facility and consist of well drained, strongly sloping soils (7 to 25 percent) that are located on ridgetops and side slopes. These soils consist of approximately 40 percent moderately deep Carbo soils, 35 percent moderately deep Chilhowie soils, and 25 percent other soils.

The typical Carbo soil profile contains a 7-inch thick surface layer that consists of yellowish brown silty clay loam underlain by a 23-inch thick subsoil of very sticky and very plastic clay. It is strong brown in the upper part of the subsoil and yellowish brown in the lower part. Hard limestone and shale bedrock is at 30 inches, but may range from 20 to 40 inches. Permeability is slow, available water capacity is low, and surface runoff is rapid. Natural fertility is high, and the organic matter content is low to moderate. The surface layer and subsoil in unlimed areas ranges from very strongly acidic to mildly alkaline.

A typical Chilhowie soil profile contains a 2-inch thick surface layer that consists of very dark grayish brown silty clay underlain by a 13-inch thick subsoil of yellowish brown, sticky and plastic clay. The substratum is olive brown, sticky and plastic very shaly clay approximately 15 inches thick. Hard interbedded shale and limestone bedrock is at 30 inches, but may range from 20 to 40 inches. Permeability is slow, available water capacity is very low, and surface runoff is rapid. Natural fertility is high, and the organic matter content is low. The surface layer and subsoil in unlimed areas varies from slightly acidic to mildly alkaline.

Carbo-Rock Outcrop Complex. The Carbo-Rock Outcrop Complex comprises approximately 3 percent of the surface area at the installation. This complex consists of strongly sloping to steep soils (10 to 45 percent slopes) and exposed rock along drainageways in irregularly shaped areas at the Horseshoe Area. Most areas of the unit are wooded, while some exist in pasture. It consists of approximately 60 percent Carbo soils, 30 percent exposed rock, and 10 percent other soils. Depth to bedrock ranges from 20 to 40 inches deep and does not have a seasonal high water table.

The surface layer of Carbo soils is typically 5-inches thick and is a dark yellowish brown silty clay loam. The subsoil is 26 inches thick and consists of strong brown clay. Limestone bedrock is at 31 inches. Soil permeability is slow, and runoff is very rapid; available water capacity is low. Natural fertility is high, while the organic matter content is moderately low. The surface layer is slightly acidic or neutral and neutral or mildly alkaline in the subsoil.

Cotaco Loam. The Cotaco Loam comprises approximately 3 percent of the soils at the installation and has a variable slope between 0 and 15 percent. The seasonal high water table is at a depth of approximately 2.5 feet. The surface layer is typically a 9-inch-thick layer of brown loam underlain by a 60-inch thick subsoil of yellowish-brown loam and clay loam and is mottled. Depth to bedrock is more than 60 inches.

Permeability of Cotaco soils is moderate, natural fertility is low, organic matter content is moderately low, and available water capacity is moderate. The permeability of this soil causes a hazard of seepage in landfills.

Craigsville Soil. Craigsville soils comprise nearly 1 percent of the facility and consist of well-drained, deep, and nearly level soils that are located on flood plains. A typical Craigsville soil profile consists of an 8-inch surface layer of dark yellowish brown cobbly sandy loam underlain by a 22-inch thick subsoil of strong brown cobbly sandy loam. The substratum is a brown, friable, very cobbly, sandy loam below a depth of about 30 inches.

Permeability is rapid and the available water capacity is low in these soils. Natural fertility is low, and organic matter content is low to moderate. Depth to bedrock is over 6 feet. The surface layer and subsoil in unlimed areas range from very strongly to strongly acid.

Fluvaquents. Fluvaquents comprise approximately 1 percent of the facility and consist of soils located along the floodplain at the northern boundary of the Horseshoe Area. These soils consist of nearly level (0 to 2 percent slopes), unconsolidated, stratified alluvium with varied texture typically including layers of gravel. Depth to bedrock is more than 60 inches deep. The seasonal high water table is at or near the surface.

Debris is often deposited on the surface of this soil during flooding. Reaction, permeability, available water capacity, natural fertility, organic matter content, and other chemical and physical properties are variable.

Frederick and Vertrees Silt Loams. Frederick and Vertrees silt loams comprise less than 1 percent of the facility and consist of well drained, gently to stongly sloping (2 to 15 percent) soils located on ridgetops and side slopes. These soils consist of approximately 40 percent Frederick soils, 35 percent deep Vertrees soils, and 25 percent other soils.

The Frederick surface soil is a 10-inch thick layer of brown silt loam underlain by a 64-inch thick subsoil. The subsoil consists of a strong brown clay loam between depths of 10 to 18 inches; yellowish red, sticky, plastic clay at depths of 18 and 48 inches; and sticky, plastic clay mottled in shades of brown and yellow between depth of 48 and 74 inches. Depth to bedrock is more than 60 inches. Permeability and available water capacity are moderate, and surface runoff is medium to rapid. Natural fertility is low, and the organic matter content is low to moderate.

Vertrees surface soil is approximately a 10 inch-thick layer of dark brown and yellowish brown silt loam. The subsoil is yellowish red, sticky, plastic clay between the depths of 10 and 50 inches and is a sticky, plastic clay mottled in shades of red, brown, and yellow between depths of 50 to 66 inches. Depth to bedrock is more than 60 inches.

Permeability is moderately slow, available water capacity is moderate, and surface runoff is medium to rapid. Natural fertility is medium, and the organic matter content is moderate. The surface layer and subsoil in unlimed areas for both soils range from very strong to medium acidity.

French Soils. French soils comprise less than 1 percent of the facility and are poorly drained, deep, and nearly level soils that are located on flood plains. These soils are commonly flooded for brief periods in winter and spring. The profile consists of a 4-inch thick surface layer that is a dark brown loam. The 26-inch thick subsoil is dark yellowish brown loam mottled in shades of gray, brown, and red. The substratum ranges from 20 to 40 inches and is a very dark grayish brown, gravelly sand. Depth to bedrock is more than 60 inches.

Permeability is moderate in the surface layer and subsoil, and rapid in the substratum. Available water capacity is low, organic matter content is low to moderate, and natural fertility is low. The thickness of the rooting zone and depth to water table range from 1 foot to 2.5 feet. The surface layer and subsoil in unlimed areas range from strongly acid to slightly acidic.

Groseclose and Poplimento. Groseclose and Poplimento soils comprise approximately 3 percent of the facility and are well drained, gently sloping to steep and very steep soils (2 percent to 60 percent) that are located on ridgetops and side slopes. These soils consist of approximately 45 percent deep Groseclose soils, 40 percent deep Poplimento soils, and 15 percent other soils.

Groseclose surface soil consists of a 10-inch thick brown loam surface layer underlain by a 29-inch thick subsoil of sticky and plastic clay. The subsoil is yellowish brown between the depths of 10 and 28 inches and is mottled in shades of brown, yellow, and red between depths of 28 and 39 inches. The substratum is mottled in shades of brown, yellow, and red between depths of 39 and 72 inches. A sticky and plastic clay layer is present between depths of 39 and 51 inches. Clay loam exists between depths of 51 and 72 inches.

Poplimento soils generally consist of a 12 inch surface layer of dark brown and light yellowish brown silt loam that is underlain by a 43-inch thick subsoil. The upper portion of the subsoil is yellowish brown, sticky, plastic clay mottled in shades of brown, yellow, green, and gray. The lower portion consists of yellowish brown shaly silty clay loam mottled in shades of brown, yellow, green, and gray and is below a depth of 55 inches.

Permeability is slow in Groseclose soils, and moderately slow in the Poplimento soils. Available water capacity is moderate in both soils and surface runoff is medium to rapid. Organic matter content is low to moderate in Groseclose soils and low in Poplimento soils. The surface layer and subsoil in unlimed areas are extremely to strongly acidic in Groseclose soils and very strongly to slightly acidic in Poplimento soils.

Guernsey Silt Loam. The Guernsey silt loam comprises less than 1 percent of the facility and consists of moderately well drained, deep, gently sloping soils (2 to 7 percent) on stream terraces. A perched seasonal high water table ranges from 24 to 42 inches.

Guernsey silt loams typically have a 10-inch thick surface layer of dark brown silt loam underlain by a 43-inch thick subsoil. The subsoil is a yellowish brown silty clay loam mottled with dark brown from 10 to 14 inches, yellowish brown silty clay loam mottled with grayish brown from 14 to 20 inches, and a grayish brown, sticky, plastic clay mottled with yellowish brown and gray from 20 to 53 inches. The substratum is a brownish yellow, friable loam mottled in shades of gray and black. Depth to bedrock is more than 50 inches.

Permeability is slow, available water capacity is high, and surface runoff is medium. Natural fertility is high and the organic matter content is low. The surface layer and subsoil in unlimed areas range from very strongly acidic to mildly alkaline.

Hayter Loam. The Hayter loam comprises less than 1 percent of the facility and is a well drained, gently sloping to strongly sloping (2 to 15 percent) soil located on stream terraces and alluvial fans. Hayter loams typically have a 14-inch thick surface layer of dark grayish brown loam underlain by a 41-inch subsoil. The upper portion of the subsoil a is brown loam, while the lower portion is a brown cobbly sandy clay loam mottled in shades of yellow and black underlain by a substratum that consists of brown cobbly loam. Depth to bedrock is more than 48 inches. Permeability is moderately rapid, available water capacity is moderate, and surface runoff is medium to rapid. Natural fertility is medium and the organic matter content is low to moderate. The surface layer and subsoil in unlimed areas range from strongly to slightly acidic.

Lowell Silt Loam. The Lowell Silt Loam comprises less than 1 percent of the soils at the installation. This soil type consists of gently to steeply sloping (2 to 30 percent) soils located on ridgetops, side slopes, and on convex side slopes at the Horseshoe Area. These soils do not have a seasonal high water table within 6 feet of the surface.

The surface layer is typically dark yellowish brown silt loam 11 inches thick and is underlain by a 27-inch thick subsoil consisting of dominantly strong brown and reddish yellow silty clay and clay. The substratum is yellowish brown shaly silt loam to a depth of 60 inches or more. Bedrock is at a depth of at least 40 inches.

Permeability of this soil is moderately slow and runoff is rapid; available water capacity is moderate. Reaction in these soils ranges from very strongly acidic to mildly alkaline. Natural fertility is high and organic matter content is moderately low.

McGary and Purdy Soils. McGary and Purdy soils comprise less than 1 percent of the facility and range from somewhat poorly drained to poorly drained. These soils are nearly level soils that are located on flood plains and low terraces. The unit consists of approximately 40 percent deep McGary soils, 35 percent deep Purdy soils, and 25 percent other soils. The McGary soil is generally flooded for brief periods in winter and spring.

A typical McGary soil profile consists of a 9-inch thick surface layer of dark gray silt loam underlain by a 28-inch thick subsoil. The upper portion of the subsoil is yellowish brown, sticky and plastic clay mottled with gray, while the lower portion is a very sticky and very plastic clay. The substratum extends below a depth of 48 inches and is a gray, sticky and plastic clay mottled with yellowish brown.

Purdy soils typically consist of an 11-inch layer of very dark grayish brown and grayish brown loam underlain by a 23-inch thick subsoil of grayish brown, sticky and plastic clay mottled with yellowish brown. The substratum is a mottled light gray and gray, sticky and plastic clay loam that extends below a depth of 34 inches.

Permeability is slow to very slow, available water capacity is moderate, and surface runoff is slow. Natural fertility is high in McGary soils and low in Purdy soils, while organic matter content is low to moderate for both soils. The surface layer and subsoil in unlimed areas are strongly acid to mildly alkaline in McGary soils and extremely to very strongly acidic in the Purdy soils.

Rock Outcrop-Newbern-Carbo Complex. The Rock Outcrop-Newbern-Carbo Complex comprises nearly 2 percent of the surface area at the facility and consists of steep and very steep soils (30 to 65 percent slopes) and rock outcrop. It is found on narrow side slopes along drainageways and ravines. This complex consists of approximately 50 percent rock outcrop, 25 percent Newbern soils, 20 percent Carbo soils, and 5 percent other soils. Depth to bedrock ranges from 10 to 20 inches in the Newbern soils and 20 to 40 inches in the Carbo soils. These soils do not have a seasonal high water table.

Newbern soils generally have a 7-inch thick surface layer of yellowish brown silt loam underlain by an 8-inch thick subsoil of brownish yellow shaly silty clay loam. Unconsolidated shale is at a depth of 15 inches, and hard shale is at a depth of 19 inches.

Carbo soils typically have a 5-inch thick surface layer of dark yellowish brown silty clay loam underlain by a 26-inch thick subsoil of strong brown clay. Limestone bedrock is at a depth of 31 inches. Permeability varies from moderate to slow, and runoff is rapid to very rapid with a low available water capacity. Organic matter content is moderately low, and natural fertility is high. The surface layer and the upper part of the subsoil are slightly acidic or neutral, and the lower part of subsoil is neutral or moderately alkaline.

Ross Soils. Ross soils comprise approximately 1 percent of the area at the installation and are located along the New River. These soils are found on levees and scoured floodplains adjacent to streams and are commonly flooded for very brief periods. They are deep, nearly level, and well drained. Typically, the surface layer is a 10-inch thick layer of dark brown loam underlain by a layer of brown loam to a depth of 35 inches. Depth to bedrock is more than 60 inches. Permeability is moderate, while natural fertility and organic matter content is moderate to high. Surface runoff is slow. The soil is slightly acidic to moderately alkaline.

Udorthents and Urban Land. Udorthents and Urban Land soils comprise less than 2 percent of the surface area of the facility and range from nearly level and gently sloping to strongly sloping and moderately steep slopes. This soil type consists of approximately 45 percent Udorthents (soils with variable characteristics), 39 percent Urban Land, and 25 percent other soils. The surface layer is 5 to 15 inches thick and variable in color and texture. The underlying material typically is mottled in shades of red, brown, and yellow and extends to a depth of several feet, but may be as shallow as 10 inches. Depth to bedrock and the thickness of the rooting zone varies from 10 inches to several feet.

Permeability of Udorthents ranges from slow to moderately rapid. The available water capacity, natural fertility, and organic matter content range from low to high depending on the texture, thickness, and content of coarse fragments in the soil. The surface layer in unlimed areas ranges from extremely acidic to moderately alkaline. Surface runoff is very slow to rapid.

Unison-Urban Land Complex. This complex makes up about 32 percent of the surface area of RFAAP, and consists of about 50 percent deep and well drained Unison soils, 30 percent Urban Land, and 20 percent other soils. This complex of soils varies in slope from 2 to 25 percent. In an undisturbed area, the Unison soils have a 15-inch thick surface layer of dark brown loam, and a 43-inch thick subsoil of yellowish-red, sticky plastic clay underlain by a red sandy clay loam to a depth of 58 inches. This clay-rich layer is typically underlain by a brown sand to about 10 feet below ground surface (bgs), which then grades into a brown clay. Urban land is land covered by pavement or structures; the original soil has been so altered or obscured that classification is not practical.

Permeability is moderate in Unison soils, natural fertility is low, and organic matter content is low to moderate. The soil is medium to strongly acidic.

Unison and Braddock Soils. Unison and Braddock soils comprise less than 1 percent of the facility and are well drained, gently sloping to moderately steep (2 to 25 percent) soils located on stream terraces and alluvial fans. This unit consists of approximately 45 percent deep Unison soils, 40 percent deep Braddock soils, and 15 percent other soils.

Unison soils typically consist of a 15-inch thick surface layer of dark brown and brown loam and a 43-inch thick subsoil of yellowish red, sticky and plastic clay. The substratum is a red sandy clay loam that extends below a depth of 58 inches.

Braddock soils typically consist of a 17-inch thick surface layer of dark yellowish brown and strong brown loam underlain by a 42-inch subsoil. The subsoil is a yellowish red, sticky and plastic clay between 17 and 28 inches and a dark red, sticky and plastic clay between 28 and 59 inches. The substratum is a red gravelly sandy clay loam below a depth of 59 inches. Depth to bedrock is more than 60 inches.

Permeability and available water capacity is moderate, and surface runoff is rapid in both of these soil types. Natural fertility is low, and the organic matter content is low to moderate. The surface layer and subsoil in unlimed areas ranges from a strong to medium acidity in Unison soils and very strong to strongly acidic in Braddock soils.

Weaver Soils. Weaver soils comprise approximately 1 percent of the facility and are moderately well drained, nearly level soils that are located on flood plains. These soils are commonly flooded for brief periods.

Weaver soils typically consist of a 10-inch thick surface layer of dark brown silt loam underlain by a 39-inch thick subsoil. The upper portion of the subsoil is a brown silt loam, the middle portion is a brown silt loam mottled with grayish brown and black, and the lower portion is a dark gray silt loam. The substratum is a dark gray gravelly sandy clay loam that extends to a depth below 49 inches. Depth to bedrock is more than 40 inches.

Permeability is moderate, available water capacity is high, and surface water runoff is slow. The seasonal high water table ranges from 18 to 30 inches. Natural fertility is medium and the organic matter content is low to moderate. The surface layer and subsoil in unlimed areas is neutral to moderately alkaline.

Wheeling Sandy Loam. The Wheeling Sandy Loam comprises approximately 9 percent of the Main Manufacturing Area soils and is level to nearly level (slopes ranging from 0 to 2 percent). The seasonal high water table is not within 6 feet of the surface.

Typically, the surface layer is a 10-inch thick, dark brown sandy loam underlain by a 42-inch thick subsoil. The upper part of the subsoil is dark brown gravely sandy loam to a depth of 60 inches or more. At greater than 60 inches in depth, the soil is predominantly a mixture of silt and sand, with minor amounts of clay. Depth to bedrock is at least 60 inches.

Permeability and available water capacity of Wheeling soils is moderate; surface runoff is slow. Natural fertility is medium, organic matter content is moderately low, and soil is moderately to strongly acidic. Hazard of erosion in this soil type is slight.

Wurno-Newbern-Faywood Silt Loams. The Wurno-Newbern-Faywood silt loams comprise approximately 2 percent of the soils at the installation. This soil type consists of moderately steep to steep soils (7 to 30 percent) that do not have a seasonal high water table. Bedrock is at a depth of 20 to 40 inches in the Wurno and Faywood soils and 10 to 20 inches in the Newbern soils. This unit is very intermingled and consists of approximately 35 percent Wurno, 30 percent Newbern, 25 percent Faywood, and 10 percent other soils.

Wurno soils typically have a surface layer of yellowish brown silt loam 8-inches thick underlain by a 6-inch thick subsoil of brownish yellow very shaly silty clay loam. The substratum is partially weathered shale 13 inches thick. Bedrock is at a depth of 27 inches. Permeability is moderate and runoff is rapid; available water capacity is very low. Reaction ranges from slightly acid to mildly alkaline.

Newbern soils generally have a 5-inch thick surface layer of yellowish brown silt loam underlain by an 8-inch thick subsoil of brownish yellow shaly silt loam. The substratum is 5-inches thick and consists of brownish yellow shale and silt loam. Bedrock is at a depth of 18 inches. Permeability of the Newbern soils is moderate and runoff is medium to rapid; available water capacity is very low. Reaction ranges from slightly acid to mildly alkaline.

Typically, Faywood soils have a 10-inch thick surface layer of yellowish brown silt loam and an 18-inch thick subsoil. The upper part of the subsoil consists of yellowish brown silty clay. Depth to bedrock is 18 inches. Permeability of the Faywood soils is moderately slow and runoff is medium to rapid; available water capacity is low. Natural fertility is high and organic matter content is moderate. Reaction of the soil ranges from neutral to strongly acidic throughout.

1.4.2.1.1 Background Soil Types. The Wheeling Sandy Loam, Braddock Loam, and Unison-Urban Land Complex were identified as the most prevalent soil types that underlay the solid waste management units and areas of concern identified in the Main Manufacturing Area. Table 1-4 presents the physical and chemical characteristics associated with the soil types that will be sampled in conjunction with background study activities.

Table 1–4
Physical and Chemical Properties of Soil Types to be Sampled at the Main Manufacturing Area

Soil Name	Depth (in.)	Clay (%)	Moist Bulk Density (g/cm³)	Permeability (in./hr)	Soil pH	Organic Matter (%)
Braddock	A: 0–7 B: 7–60	10–55	1.20–1.50	0.6–6.0	4.5–5.5	1–2
Unison	A: 0–10 B: 10–52 C: 52–60	10–70	1.30–1.65	0.6–2.0	4.5–6.0	1–3
Wheeling	A: 0–10 B: 10–52 C: 52–60	8–30	1.20–1.50	0.6–20	5.1–6.0	1–3

1.4.2.2 New River Unit

The NRU is underlain by 11 soil types as depicted graphically on Figure 1-5. Chemical and physical properties associated with these soil types are presented in Table 1-5. Descriptions of these soils are as follows.

Carbo Silty Clay Loam. The Carbo silty clay loam comprises 12 percent of the NRU and consists of strongly sloping to steep soils (7 to 30 percent slopes) that are 20 to 40 inches deep to bedrock and do not have a seasonal high water table. This soil is located on ridgetops and convex side slopes along drainageways. Rock outcrops cover 1 to 10 percent of the surface area. The surface layer of this soil is a 5-inch thick layer of dark yellowish strong brown silty clay loam which is underlain by a 26-inch thick subsoil of strong brown clay. Bedrock is at a depth of 31 inches. Permeability of this soil is slow, and runoff is medium to rapid; available water capacity is low. Natural fertility is high, and the organic matter content is moderately low. Reaction is slightly acid to mildly alkaline in these soils.

Carbo-Rock Outcrop Complex. The Carbo-Rock outcrop complex comprises approximately 10 percent of the NRU and consists of strongly sloping to steep soils (10 to 45 percent slopes) and exposed rock along drainageways. This complex consists of approximately 60 percent Carbo soils, 30 percent exposed rock, and 10 percent other soils. Depth to bedrock ranges from 20 to 40 inches deep and does not have a seasonal high water table.

The surface layer of the Carbo soil is typically 5-inches thick and is a dark yellowish brown silty clay loam. The subsoil is 26 inches thick and consists of strong brown clay. Limestone bedrock is at 31 inches. Soil permeability is slow, and runoff is very rapid; available water capacity is low. Natural fertility is high, while the organic matter content is moderately low. The surface layer is slightly acidic or neutral and neutral or mildly alkaline in the subsoil.

Frederick Loam. This soil type comprises 9 percent of the soils at the NRU and consists of gently to steeply sloping soils (2 to 30 percent slopes) located on ridgetops and side slopes of irregularly shaped areas. A few random areas of exposed limestone bedrock, sinkholes, and soils with a surface layer of cherty loam are also included in this soil type.

The surface layer is typically 7 inches thick and is a yellowish brown loam. The subsoil extends to a depth of 60 inches or more and consists of strong brown clay in the upper portion, strong brown silty clay in the middle part, and yellowish red clay in the lower portion. Depth to bedrock is at least 60 inches.

Table 1–5
Physical and Chemical Properties of the Soils
New River Unit

Soil Name	Depth (in.)	Clay (%)	Moist Bulk Density (g/cm^3)	Permeability (in./hr)	Soil pH	Organic Matter (%)
Carbo	A: 0–5 B: 5–31	20–80	1.20–1.50	0.06–2.0	4.5–7.8	0.5–3
Groseclose	A: 0–8 B: 8–62 C: 62–67	7–60	1.25–1.60	0.06–6.0	4.5–5.5	1–2
Poplimento	A: 0–7 B: 7–44 C: 44–70	17–60	1.20–1.60	0.2–2.0	4.5–6.0	0.5–2
Lowell	A: 0–11 B: 11–38 C: 38–60	12–60	1.20–1.70	0.2–2.0	4.5–7.8	1–4
Slabtown	A: 0–18 B: 18–76	10–60	1.25–1.55	0.6–2.0	5.1–7.8	1–3
Frederick	A: 0–7 B: 7–50	13–80	1.25–1.65	0.6–6.0	4.5–6.0	1–3
Lodi	A: 0–8 B: 8–65	10–60	1.20–1.65	0.6–6.0	4.5–5.5	0.5–2
Wurno	A: 0–8 B: 8–14 C: 14–27	10–55	1.20–1.60	0.6–2.0	6.1–7.8	1–2
Newbern	A: 0–5 B: 5–13 C: 13–18	10–27	1.20–1.60	0.6–2.0	5.6–7.8	1–2
Faywood	A: 0–10 B: 10–28	15–60	1.30–1.45	0.06–6.0	5.1–7.3	1–4
Lindside	A: 0–10 B: 10–38 C: 38–60	15–35	1.20–1.40	0.2–6.0	5.6–7.8	2–4
Nolin	A: 0–7 B: 7–38 C: 38–60	12–35	1.20–1.50	0.6–2.0	5.6–7.8	2–4
Newark Variant	A: 0–21 B: 21–49 C: 49–63	7–40	1.20–1.50	0.6–2.0	5.6–7.8	1–4

Permeability is moderate, and runoff is medium to rapid. The soil erosion hazard is severe. Natural fertility is low due to a moderately low organic content. The subsoil is strongly to very strongly acidic, while the surface layer varies depending on liming practices. A seasonal high water table is not within 6 feet of the surface.

Groseclose-Urban Land Complex. The Groseclose-Urban Land Complex comprises approximately 4 percent of the NRU. This soil complex consists of gently to strongly sloping Groseclose soils (2 to 15 percent slopes) and areas that have been partly altered by grading or filling activities. The unit consists of approximately 50 percent Groseclose, 40 percent urbanized, and 10 percent other soils.

This complex typically has an 8-inch thick surface layer of dark yellowish brown silt loam. The subsoil extends to a depth of at least 60 inches. The upper portion of the subsoil is strong brown silty clay, the middle portion is strong brown clay, while the lower portion consists of strong brown silty clay loam.

Fill material from surrounding soils has been added to some areas to a depth of 36 inches or more. Undisturbed areas of the complex have slow permeability that has been variably cut or filled. Runoff is medium to rapid with a moderate water capacity. The soil is strongly or very strongly acidic throughout.

Groseclose and Poplimento Silt Loams. The Groseclose and Poplimento silt loams comprise 19 percent of the NRU and are grouped together because they have no major differences in use and management. These soils consist of moderately steep and steep soils (slopes ranging from 2 to 30 percent) that are at least 48 inches deep to bedrock and do not have a seasonal high water table. These soils exist on side slopes and ridgetops in irregularly shaped areas.

Groseclose soils typically have an 8-inch thick surface layer of dark yellowish brown silt loam that is underlain by a 54-inch thick subsoil. The upper portion of the subsoil consists of strong brown silty clay, the middle part is yellowish red and strong brown clay, while the lower portion consists of brownish yellow silty clay loam. At depths greater than 54 inches, the substratum is a yellowish brown silty clay loam to a depth of at least 67 inches.

Poplimento soils generally consist of a 7-inch thick surface layer of dark yellowish brown silt loam that is underlain by a 37-inch thick subsoil. The upper portion is strong brown silt loam, the middle portion is yellowish brown and strong brown clay, while the lower part consists of reddish yellow clay. The substratum extends to a depth of at least 60 inches and consists of reddish yellow and strong brown silty clay loam.

Permeability in Groseclose soils is characterized as slow and moderately slow in Poplimento soils. Water capacity is moderate and surface runoff is rapid. Groseclose soils are low in natural fertility and medium in Poplimento soils. Both soil types contain a moderately low organic matter content. Groseclose soils are strongly acidic, while Poplimento soils have a medium acid content. Both soil types are have a severe erosion hazard.

Lindside-Nolin Silt Loams. Lindside-Nolin silt loams comprise approximately 3 percent of the NRU and consist of nearly level soils (0 to 2 percent slopes). that are more than 60 inches deep to bedrock. These soils have a seasonal high water table and are subject to frequent flooding during the spring. The areas of this unit are long and narrow. This unit consists of approximately 55 percent Lindside soils, 35 percent Nolin soils, and 10 percent other soils.

Lindside soils typically have a 10-inch thick surface layer of dark yellowish brown silt loam and is underlain by a mottled 28-inch thick subsoil. The upper 5 inches is yellowish brown and pale brown silt loam, the middle 9 inches is yellowish brown and light gray silty clay loam, and the lower 14 inches is brown and grayish brown silt loam. The substratum is grayish brown silt loam to a depth of 60 inches or more.

Nolin soils generally have a 7-inch thick surface layer of brown silt loam and is underlain by 31-inch thick subsoil of brown and dark brown silt loam. The substratum is dark yellowish brown silty clay loam to a depth of 60 inches or more.

Permeability of the Lindside and Nolin soils is moderate, surface runoff is very slow, and available water capacity is high. Natural fertility is high, and organic matter content is moderate. The Lindside soils have a seasonal high water table of 18 to 36 inches bgs, and the Nolin soils have a seasonal high water table of 36 to 72 inches bgs.

Lodi Loam. The Lodi loam comprises 8 percent of the soils at the NRU. This soil type consists of gently to steeply sloping soils (2 to 30 percent slopes) and is found along convex ridgetops and side slopes in irregularly shaped areas of the NRU. Depth to bedrock is more than 60 inches and the soil does not have a seasonal high water table within 6 feet of the surface.

A typical surface layer is 7 inches thick and is a yellowish brown loam. The subsoil extends to a depth of 60 inches or more and consists of a yellowish brown loam in the upper portion, strong brown clay in the middle part, and yellow and brownish yellow clay loam in the lower portion.

Permeability and available water capacity is moderate; surface runoff is medium. Organic matter content in this soil is moderately low and is natural fertility is also low. The surface layer and subsoil predominantly are strongly or very strongly acidic, but less acidic in limed areas. The soil is rarely used as a source of roadfill or as a site for roads and streets because of the low strength and erosion hazard.

Lowell Silt Loam. The Lowell silt loam comprises about 18 percent of the NRU and consists of gently to steeply sloping (2 to 30 percent) soils located on ridgetops, side slopes, and on convex side slopes. These soils do not have a seasonal high water table within 6 feet of the surface.

The surface layer is typically dark yellowish brown silt loam 11 inches thick and is underlain by a 27-inch thick subsoil consisting of dominantly strong brown and reddish yellow silty clay and clay. The substratum is yellowish brown shaly silt loam to a depth of 60 inches or more. Bedrock is at a depth of at least 40 inches. Permeability of this soil is moderately slow and runoff is rapid; available water capacity is moderate. Reaction in these soils ranges from very strongly acidic to mildly alkaline. Natural fertility is high and organic matter content is moderately low.

Newark Variant Silt Loam. The Newark Variant silt loam comprises less than 1 percent of the NRU and is nearly level with slopes ranging from 0 to 2 percent. This soil is found along drainageways in long, narrow areas of the NRU. It has a seasonal high water table at a depth of 6 to 18 inches.

Generally, the surface layer is silt loam approximately 21 inches thick. The upper 10 inches is dark brown, the middle 5 inches is pale brown with light grayish brown mottles, and the lower 6 inches is light yellowish brown with pale brown and gray mottles. The subsoil is 28 inches thick. The upper part is yellowish brown silt loam 9 inches thick with grayish brown mottles, the middle is strong brown silty clay loam 12 inches thick with grayish brown mottles, and the substratum is gray and extends to a depth of 60 inches or more. The upper part is very gravelly clay, and the lower part is clay. Depth to bedrock is greater than 60 inches.

Permeability is moderate, runoff is very slow, and available water capacity is moderate to high. Reaction is medium acid to mildly alkaline throughout the soil. Natural fertility is high and organic matter content is moderate. This soil is subject to occasional, brief flooding in the spring.

Slabtown Silt Loam. The Slabtown silt loam comprises approximately 4 percent of the soils at the NRU and consists of gently to strongly sloping soils (2 to 15 percent) located on concave toe and foot slopes and at the heads of drainageways. It has a seasonal high water table at a depth of 18 to 36 inches.

The surface layer of this soil type is brown silt loam 9 inches thick, and the subsoil extends to a depth of 60 inches or more. The upper part is yellowish brown silt loam and gravelly silty clay loam, and the lower part is yellowish brown clay. Depth to bedrock is greater than 60 inches. Permeability of this soil is moderately slow and surface runoff is medium; available water capacity is high. Reaction is medium acid to mildly alkaline. Natural fertility is low and organic matter content is moderately low.

Wurno-Newbern-Faywood Silt Loams. The Wurno-Newbern-Faywood silt loams comprise approximately 12 percent of the soils at the NRU and consist of moderately steep to steep soils (7 to 30 percent) that do not have a seasonal high water table. Bedrock is at a depth of 20 to 40 inches in the Wurno and Faywood soils and 10 to 20 inches in the Newbern soils. This unit is very intermingled and consists of approximately 35 percent Wurno, 30 percent Newbern, 25 percent Faywood, and 10 percent other soils.

Wurno soils typically have a surface layer of yellowish brown silt loam 8-inches thick underlain by a 6-inch thick subsoil of brownish yellow very shaly silty clay loam. The substratum is partially weathered shale 13 inches thick. Bedrock is at a depth of 27 inches. Permeability is moderate and runoff is rapid; available water capacity is very low. Reaction ranges from slightly acid to mildly alkaline.

Newbern soils generally have a 5-inch thick surface layer of yellowish brown silt loam underlain by an 8-inch thick subsoil of brownish yellow shaly silt loam. The substratum is 5-inches thick and consists of brownish yellow shale and silt loam. Bedrock is at a depth of 18 inches. Permeability of the Newbern soils is moderate and runoff is medium to rapid; available water capacity is very low. Reaction ranges from slightly acid to mildly alkaline.

Typically, the Faywood soils have a 10-inch thick surface layer of yellowish brown silt loam and an 18-inch thick subsoil. The upper part of the subsoil consists of yellowish brown silty clay. Depth to bedrock is 18 inches. Permeability of the Faywood soils is moderately slow and runoff is medium to rapid; available water capacity is low. Natural fertility is high and organic matter content is moderate. Reaction of the soil ranges from neutral to strongly acidic throughout.

1.4.2.2.1 Background Soil Groupings. A soil grouping approach was adopted at the New River Unit that included the evaluation of soil formation properties, physical and chemical soil characteristics associated with each soil series, and delineating associated family groups. The reviews of this information resulted in the designations of four soil groupings for this area.

Table 1-6 presents the chemical and physical data for the soil groupings that have been identified for the NRU as described below.

Table 1–6
Physical and Chemical Properties of Soil Groupings to be Sampled at the New River Unit

Soil Group	Soil Type	Depth (in.)	Clay (%)	Moist Bulk Density (g/cm^3)	Permeability (in./hr)	Soil pH	Organic Matter (%)
Carbo Silty Clay Loam, Very Rocky	Carbo Silty Clay Loam, Very Rocky Carbo-Rock Outcrop Complex	A: 0–5 B: 5–31	20–80	1.20–1.50	0.06–2.0	4.5–7.8	0.5–3
Groseclose and Poplimento Silt Loam	Groseclose Silt Loam Groseclose Urban Land Complex	A: 0–8 B: 8–62 C: 62–67	7–60	1.25–1.60	0.06–6.0	4.5–5.5	1–2
	Poplimento Silt Loam	A: 0–7 B: 7–44 C: 44–70	17–60	1.20–1.60	0.2–2.0	4.5–6.0	0.5–2
Lowell Silt Loam	Lowell Silt Loam	A: 0–11 B: 11–38 C: 38–60	12–60	1.20–1.70	0.2–2.0	4.5–7.8	1–4
	Slabtown Silt Loam	A: 0–18 B: 18–76	10–60	1.25–1.55	0.6–2.0	5.1–7.8	1–3
Wurno-Newbern-Faywood Silt Loam	Frederick Loam	A: 0–7 B: 7–50	13–80	1.25–1.65	0.6–6.0	4.5–6.0	1–3
	Lodi Loam	A: 0–8 B: 8–65	10–60	1.20–1.65	0.6–6.0	4.5–5.5	0.5–2
	Wurno Silt Loam	A: 0–8 B: 8–14 C: 14–27	10–55	1.20–1.60	0.6–2.0	6.1–7.8	1–2
	Newbern Silt Loam	A: 0–5 B: 5–13 C: 13–18	10–27	1.20–1.60	0.6–2.0	5.6–7.8	1–2
	Faywood Silt Loam	A: 0–10 B: 10–28	15–60	1.30–1.45	0.06–6.0	5.1–7.3	1–4

Carbo Silty Clay Loam (very rocky). The Carbo series are formed in material weathered from limestone bedrock. Members of this family include Carbo Silty Clay Loam, Carbo Silty Clay Loam (very rocky), and the Carbo-Rock Outcrop Complex. The grouping of these soils was based on the Carbo family designation.

Groseclose and Poplimento Silt Loam. The Urban Land Complex represents disturbed Groseclose soils. Background samples collected from the Groseclose and Poplimento series will take Urban Land Complex soil characteristics into account.

Lowell Silt Loam. The Lowell series consists of deep and very deep, well drained soils formed in residuum of limestone interbedded with thin layers of shale on upland ridgetops and sideslopes. Soils of the Slabtown series are deep, moderately well drained and have moderately slow permeability. Slabtown soils were formed in weathered material of mixed colluvium and underlying limestone residuum and are geographically associated with the Carbo, Faywood, Federick, Lodi, Lowell, Poplimento, and Wurno series. This soil series was grouped with the Lowell series based on its chemical and physical properties.

Wurno-Newbern-Faywood. The Lodi and Federick series are from the same family and are formed in residuum weathered from limestone rocks with interbedded sandstone and shale. These soils are consistent with the Wurno-Newbern-Faywood series in that permeability ranges from moderately slow to moderate, and soil pH ranges from strongly acidic to mildly alkaline.

Figure 1-6 depicts the grouping of these soil types based on their physical and chemical properties.

1.4.3 Proposed Samples and Locations

1.4.3.1 Sample Location Rationale

Background sample locations have been chosen in areas that took into consideration several factors, including: soil type, land use, accessibility, and tree stands. These components were taken into consideration to ensure that background sample locations were positioned in locations minimally influenced by past site activities or releases. A description of these factors are described below.

- **Soil Type:** Soil types associated within the Main Manufacturing Area and New River Unit were assessed and locations were selected to include the major soil types. Three soil types were selected at the Main Manufacturing Area, including the Braddock Loam, Wheeling Sandy Loam, and the Unison Urban Land Complex. These three soil types account for approximately 72 percent of the soils (excluding rock outcrop) at the Main Manufacturing Area. Four soil groupings were selected for background sampling at the NRU including, Carbo Silty Clay Loam (very rocky), Groseclose and Poplimento Silt Loam, Lowell Silt Loam, and the Wurno-Newbern-Faywood Silt Loam. These four soil groupings account for 78 percent of the soils at the NRU. In an effort to ensure the appropriate soil type has been selected, the project lead geologist will evaluate the associated soil properties in the field. Sample locations will be adjusted to accommodate existing field conditions.

- **Land Use:** Aerial photographs, facility base maps, and topographic maps were evaluated to discern construction activities and other associated features to ensure background sampling locations were representative of areas that had been minimally impacted by facility operations. Aerial photographs dating from 1949 to 1986 were reviewed to evaluate facility activities. Topographic and facility base maps were evaluated to provide additional information including ground elevation, land features, water bodies, and associated physical features of the study area.

- **Accessibility:** Sampling locations were positioned to ensure associated soil samples were accessible for direct push sampling equipment. Potential issues affecting or limiting accessibility include, the density or thickness of tree stands, drainage ditches, and slope grade. It may be necessary to clear paths in tree stands or reposition sample locations to allow for direct push sampling equipment accessibility. A description of the location for each background sample location is provided in Table 1-7 for the Main Manufacturing Area and Table 1-8 for the NRU. The tables provide detailed background location descriptions including information on the location of the samples in relation to an established landmark, elevation, and representative tree stand characteristics.

- **Tree stands:** Wherever possible, background samples were placed in tree stands estimated to predate potential construction activity at each location. The use of aerial photographs dating back to 1949 were reviewed to locate areas that had been minimally impacted by facility operations. The circumference of trees representative of the sampling area was recorded and a leaf sample was collected to assist in determining the approximate age and common name of select trees. Background samples located in pine tree stands have the potential to be more acidic due to the pine needles tendency to increase the soil acidity (Barbour et al. 1987). However, other proposed sampling locations exist outside of coniferous tree stands to allow for adequate comparisons of background pH values.

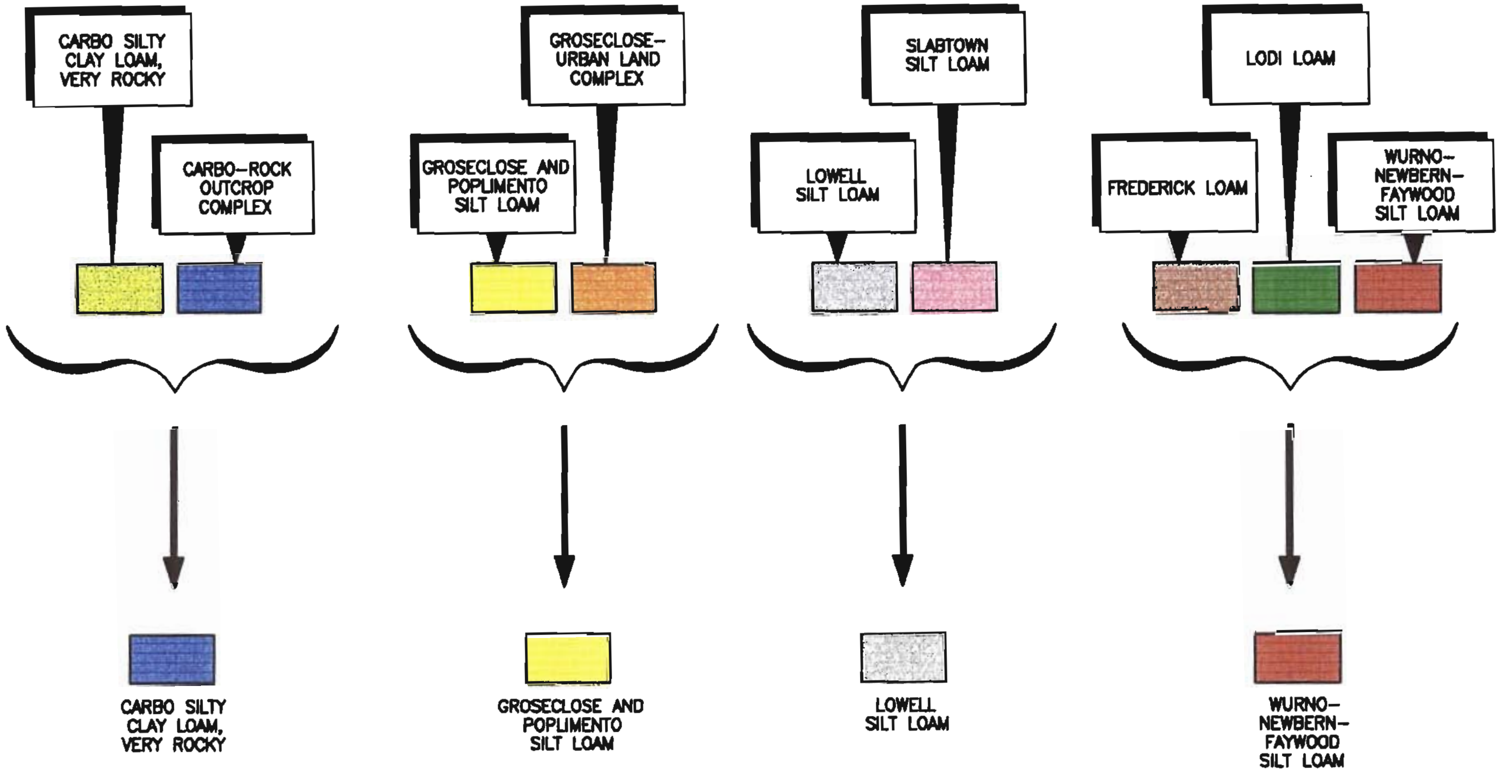

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FIGURE 1-6

NEW RIVER UNIT SOIL GROUPING

Table 1–7
Proposed Background Sampling Locations, Main Manufacturing Area

SOIL TYPE	SAMPLE ID	LOCATION DESCRIPTION	ANALYSIS
Braddock Loam (comprises 21% of the MMA)	B1	Eastern portion of Horseshoe Area, west of Magazine Storage Area 1932, along stand of pine trees approximately 30-40 ft tall, on level ground, upgradient of road, approximately 50 ft from road, ditch along road, representative pine tree circumference of 3 ft 9 in,	Metals, pH
	B2	South central portion of Horseshoe Area, east of SWMU 26, approximately 100 ft from road, small ditch along road in pine tree stand, trees approximately 40 ft tall, tree circumferences of 4 ft to 6 ft 2 in, on level ground,	Metals, pH
	B3	Co-located within 1/2 acre of B2, 60 ft east of B2	VOCs, SVOCs, Metals, pH, immunoassay
	B4	Central portion of Horseshoe Area, on top of steep slope above SWMU 32 and Magazine 4601-2, along downslope edge of pine tree stand, trees approximately 40 ft tall, representative tree circumference of 3 ft 8 in	Metals, pH
Unison-Urban Land Complex (comprises 40% of the MMA)	U1	South of Main Manufacturing Facility, west of main gate on right side of road just before shipping and receiving facility (Building 534), upgradient and approximately 40 ft from road, in deciduous tree forest (e.g., oak and maple), trees approximately 40-50 ft tall, average circumference of trees is 6 ft 8 in,	VOCs, SVOCs, Metals, pH, immunoassay
	U2	Co-located within 1/2 acre of U1, 80 ft east of U1.	Metals, pH
	U3	Southwest of Building 7801, outside and approximately 100 ft from Main Manufacturing Area fence, on western edge of the facility, on top of ridge above dirt road, in deciduous tree forest (e.g., tulip poplar, oak, maple), trees average 40-50 ft tall	Metals, pH
	U4	Eastern portion of Main Manufacturing Facility, south and outside fence surrounding Building 3904, approximately 15 ft above former railroad grade and approximately 40 ft into deciduous tree forest (e.g., oak and maple), trees approximately 35 to 40 ft tall	Metals, pH
Wheeling Sandy Loam (comprises 11% of the MMA)	W1	Northeastern portion of Horseshoe Area, northwest of Gate 19-C, north of fence, in pine tree forest, approximately 80 ft from fence line, trees approximately 40 ft tall	Metals, pH
	W2	North central portion of Horseshoe Area, approximately 100 ft south of road, in pine and deciduous tree stand(e.g.,oak and maple) trees approximately 30 to 40 ft tall, representative pine tree circumference of 3.5 ft.,	VOCs, SVOCs, Metals, pH, immunoassay
	W3	Co-located within 1/2 acre of W2, 35 ft south of W2	Metals, pH
	W4	Northwestern portion of Horseshoe Area, near Gate 19-1, outside the fence approximately 80 ft from New River, upgradient and approximately 50 ft from road, along grassy area in deciduous trees (e.g., locust and maple) and brush	Metals, pH

Table 1–8
Proposed Background Sampling Locations, New River Unit

SOIL TYPE	SAMPLE ID	LOCATION DESCRIPTION	ANALYSIS
Carbo Silty Clay Loam (very rocky) Comprises 12% of the NRU)	C1	East of Magazine 1125, on a moderate slope, upgradient and approximately 100 ft from road, drainage ditch along road, in area containing pine, cedar, and deciduous (e.g., cherry) trees interspersed with grassy areas, trees approximately 15-30 ft tall, representative deciduous tree circumference of 3 ft	VOCs, SVOCs, Metals, pH, immunoassay
	C2	Co-located within ½ acre of sample location C1, 75 ft east of C1	Metals, pH
	C3	Eastern portion of NRU, slightly west and upgradient of Guard Road, northeast of Magazine 4603-15 on a slight to Moderate slope, upgradient and approximately 100 ft from Magazine and road, in pine tree stand approximately 30-40 ft tall, representative pine tree circumference of 3 ft 7 in	Metals, pH
	C4	Northeastern portion of NRU, on the north side of access road near Magazine 4603-53, upgradient and approximately 100 ft from road, on moderate slope, in cedar tree stand interspersed with grassy area, trees about 20 ft tall	Metals, pH
Groseclose and Poplimento Silt Loam (Comprises 19% of the NRU)	G1	Northwestern portion of NRU, between Magazines 4603-33 and 4603-34, upgradient and approximately 100 ft from road in pine trees approximately 40 ft tall, representative tree circumference of 3 ft 7 in	Metals, pH
	G2	South-central portion of NRU west of 16th Street, north of Magazine 1604 upgradient and approximately 100 ft from road in a loblolly pine tree stand, pine trees approximately 40 ft tall, representative tree circumference of 4 ft 7 in,	VOCs, SVOCs, Metals, pH, immunoassay
	G3	Co-located within 1/2 acre of sample location G2, 65 ft north of G2	Metals, pH
	G4	West-central portion of NRU, upgradient and approximately 150 ft northeast of Truck Loading Yard No. 2 , in pine tree stand	Metals, pH
Lowell Silt Loam (Comprises 18% of the NRU)	L1	Southern portion of NRU, on level ground, east of former bagging plant on Guard Road, approximately 100 ft from road, slight gully along roadway, in thick white pine tree stand, trees approximately 30 ft tall, representative tree circumference of 2 ft 7 in,	VOCs, SVOCs, Metals, pH, immunoassay
	L2	Co-located within 1/2 acre of sample location L1, 60 ft east of L1	Metals, pH
	L3	Central portion of NRU, southwest of Magazine 1614, approximately 150 ft north and upgradient of 14 ½ Street, in grassy area interspersed with 15-20 ft tall cedar trees, average tree circumference of 10-12 in.	Metals, pH
	L4	Northern portion of NRU, approximately 150 ft south of Old Rock Road, on slight slope, between two deciduous trees (e.g., oak and poplar) in predominantly grassy field, trees about 30 ft tall,	Metals, pH

Table 1-8 (Continued)
Proposed Background Sampling Locations, New River Unit

SOIL TYPE	SAMPLE ID	LOCATION DESCRIPTION	ANALYSIS
Wurno-Newbern-Faywood Silt Loam (Comprises 29% of the NRU)	W1	East-central portion of NRU, approximately 100 ft north of road and northwest of Magazine 1817, in a flat grassy area interspersed with loblolly pine trees, average height of trees 30-40 ft tall with representative circumference of 4 ft 3 in.	VOCs, SVOCs, Metals, pH, immunoassay
	W2	Co-located within 1/2 acre of sample location W1, 60 ft east of W1	Metals, pH
	W3	Northeast portion of NRU, across road and upgradient from Magazine 4603-52, between several 20-30-ft tall locust trees, area surrounded by grassy fields.	Metals, pH
	W4	South central portion of NRU, north of the intersection of A Avenue and 13th street, across road and upgradient of Magazine 1206, in stand of several locust trees about 30 ft tall, representative tree circumference 2 ft 2 in.	Metals, pH

1.4.3.2 Number of Samples and Analyses

Background sample locations have been selected such that they are representative of areas that have been minimally impacted by previous site operations or HWMU/SWMU releases. Four locations have been selected for sample collection from each of the major soil types at the MMA and NRU. At each location, one surface (0 to 6 inches) and two subsurface soil samples (one each from the B and C soil horizons) will be collected and analyzed for metals and pH. If the C soil horizon does not exist in a particular boring or soil type, then only one subsurface sample will be collected from the B horizon. One sample location from each soil type will be grouped or clustered within ½ acre of another sample location of the same soil type to evaluate organic concentrations and demonstrate the locations represent background conditions. Background soil sampling locations for the MMA and NRU are presented on Figures 1-7 and 1-8, respectively. The use of a photoionization detector (PID) will be employed to screen all samples to monitor for the presence organic compounds.

All borings will be logged for stratigraphic characterization, as outlined in SOP 20.6 of the MWP. One sample will be collected from each soil horizon of a clustered boring from each soil type and screened for the presence/absence of explosive constituents (RDX and TNT). Samples will be field screened using RDX and TNT immunoassay test kits following the procedures outlined in SOP 30.13, contained in Appendix A. If explosive constituents are detected in any soil horizon, the boring will be abandoned and a new sampling location will be selected and field screened. Once field screening results indicate the absence of explosive constituents, a surface soil sample (0 to 6 inches) will be collected and analyzed for SVOCs, TAL metals, and pH. Subsurface soil samples from the B and C horizons (if a C horizon exists) will then be collected and analyzed for VOCs, SVOCs, TAL metals, and pH.

Main Manufacturing Area. Approximately 48 soil samples will be collected from three of the major soil types (Braddock Loam, Wheeling Sandy Loam, and the Unison-Urban Land Complex) at the MMA. Eighteen of the 48 samples will be collected from the surface (0 to 6 inches) and 30 of the 48 samples will be collected from the subsurface soil (B and C horizons, if present) of each soil type. The number of samples and analyses is presented in Table 1-9.

New River Unit. Approximately 66 samples will be collected from four soil groupings [Carbo Silty Clay Loam (very rocky), Groseclose and Poplimento Silt Loam, Lowell Silt Loam, and the Wurno-Newbern-Faywood Silt Loam] at the NRU. Twenty-four of the 66 samples will be collected from the surface and 42 of the 66 samples will be collected from the subsurface soil (B and C horizons, if present) of each soil type. The number of samples and analyses is presented in Table 1-9.

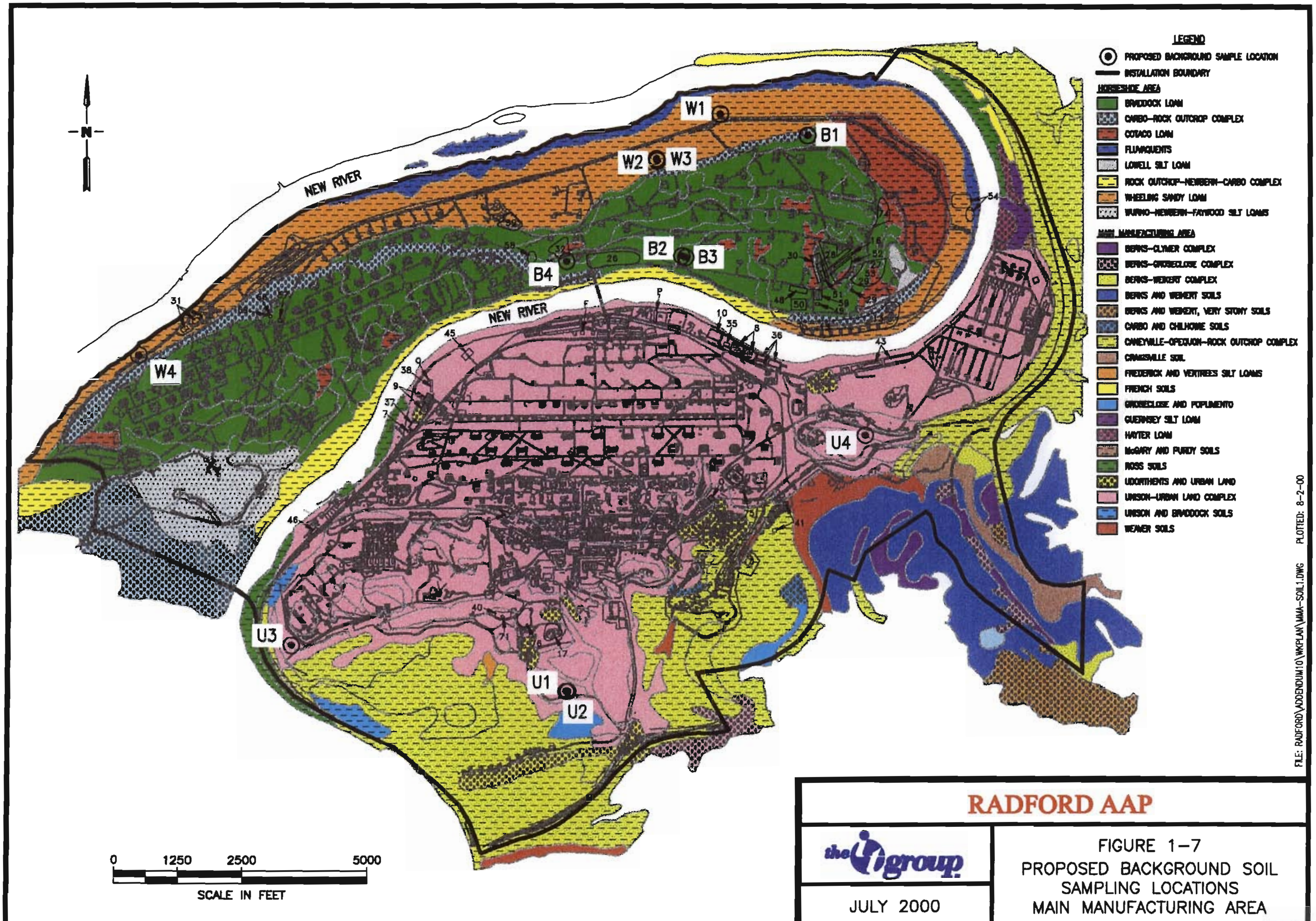

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FIGURE 1-7
PROPOSED BACKGROUND SOIL SAMPLING LOCATIONS
MAIN MANUFACTURING AREA

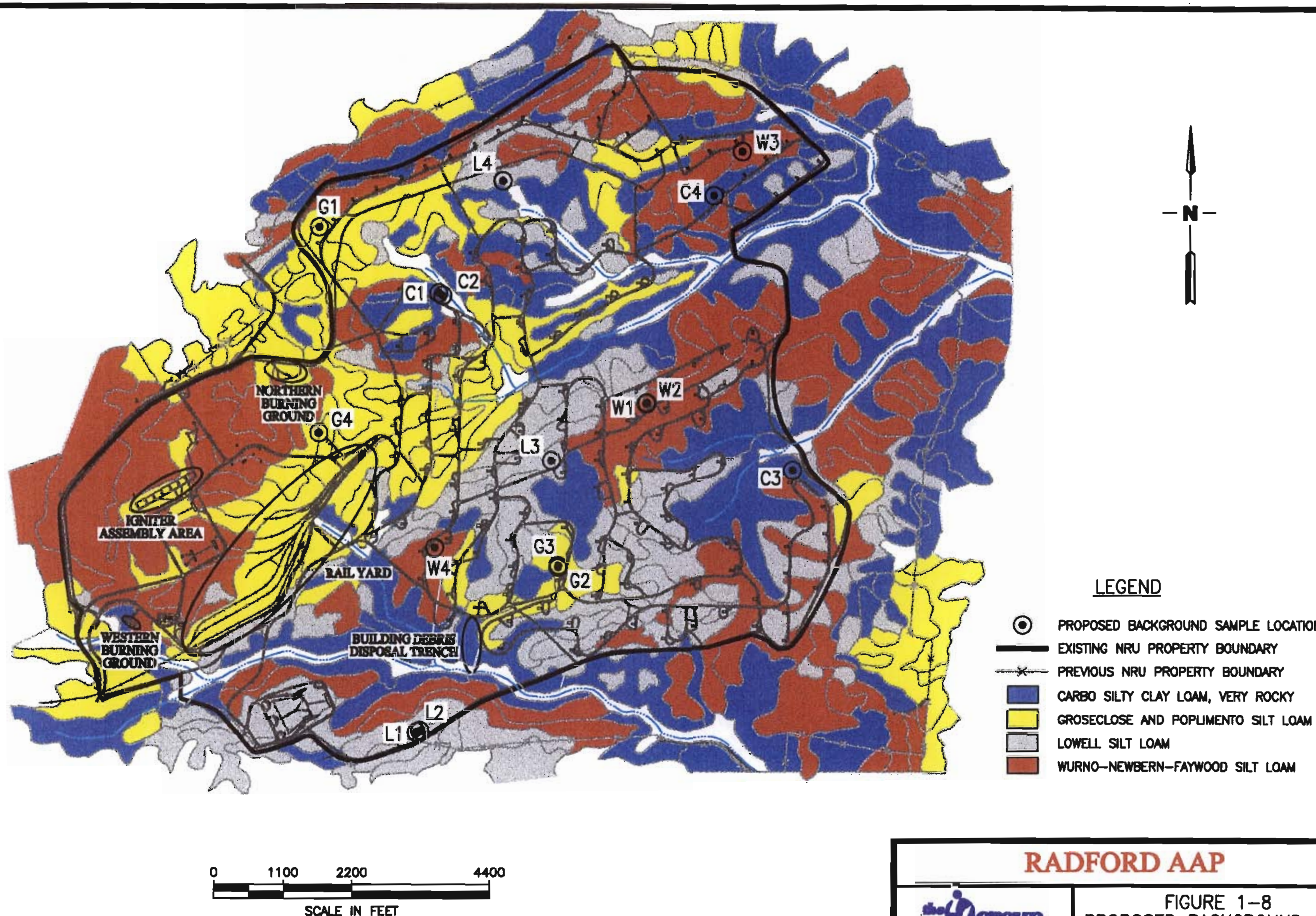

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FIGURE 1-8
PROPOSED BACKGROUND SOIL SAMPLING LOCATIONS
NEW RIVER UNIT

Table 1–9
Number of Environmental Samples and Analyses

Soil Type	Main Manufacturing Area							New River Unit						
	Surface			Subsurface*			Total	Surface			Subsurface*			Total
	SVOC†	Immuno-assay†	TAL Metals	VOC/ SVOC†	Immuno-assay†	TAL Metals		SVOC†	Immuno-assay†	TAL Metals	VOC/ SVOC†	Immuno-assay†	TAL Metals	
Braddock Loam	1	1	4	1	1	4	12							
Wheeling Sandy Loam	1	1	4	2	2	8	18							
Unison Urban Land Complex	1	1	4	2	2	8	18							
Carbo Silty Clay Loam (very rocky)								1	1	4	1	1	4	12
Groseclose and Poplimento Silt Loam								1	1	4	2	2	8	18
Lowell Silt Loam								1	1	4	2	2	8	18
Wurno-Newbern-Faywood Silt Loam								1	1	4	2	2	8	18
Subtotal	3	3	12	5	5	20	**48**	4	4	16	7	7	28	**66**

*Subsurface sampling will be performed in available soil horizons. As noted in the presentation and verbal discussions, B and C horizons may not be available in each sampling location.

†These samples are co-located with TAL metal sample locations and *do not* represent an addition to the sampling locations covered by the TAL metal sampling.

NOTES: (1) Numbers do not include QC samples. (2) All soil samples are to be analyzed for pH.

1.5 MATERIAL HANDLING AND DISPOSAL

All 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 investigative-derived material (IDM) and hazardous materials. In addition, activities will be performed in accordance with installation safety rules, protocols, and MWP SOP 70.1. Material disposal will be documented in the field logbook. Specific compliance issues that may be confronted during investigative activities include:

- Material Characterization – Materials will be sampled prior to disposal to determine waste characteristics, in accordance with 40 Code of Federal Regulations (CFR) 264 and Virginia Hazardous Waste Management Regulations. Material characterization analyses will be performed by Envirosystems, Inc., using USEPA-approved SW-846 Methods (USEPA 1996). Table 1-10 gives the suspected nature (hazardous vs. nonhazardous) of the materials that are expected to be produced during investigation activities.
- 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 – Hazardous materials are not expected to be encountered during this investigation.
- Handling and disposal of hazardous waste – Hazardous waste is not expected to be encountered during investigation activities.

Miscellaneous IDM – Miscellaneous IDM will include decontamination sludge and used PPE. All IDM will be disposed off in accordance with federal, state, and installation requirements.

- Accumulation and storage – IDM will not be stored at RFAAP for greater than 90 days. Containerized material will be stored in an Alliant Techsystems, Inc. (ATK) approved area.
- General disposal – Analytical results, including analytical methods and detection limits, will generally be submitted to 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.
- Transporter, 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, 9VAC20-60-370 will be complied with. ATK will provide an authorized signature prior to shipment.

1.5.1 Nonhazardous Materials

Specific information on nonhazardous materials that are expected to be encountered at the site, including description, estimated quantity, and final disposition, are presented in Table 1-10. Handling and disposal of nonhazardous materials associated with investigation activities include the following:

- Soil cuttings from soil borings at the Main Manufacturing Area and the NRU.
- Decontamination sludge, containing water and sludge collected from all sites.
- Miscellaneous PPE items (e.g., Tyvek, nitrile/latex gloves, booties, etc.)

1.5.2 Hazardous Materials

Hazardous materials are not expected to be encountered during this investigation.

Table 1–10
Handling and Disposal of Nonhazardous Materials

Area	Material	Description	Quantity	Concern	Action	Expected Nature of Material
Main Manufacturing Area	Soil cuttings	From 12 borings	Approx. 1 55-gal. drums	COCs	Collect IDM samples for TCLP metals	Nonhazardous. Concentrations in soil are not expected to exceed TCLP limits.
NRU	Soil cuttings	From 16 borings	Approx. 1 55-gal. drums	COCs	Collect IDM samples for TCLP metals	Nonhazardous. Concentrations in soil are not expected to exceed TCLP limits.
Miscellaneous	Decontamination Sludge	Sludge	Approx. 2 55-gal. Drums	IDM	Collect IDM samples for TCLP metals	Nonhazardous. Concentrations in soil are not expected to exceed TCLP limits.
	PPE	Miscellaneous IDM	Approx. 5 55-gal. drums	IDM	None	Nonhazardous material. Will be disposed as IDM.

2.0 QUALITY ASSURANCE PLAN ADDENDUM

2.1 OBJECTIVE AND SCOPE

This QAPA establishes function-specific responsibilities and authorities for ensured data quality for investigative activities at RFAAP. 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

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	--
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	20.5, 20.7, 40.1, 90.1, 90.2
Data Reduction, Validation, Reporting, and Management	9.0	60.1
Corrective Action	10.0	--
Quality Assessments	11.0	--

2.2 PROJECT ORGANIZATION

2.2.1 Contractor and Subcontractor Responsibilities

Contractor and subcontractor personnel responsibilities 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 IT Corporation project management personnel. Statements of Qualification (SOQs) for IT Corporation personnel are provided in Appendix C. SOQs for subcontractor personnel will be included when all subcontractors have been selected.

2.2.2 Key Points of Contact

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

Figure 2–1
IT Corporation Organizational Chart

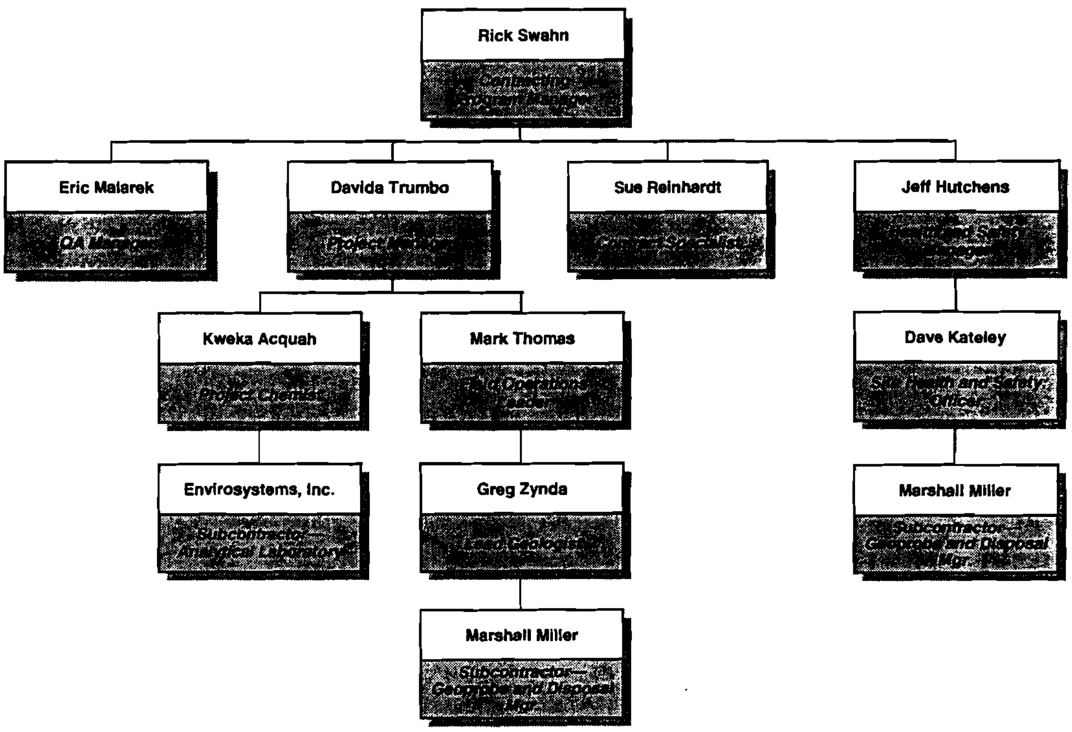


Table 2–2
Contractor and Subcontractor Key Points of Contact

Contractor	Key Point of Contact
Project Manager, Davida Trumbo e-mail: DTrumbo@theitgroup.com	IT Corporation Trinity Centre III 5885 Trinity Parkway, Ste. 120 Centreville, VA 20120 Tel (703) 815-5974; Fax (703) 815-5207
Quality Assurance Manager, Eric Malarek e-mail: EMalarek@theitgroup.com	IT Corporation 2113 Emmorton Park Rd Edgewood, MD 21040 Tel (410) 612-6322; Fax (410) 612-6351
Project Chemist, Kweku Acquah e-mail: KAcquah@theitgroup.com	IT Corporation 2113 Emmorton Park Rd Edgewood, MD 21040 Tel (410) 612-6335; Fax (410) 612-6351
Field Operations Leader, Mark Thomas e-mail: MAThomas@theitgroup.com	IT Corporation 2113 Emmorton Park Rd Edgewood, MD 21040 Tel (410) 612-6375; Fax (410) 612-6351
Lead Geologist, Greg Zynda e-mail: GZynda@theitgroup.com	IT Corporation 2113 Emmorton Park Rd Edgewood, MD 21040 Tel (410) 612-6319; Fax (410) 612-6351
Project Contract Specialist, Susan Reinhardt e-mail: SReinhardt@theitgroup.com	IT Corporation 2113 Emmorton Park Rd Edgewood, MD 21040 Tel (410) 612-6366; Fax (410) 612-6351
Health and Safety Manager, Jeff Hutchens e-mail: JHutchens@theitgroup.com	IT Corporation 13 British American Blvd. Latham, NY 12110 Tel (518) 783-1996; Fax (518) 783-8397
Site Health and Safety Officer, Dave Kateley e-mail: DKateley@theitgroup.com	IT Corporation 2113 Emmorton Park Rd Edgewood, MD 21040 Tel (410) 612-6313; Fax (410) 612-6351
Subcontractor	**Key Point of Contact**
Analytical Laboratory Envirosystems, Inc.	Tara Martz 9200 Rumsey Road Suite 102 Columbia, MD 21045-1934 Tel (410) 964-0330; Fax (410) 740-9306
Geoprobe and Disposal Management Marshall Miller	Chuck Cline Route 720, Industrial Park P.O. Box 848 Bluefield, VA 24605-0848 Tel (540) 322-5467; Fax (540) 322-1510

2.3 DATA QUALITY OBJECTIVES

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

The overall QA objective is to develop and implement procedures for sample and data collection, evaluation, and reporting that will allow reviewers to determine whether the field and laboratory procedures meet the criteria and endpoints established in the DQOs. DQOs are qualitative and quantitative statements that outline the decision-making process and specify the data required to support corrective actions. DQOs specify the level of uncertainty that will be accepted in results derived from environmental data. 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 consists of the seven steps specified below. DQO elements common to all investigative areas are included in italics following each process step. Project-specific DQOs are included in Table 2-3 for investigation activities.

Table 2–3
Project Data Quality Objectives

DQO ELEMENT	INVESTIGATION AREA	
	Main Manufacturing Area	NRU
Problem Statement	Establish naturally occurring background concentrations	Establish naturally occurring background concentrations
Decision Inputs	Metals SVOCs VOCs pH Immunoassay	Metals SVOCs VOCs pH Immunoassay
Study Boundary	1. 6,900 acres 2. In-situ 3. NA	1. 2,813 acres 2. In-situ 3. NA

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 Army, ACE, USEPA, Alliant Techsystems, and IT Corporation.

   (2) The Army is the primary decision-maker.

   (3) Refer to Table 2-3.

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) Identify and establish a background baseline for compounds of concern at RFAAP Main Manufacturing Area and New River Unit for RFI/CMS and RI/FS activities.

   (2) Resultant alternative actions include:

   (2a) Background data is required from each area.

   (2b) Background comparisons may include the use of historical data.

   (2c) Background comparisons may include the combination of surface and subsurface soil as statistically demonstrated.

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

(1) Refer to Table 2-3.

(2) Samples will be analyzed using USEPA SW-846 methodology. Refer to Section 2.5.

(3) Background values will be statistically evaluated.

(4) Field sampling will be performed in accordance with the MWP (ICF KE 1998a). Analytical methods are contained in Section 2.5.

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

   (1, 2, 3) Refer to Table 2-3

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

   (1) Parameters of interest are listed in the decision inputs. The field test kits are to be used as a screening tool for RDX and TNT. Refer to Table 2-3.

   (2) Background values will be statistically evaluated.

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

   (1) Parameter ranges are not defined at this time.

   (2) Decision errors include:

   (2a) Deciding that background values are representative of the site when they are not and (II) deciding that background values are not representative of the site when they actually are. The consequence of deciding that background values are representative of the site when they are not will result in unnecessary remedial actions. The consequences of deciding that background values are not representative of the site when they are will result in additional environmental costs. Additionally, public opinion will be compromised.

   (2b) The true state when the most severe decision error occurs (background values are representative of the site when they actually are not) is that background values are not representative of the site. The true state when the less severe decision error occurs (background values are not representative of the site when they are) is that additional effort is expended to obtain additional data when background values are representative of the site.

   (2c) The null hypothesis (H_0) is: background values are representative of the site. The alternative hypothesis (Ha) is: background values are not representative of the site.

   (2d) The false positive decision error occurs when H_0 is erroneously rejected corresponding to decision error I. The false negative decision error occurs when Ha is erroneously accepted corresponding to decision error II. Project-specific Type I and II error rates are 0.05 and 0.2, respectively.

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

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

(1) This addendum contains the proposed sampling design program. A phased focus approach has been adopted for site characterization to optimize resource utilization and minimize decision errors. DQO refinement will be an iterative process throughout the project life cycle.

(2) Biased sampling will be performed to select background sample locations.

(3) The mathematical equations will be established during the refinement process.

(4) This addendum contains the proposed sampling design program based on cost and project DQOs.

(5) Refer to Section 1.3.

2.4 SAMPLE MANAGEMENT

2.4.1 Number and Type

The estimated number and type of environmental samples proposed during the sampling event is included in Table 2-4.

2.4.2 Sample Containers, Preservation, and Holding Times

Parameter, container and preservation requirements, and holding times are presented in Table 2-5 and should follow SOP 50.3 (Appendix A, MWP).

2.4.3 Sample Identification

The sample identification number will be in a similar manner with past nomenclature 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 should not exceed eight characters for subsequent entry into IRDMIS or ERIS. Field screening samples do not require entry into IRDMIS or ERIS. Samples will be coded in the following order to ensure a unique identification.

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

MMA	=	Main Manufacturing Area
NRU	=	New River Unit

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

B	=	Braddock Loam
C	=	Carbo Silty Clay, Very Rocky
DW	=	IDM
G	=	Groseclose and Poplimento Silt Loam
L	=	Lowell Silt Loam
U	=	Unison-Urban Land Complex
W	=	Wheeling Sandy Loam or Wurno-Newberm-Faywood Silt Loam

- **Sampling Location Number:** The next one or two characters will be the number of the sampling location (e.g., 1, 2, 3,..., 9, 10, 11, ...).
- **Sample Depth:** At sites where there are several samples to be collected at different horizons, the sequential collection order will be followed by a letter in alphabetic order indicating shallow to deep depths (e.g., A, B, C), where A would be the surface soil sample or A horizon.
- **Explosives Screening.** Explosives screening samples will be identified with an "E" designation.
- **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 at location 1 collected at the Main Manufacturing Area from the Braddock Loam B soil horizon would be identified as MMAB1B. The field duplicate for the same sample would be MMAB1BD.
2. A subsurface soil sample collected at soil boring location 1 at the New River Unit from the Lowell soil group C horizon would be identified as NRUL1C. The duplicate for the same sample would be NRUL1CD.

- **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
T	=	Trip Blank

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

Table 2-4
Estimated Number and Location of Samples

Sample	Area		Total Samples
	Main Manufacturing Area	NRU	
Surface Soil	15	20	35
Subsurface Soil	25	35	60
Total Environmental	**40**	**55**	**95**
Trip Blank	2	2	4
Rinse Blank	2	3	5
MS	2	3	5
MSD	2	3	5
Field Duplicate	4	6	10
Total QC	**12**	**17**	**29**
Investigative Derived Material (aqueous)	1	1	2
(solid)	1	1	2
Total IDM	**2**	**2**	**4**
Total Samples	**54**	**74**	**128**

2.5 ANALYTICAL PROCEDURES

2.5.1 Laboratory Procedures for Chemical Analyses

Envirosystems, Inc., will perform offsite analytical activities. IT Corporation personnel will perform on-site screening activities. Analytical compound lists and reporting limits to be used are given in Table 2-6. Off-site analysis will be in accordance with USEPA approved methods for the analysis of Target Analyte List (TAL) metals, Toxicity Characteristic Leachate Procedure (TCLP) metals, TCL VOCs and SVOCs, and pH. On-site screening analysis will be in accordance with USEPA-approved methods for the analysis of RDX and TNT. The following sections briefly describe the analytical methodologies to be used in the RFAAP site investigation.

2.5.2 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).

1.4.4 Statistical Performance Objectives

Statistical performance objectives designated for the background study were designed to ensure study data were scientifically based and statistically significant. Risk assessment considerations were factored into the design to ensure data users were provided with the minimum quality and quantity of environmental analytical data that are sufficient to support Superfund risk assessment decisions. Additionally, previously collected background samples were evaluated to assess the strength of proposed statistical parameters. The required number of samples suggested by this evaluation are presented in Appendix C. The following subsections discuss the strategy for determining the number of samples required to achieve statistical performance objectives and the subsequent statistical data evaluation.

1.4.4.1 Number of Environmental Samples

Guidance for determining the number of samples needed for background comparisons associated with risk assessments was obtained from the Guidance for Data Usability in Risk Assessment, 1992. Based on discussions with EPA Region III, the following elements were used to arrive at the collection of 12 samples to conduct a one-sided, one-sample t-test in accordance with Equation 1:

- confidence level = 80%
- power = 90%
- coefficient of variation = 30%
- minimum detectable relative difference of 20%

$$n \geq [(Z_\alpha + Z_\beta)/D]^2 + 0.5Z_\alpha^2 \quad (1)$$

where

Z_α and Z_β = percentile of the standard normal distribution;
D = MDRD/CV;
MDRD = minimum detectable relative difference; and
CV = coefficient of variation

Equation 1 resulted is expressed into the following result.

1. $n \geq [(0.842+1.282)/0.667]^2 + 0.5(0.842)^2$
2. $n \geq 10.14+0.35$
3. $n \geq 11$ samples

Statistical Evaluation of Data. The qualitative assessment of surface and subsurface soil characteristics suggest that these data can be grouped into one data set. The Mann-Whitney or Student's t test will be used to evaluate the assumption that background levels are statistically the same across soil types, across soil horizons, and between surface and subsurface soils. Tests of hypotheses will be used to expand the effective data set.

- Surface soil samples will be collected from each soil type. These samples will be statistically evaluated to discern if they can be grouped into one data set.
- Subsurface soil samples will be collected from each soil type. Statistical evaluation will be performed for each soil horizon (B and C) and across soil types.
- Surface and subsurface soil samples data sets will be statistically evaluated against each other to discern the possibility of grouping all of the data into one data set. This grouping will provide greater confidence and power.
- Background values will be independent of screening and risk-based concentrations. Evaluation of data against background will be discussed during the appropriate phase of the risk assessment.

Table 2–5
Parameter, Container, Preservation Requirements, and Holding Times

Parameter	Sample Container		Preservation Requirement	Holding Time
	Solid	Aqueous		
TCL VOCs	3, 5 gram EnCore sampler	3, 40 mL vials with Teflon septum	Cool: 4 ± 2°C, HCl to pH<2 for aqueous	Aqueous: Analysis: 14 days Solid: Preparation: 2 days Analysis: 14 days
TCL SVOCs	8 oz, wide mouth glass with Teflon cap	2, 1-L amber glass with Teflon lined cap	Cool: 4 ± 2°C	Aqueous: Extraction: 7 days Analysis: 40 days Solid: Extraction: 14 days Analysis: 40 days
TAL Metals	8 oz, wide mouth glass with Teflon cap	1-L polyethylene	Cool: 4 ± 2°C, HNO_3 to pH<2 for aqueous	Metals: 180 days Mercury: 28 days
TCLP Metals	8 oz, wide mouth glass with Teflon cap	1-L amber glass or polyethylene	Cool: 4 ± 2°C	TCLP Extraction: 180 days ICP Mercury: 28 days Sample Analysis: 180 days ICP Mercury: 28 days
pH	4 oz, wide mouth glass with Teflon cap	NA	Cool: 4 ± 2°C	Solid: ASAP
TNT and RDX (field test kit)	8 oz, wide mouth glass with Teflon cap	NA	In-situ	In-situ

NA = Not Applicable
TCL = Target Compound List
TCLP = Toxicity Characteristic Leachate Procedure

Table 2–6
Analyte List

Parameter	Quantitation Limits		Tap Water RBCs	Region III Soil Risk Based Concentration April 2000		SSL Transfers Soil to Groundwater (DAF 20)	Region III BTAG Screening Levels	
	Aqueous (µg/L)	Soil (mg/kg)	(µg/L)	Residential (mg/kg)	Industrial (mg/kg)	(mg/kg)	Aqueous (µg/L)	Soil (mg/kg)
Metals								
Aluminum	200	40	37,000	7,800	200,000	NA	25	1
Antimony	60	12	15	3.1	82	13	30	0.48
Arsenic	10	2	0.04	0.43	3.8	0.026	48	328
Barium	200	40	2,600	550	14,000	2,100	10,000	440
Beryllium	5	1	73	16	410	1,200	5.3	0.02
Cadmium	5	1	18	3.9	100	27	0.53	3
Calcium	5,000	1,000	NA	NA	NA	NA	NA	NA
Chromium VI	10	2	110	23	610	42	2	0.02
Cobalt	50	10	2,200	470	12,000	NA	35,000	0.1
Copper	25	5	1,500	310	8,200	11,000	6.5	15
Iron	100	20	11,000	2,300	61,000	NA	320	3,260
Lead	3	0.6	50	400	750	400	3.2	2
Magnesium	5,000	1,000	NA	NA	NA	NA	NA	0.00044
Manganese	15	3	730	160	4,100	950	14,500	330
Mercury	0.2	0.1	NA	2.3	61	NA	0.012	0.058
Nickel	40	8	730	160	4,100	NA	160	2
Potassium	5,000	1,000	NA	NA	NA	NA	NA	NA
Selenium	5	1	180	39	1,000	19	5	2
Silver	10	2	180	39	1,000	31	0.0001	0.0000098
Sodium	5,000	1,000	NA	NA	NA	NA	NA	NA
Thallium	10	2	2.6	0.55	14	3.6	40	0.001
Vanadium	50	10	260	55	1,400	5,100	10,000	0.5
Zinc	20	4	11,000	2,300	61,000	14,000	30	10
Explosives								
Cyclotrimethylene-trinitramine (RDX)	0.5	0.2	0.61	5.8	52	NA	NA	NA
Cyclotetramethylene-tetranitramine (HMX)	0.5	2.1	1,800	390	10,000	NA	NA	NA
1,3-Dinitrobenzene	0.5	0.2	3.7	0.78	20	0.037	1,200	NA
2,4-Dinitrotoluene	0.5	0.2	73	16	410	0.57	230	NA
2,6-Dinitrotoluene	0.5	0.2	37	7.8	200	0.25	230	NA
Dinitrotoluene Mix	0.5	0.2	0.09	0.94	8.4	NA	230	NA
TETRYL	0.5	0.2	370	78	2,000	NA	NA	NA
Nitrobenzene	0.5	0.2	3.5	3.9	100	0.023	27,000	NA
Nitroglycerin	2.5	1.1	4.8	0.3	2.7	NA	NA	NA
1,3,5-Trinitrobenzene	0.5	0.2	1,100	230	6,100	NA	NA	NA
2,4,6-Trinitrotoluene	0.5	0.2	2.2	21	190	NA	NA	NA
2-Nitrotoluene	0.5	0.2	NA	1,600	41,000	NA	NA	NA
3-Nitrotoluene	0.5	0.2	NA	780	20,000	NA	NA	NA
4-Nitrotoluene	0.5	0.2	NA	780	20,000	NA	NA	NA
4-Amino-2,6-dinitrotoluene	0.5	0.2	NA	0.47	12	NA	NA	NA

Table 2-6 (Continued)
Analyte List

Parameter	Quantitation Limits		Tap Water RBCs	Region III Soil Risk Based Concentration April 2000		SSL Transfers Soil to Groundwater (DAF20)	Region III BTAG Screening Levels	
	Aqueous (µg/L)	Soil (mg/kg)	(µg/L)	Residential (mg/kg)	Industrial (mg/kg)	(mg/kg)	Aqueous (µg/L)	Soil (mg/kg)
2-Amino-4,6-dinitrotoluene	0.5	0.2	NA	0.47	12	NA	NA	NA
SVOCs								
1,2-Dichlorobenzene	10	0.33	550	700	18,000	9.3	763	0.3
1,2,4-Trichlorobenzene	10	0.33	190	78	2,000	7.5	50	0.1
1,3-Dichlorobenzene	10	0.33	5.5	7	180	0.087	763	NA
1,4-Dichlorobenzene	10	0.33	0.47	27	240	0.0071	763	0.1
2-Chloronaphthalene	10	0.33	490	6,300	160,000	32	NA	NA
2-Chlorophenol	10	0.33	30	390	10,000	NA	970	0.1
2-Methylnaphthalene	10	0.33	120	160	4,100	22	NA	NA
2-Methylphenol	10	0.33	1,800	390	10,000	NA	NA	0.1
2-Nitroaniline	50	1.6	NA	NA	NA	NA	NA	NA
2-Nitrophenol	10	0.33	NA	NA	NA	NA	150	0.1
2,4-Dichlorophenol	50	1.6	110	23	610	1.2	365	0.1
2,4-Dimethylphenol	10	0.33	730	160	4,100	6.7	NA	0.1
2,4-Dinitrophenol	10	0.33	73	16	410	NA	150	0.1
2,4-Dinitrotoluene	10	0.33	73	16	410	0.57	230	NA
2,4,5-Trichlorophenol	10	0.33	3,700	780	20,000	NA	63	0.1
2,4,6-Trichlorophenol	10	0.33	6.1	58	520	NA	970	0.1
2,3,7,8-Tetrachlorodibenzodioxin (dioxin)	0.00001	0.000001	0.00000045	0.000038	0.0000043	0.0000086	NA	NA
2,6-Dinitrotoluene	10	0.33	37	7.8	200	0.25	230	NA
3-Nitroaniline	50	1.6	NA	NA	NA	NA	NA	NA
3,3'-Dichlorobenzidine	20	0.65	0.15	1.4	13	0.0049	NA	NA
4-Bromophenylphenylether	10	0.33	NA	NA	NA	NA	NA	NA
4-Chloro-3-methylphenol	20	0.65	NA	NA	NA	NA	NA	NA
4-Chloroaniline	20	0.65	150	31	820	0.97	NA	NA
4-Chlorophenylphenylether	10	0.33	NA	NA	NA	NA	NA	NA
4-Methylphenol	10	0.33	180	39	1,000	NA	NA	0.1
4-Nitroaniline	50	1.6	NA	NA	NA	NA	NA	NA
4-Nitrophenol	50	1.6	290	630	16,000	2	150	0.1
4,6-Dinitro-2-methylphenol	50	1.6	3.7	7.8	200	NA	NA	NA
Acenaphthylene	10	0.33	NA	NA	NA	NA	NA	0.1
Acenaphthene	10	0.33	370	470	12,000	100	520	0.1
Anthracene	10	0.33	1,800	2,300	61,000	470	0.1	0.1
Benz[a]anthracene	10	0.33	0.092	0.87	7.8	1.5	6.3	0.1
Benzo[b]fluoranthene	10	0.33	0.092	0.87	7.8	4.5	NA	0.1
Benzo[a]pyrene	10	0.33	0.0092	0.087	0.78	0.37	NA	0.1
Benzo[g,h,I]pyrene	10	0.33	NA	NA	NA	NA	NA	0.1
Benzo[k]fluoranthene	10	0.33	0.92	8.7	78	45	NA	0.1
bis(2-Chloroethoxy)methane	10	0.33	NA	NA	NA	NA	11,000	NA

Table 2-6 (Continued)
Analyte List

Parameter	Quantitation Limits		Tap Water RBCs	Region III Soil Risk Based Concentration April 2000		SSL Transfers Soil to Groundwater (DAF20)	Region III BTAG Screening Levels	
	Aqueous (µg/L)	Soil (mg/kg)	(µg/L)	Residential (mg/kg)	Industrial (mg/kg)	(mg/kg)	Aqueous (µg/L)	Soil (mg/kg)
bis(2-Chloroethyl)ether	10	0.33	0.0096	0.58	5.2	0.00004	NA	NA
bis(2-Chloroisopropyl)ether	10	0.33	0.26	9.1	82	0.0017	NA	NA
bis(2-Ethylhexyl)phthalate	10	0.33	4.8	46	410	2,900	30	NA
Butylbenzylphthalate	10	0.33	7,300	1,600	41,000	17,000	3	NA
Carbazole	10	0.33	3.3	32	290	0.47	NA	NA
Chrysene	10	0.33	9.2	87	780	150	NA	0.1
Di-n-butylphthalate	10	0.33	3,700	780	20,000	5,000	0.3	NA
Di-n-octylphthalate	10	0.33	730	160	4,100	2,400,000	0.3	NA
Dibenz[a,h]anthracene	10	0.33	0.0092	0.087	0.78	1.4	NA	0.1
Dibenzofuran	10	0.33	24	31	820	8	NA	NA
Diethylphthalate	10	0.33	29,000	6,300	160,000	450	3	NA
Dimethylphthalate	10	0.33	370,000	78,000	2,000,000	NA	3	NA
Fluoranthene	10	0.33	1,500	310	8,200	6,300	3,980	0.1
Fluorene	10	0.33	240	310	8,200	140	430	0.1
Hexachlorobenzene	10	0.33	0.042	0.4	3.6	0.052	3.68	NA
Hexachlorobutadiene	10	0.33	0.86	8.2	73	1.8	9.3	NA
Hexachlorocyclopentadiene	10	0.33	260	55	1,400	2,000	5.2	NA
Hexachloroethane	10	0.33	4.8	46	410	0.36	540	NA
Indeno[1,2,3-cd]pyrene	10	0.33	0.092	0.87	7.8	13	NA	0.1
Isophorone	10	0.33	70	670	6,000	0.41	117,000	NA
N-Nitrosodi-n-propylamine	10	0.33	0.0096	0.091	0.82	0.000047	NA	NA
N-Nitrosodiphenylamine	10	0.33	14	130	1,200	0.76	5,850	NA
Naphthalene	10	0.33	6.5	160	4,100	0.15	100	0.1
Nitrobenzene	10	0.33	3.5	3.9	100	0.023	27,000	NA
Pentachlorophenol	50	1.6	0.56	5.3	48	NA	13	0.1
Phenanthrene	10	0.33	180	230	6,100	680	6.3	0.1
Phenol	10	0.33	22,000	47,000	1,200,000	130	79	0.1
Pyrene	10	0.33	180	230	6,100	680	NA	0.1
PAHs								
Acenaphthylene	1	0.033	NA	NA	NA	NA	NA	0.1
Acenaphthene	0.1	0.017	370	470	12,000	100	520	0.1
Anthracene	0.05	0.0017	1,800	2,300	61,000	470	0.1	0.1
Benzo[a]anthracene	0.05	0.0017	0.092	0.87	7.8	1.5	6.3	0.1
Benzo[b]fluoranthene	0.1	0.0033	0.092	0.87	7.8	4.5	NA	0.1
Benzo[a]pyrene	0.05	0.0017	0.0092	0.087	0.78	0.37	NA	0.1
Benzo[g,h,i]pyrene	0.01	0.0033	NA	NA	NA	NA	NA	0.1
Benzo[k]fluoranthene	0.05	0.0017	0.92	8.7	78	45	NA	0.1
Chrysene	0.05	0.0017	9.2	87	780	150	NA	0.1
Dibenz[a,h]anthracene	0.1	0.0033	0.0092	0.087	0.78	1.4	NA	0.1
Fluoranthene	0.1	0.0033	1,500	310	8,200	6,300	3,980	0.1

Table 2-6 (Continued)
Analyte List

Parameter	Quantitation Limits		Tap Water RBCs	Region III Soil Risk Based Concentration April 2000		SSL Transfers Soil to Groundwater (DAF20)	Region III BTAG Screening Levels	
	Aqueous (µg/L)	Soil (mg/kg)	(µg/L)	Residential (mg/kg)	Industrial (mg/kg)	(mg/kg)	Aqueous (µg/L)	Soil (mg/kg)
Fluorene	0.01	0.0033	240	310	8,200	140	430	0.1
Indeno[1,2,3-cd]pyrene	0.05	0.0017	0.092	0.87	7.8	13	NA	0.1
Naphthalene	0.1	0.017	6.5	160	4,100	0.15	100	0.1
Phenanthrene	0.05	0.0017	180	230	6,100	680	6.3	0.1
Pyrene	0.05	0.0017	180	230	6,100	680	NA	0.1
VOCs								
Acetone	5	0.005	610	780	20,000	2.5	9,000,000	NA
Benzene	1	0.005	0.32	12	100	0.0018	5,300	0.1
Bromodichloromethane	1	0.005	0.17	10	92	0.0011	11,000	450
Bromoform	1	0.005	8.5	81	720	4.1	NA	NA
Bromomethane	1	0.005	8.5	11	290	0.041	NA	NA
2-Butanone	5	0.005	NA	4,700	120,000	8	3,220,000	NA
Carbon disulfide	5	0.005	1,000	780	20,000	19	2	NA
Carbon tetrachloride	1	0.005	0.16	4.9	44	0.0021	35,200	0.3
Chlorobenzene	1	0.005	110	160	4,100	0.8	50	0.1
Chloroethane	1	0.005	3.6	220	2,000	0.019	NA	NA
Chloroform	1	0.005	0.15	100	940	0.00089	1,240	0.3
Chloromethane	1	0.005	2.1	49	440	0.01	NA	NA
Dibromochloromethane	1	0.005	0.13	7.6	68	0.00083	11,000	NA
1,1-Dichloroethane	1	0.005	800	780	20,000	4.5	160,000	0.3
1,2-Dichloroethane	1	0.005	0.12	7	63	0.001	20,000	870
1,1-Dichloroethene	1	0.005	0.044	1.1	9.5	0.00036	11,600	NA
cis-1,2-Dichloroethene	1	0.005	60	78	2,000	0.35	11,600	0.3
trans-1,2-Di-chloroethene	1	0.005	120	160	4,100	0.82	11,600	0.3
1,2-Dichloropropane	1	0.005	0.16	9.4	84	0.0021	NA	NA
cis-1,3-Dichloropropene	1	0.005	NA	NA	NA	NA	244	0.3
trans-1,3-Dichloropropene	1	0.005	NA	NA	NA	NA	244	0.3
Ethylbenzene	1	0.005	1,300	780	20,000	15	32,000	0.1
2-Hexanone	5	0.005	1,500	310	8,200	NA	428,000	NA
4-Methyl-2-pentanone	5	0.005	NA	630	16,000	NA	460,000	100
Methylene chloride	5	0.005	4.1	85	760	0.019	11,000	0.3
Styrene	5	0.005	1,600	16,000	410,000	57	NA	0.1
1,1,2,2-Tetrachloroethane	5	0.005	0.053	3.2	29	0.00068	2,400	0.3
Tetrachloroethene	5	0.005	1.1	12	110	0.048	840	0.3
Toluene	5	0.005	750	16,000	410,000	8.8	17,000	0.1
1,1,1-Trichloroethane	5	0.005	3,200	22,000	570,000	60	9,400	0.3
1,1,2-Trichloroethane	5	0.005	0.19	11	100	0.00078	9,400	0.3
Trichloroethene	5	0.005	1.6	58	520	0.015	21,900	0.3
Vinyl chloride	5	0.005	0.019	0.34	3	0.00016	11,600	0.3
m- & *p*-Xylene	1	0.005	12,000	16,000	410,000	250	6,000	0.1
o-Xylene	1	0.005	12,000	16,000	410,000	230	6,000	0.1

Table 2-6 (Continued)
Analyte List

Parameter	Quantitation Limits		Tap Water RBCs	Region III Soil Risk Based Concentration April 2000		SSL Transfers Soil to Groundwater	Region III BTAG Screening Levels	
	Aqueous (µg/L)	Soil (mg/kg)	(µg/L)	Residential (mg/kg)	Industrial (mg/kg)	(mg/kg)	Aqueous (µg/L)	Soil (mg/kg)
Xylene (total)	1	0.005	12,000	16,000	410,000	170	6,000	0.1
Pesticides/PCBs								
Aldrin	0.05	0.0017	0.0039	0.038	0.34	0.0072	3	0.0001
Alpha-BHC	0.05	0.0017	0.011	0.1	0.91	0.0004	0.08	0.0001
Beta-BHC	0.05	0.0017	0.037	0.35	3.2	0.002	0.08	0.0001
Gamma-BHC	0.05	0.0017	0.052	0.49	4.4	0.006	0.08	0.0001
Alpha-Chlordane	0.05	0.0017	0.19	1.8	16	0.092	0.0043	0.0001
Gamma-Chlordane	0.05	0.0017	0.19	1.8	16	0.092	0.0043	0.0001
Dieldrin	0.1	0.0033	0.0042	0.04	0.36	0.0022	0.0019	0.0001
4,4'-DDD	0.1	0.0033	0.28	2.7	24	11	0.6	0.0001
4,4'-DDE	0.1	0.0033	0.20	1.9	17	35	1,050	0.0001
4,4'-DDT	0.1	0.0033	0.20	1.9	17	1.2	0.001	0.0001
Endosulfan I	0.05	0.0017	220	47	1,200	20	0.056	0.0001
Endosulfan II	0.1	0.0033	220	47	1,200	20	0.056	0.0001
Endosulfan sulfate	0.1	0.0033	220	47	1,200	20	0.056	0.0001
Endrin	0.1	0.0033	11	2.3	61	5.4	0.0023	0.0001
Endrin ketone	0.1	0.0033	11	2.3	61	5.4	0.0023	0.0001
Heptachlor	0.05	0.0017	0.015	0.14	1.3	0.84	0.0038	0.0001
Heptachlor epoxide	0.05	0.0017	0.0074	0.07	0.63	0.025	0.0038	0.0001
Methoxychlor	0.5	0.017	180	39	1,000	310	0.3	0.0001
Toxaphene	5	0.17	0.061	0.58	5.2	0.04	0.0002	0.0001
AROCLOR-1016	1	0.033	0.96	5.5	82	4.2	0.0014	0.0001
AROCLOR-1221	2	0.067	0.033	0.32	2.9	NA	0.0014	0.0001
AROCLOR-1232	1	0.033	0.033	0.32	2.9	NA	0.0014	0.0001
AROCLOR-1242	1	0.033	0.033	0.32	2.9	NA	0.0014	0.0001
AROCLOR-1248	1	0.033	0.033	0.32	2.9	NA	0.0014	0.0001
AROCLOR-1254	1	0.033	0.033	0.32	2.9	1.1	0.0014	0.0001
AROCLOR-1260	1	0.033	0.033	0.32	2.9	N/A	0.0014	0.0001
Inorganic								
Cyanide	10	0.4	730	160	4,100	150	5.2	0.000005
Explosives by field test kit								
Cyclotrimethylene-trinitramine (RDX)	5	0.5	0.61	5.8	52	NA	NA	NA
2,4,6-Trinitrotoluene	5	0.5	2.2	21	190	NA	NA	NA

NA = Not Applicable

1. The reporting levels for soil ingestion of noncarcinogenic chemicals are presented with a hazard quotient of 0.1 to allow for cumulative effects, multiple contaminated media, and multiple routes of exposure.
2. The SSLs for soil to groundwater migration contains a default value of 20 for the dilution attenuation factor (DAF).
3. Lead values were provided by USEPA Region III

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 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 any 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.

2.5.3 Organics

Samples will be analyzed for volatiles using USEPA SW-846 Method 5030B/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 determine the approximate concentration of organic constituents in the sample. An inert gas is bubbled through a mixture of reagent water and soil sample or through either a 5 milliliters (mL) (surface water) or a 25 mL (groundwater) sample contained in a specifically designed purging chamber at 40°C for soil and ambient temperature for water. The vapor is swept through a sorbent column where the purgeable compounds are trapped. After purging is completed for both soil and aqueous samples, the sorbent column is heated and backflushed with the inert gas to desorb the purgeable compounds onto a gas chromatograph programmed to separate the purgeable compounds, which are then detected with a mass spectrometer.

Samples will be analyzed for semivolatiles using USEPA SW-846 Method 8270C. Soil samples will be extracted using sonication according to USEPA SW-846 Method 3550C or soxhlet extraction according to USEPA SW-846 Method 3540C; aqueous samples will be extracted using a continuous liquid-liquid extraction technique according to USEPA SW-846 Method 3520C. Soil samples should be screened to determine 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 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.

2.5.4 Field Screening

Samples will be analyzed for Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX) for field screening using immunoassay method USEPA SW-846 4051. This method is a test kit procedure for screening soils to determine when RDX is present at concentrations above 0.5 mg/kg and provides an estimate of the concentration of RDX by comparison with a reference. The manufacturer's directions (D TECH) should be followed. In cases where the exact concentrations of RDX are required, quantitative techniques (i.e., Method 8330) should be used. In general, the method is performed using an extract of a soil sample. Samples and an enzyme conjugate reagent are added to immobilized RDX antibody. The enzyme-RDX conjugate "competes" with RDX present in the sample for binding to an immobilized RDX antibody. The enzyme-RDX conjugate bound to the antibody then catalyzes a colorless substrate to a colored product. The test is interpreted by comparing the color produced by a sample to the response produced by a reference reaction.

Samples will be analyzed for trinitrotoluene (TNT) for field screening using immunoassay method USEPA SW-846 4050. This method is a test kit procedure for screening soils to determine when TNT is present at concentrations above 0.5 mg/kg and provides an estimate for the concentration of TNT by comparison with a reference. The manufacturer's directions (D TECH) should be followed. In cases where the exact concentrations of TNT are required, quantitative techniques (i.e., Method 8330) should be used. In general, the method is performed using an extract of a soil sample. Samples and an enzyme-TNT conjugate reagent are added to an immobilized TNT antibody. The enzyme-TNT conjugate "competes" with TNT present in the sample for binding to the immobilized TNT antibody. The enzyme-TNT conjugate bound to the TNT antibody then catalyzes a colorless substrate to a colored product. The test is interpreted by comparing the color produced by a sample to the response produced by a reference reaction.

2.6 INTERNAL QUALITY CONTROL CHECKS

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

2.6.1 Field Quality Control Samples

Rinse blanks, trip blanks, and field duplicates will be collected during the acquisition of environmental samples at RFAAP. Table 2-7 presents guidelines for the collection of QC samples that will be taken in conjunction with environmental sampling at the Main Manufacturing Area, and NRU. Field QC acceptance criteria for investigative activities is summarized in Table 2-8.

Table 2–7
Field Quality Control Samples

Control	Purpose of Sample	Estimated Number				Collection Frequency
		Main Manufacturing Area		NRU		
		Aqueous	Solid	Aqueous	Solid	
Duplicate sample	Ensure precision in sample homogeneity	NA	4	NA	6	1 per 10 (10%) of field samples per matrix
Rinse blank	Ensure the decontamination of sampling equipment has been adequately performed to assess cross-contamination and/or incidental contamination to the sample container	NA	2	NA	3	1 per 20 (5%) of field samples per matrix per equipment type for off-site analysis
Temperature blank	Verify sample cooler temperature during transport	NA	2	NA	2	1 temperature blank per cooler for off-site analysis
Trip blank	Determine if cross-contamination occurs during shipment or storage with aqueous VOC samples	2	NA	2	NA	1 trip blank per cooler containing aqueous VOC samples

NA = not applicable.

Table 2–8
Field Quality Control Elements Acceptance Criteria for Investigative Activities

Item	DQO	Parameter	Frequency of Association	Criteria Requirement
Field Duplicate	P	Inorganics	1 per 10 samples per matrix	RPD ≤ 20% Aqueous RPD ≤ 35% Solid
		Organics	1 per 10 samples per matrix	RPD ≤ 50% Aqueous RPD ≤ 100% Solid
Trip Blank	A,R	VOCs in water	1 per cooler with aqueous VOCs	No target analytes detected in the trip blanks, 5% of decision limit, 5% of sample concentration, or the MDL, whichever is higher
Rinse Blank	A,R	All	1 per 20 samples per matrix per equipment type	No target analytes detected in the rinse blanks, 5% of decision limit, 5% of sample concentration, or the MDL, whichever is higher
Chain-of-Custody Forms	R	All	Every sample	Filled out correctly to include signatures; no missing or incorrect information.
Field Logbook	R	All	Every sample	Filled out correctly to include analytical parameters; map file data; and applicable coding information.
Field Instrument Calibration Logs	A	All	Every measurement	All measurements must have associated calibration reference

A = Accuracy P = Precision R = Representativeness

2.6.2 Laboratory Quality Control Elements

The laboratory QC elements are summarized in Table 2-9. Laboratory analytical goals are summarized in Tables 2-10 through 2-13 for the parameters specified in Section 2.5.

Table 2–9
Analytical Quality Control Elements of a Quality Assurance Program

Item	DQO[a]	Parameter	Frequency of Association	Criteria Requirement
Analytical Method	C	All	Each analysis	Method analysis based on USEPA methods as defined in Section 2.5.
Chemical Data Packages	A,P,C	All	Each lot/batch	Pass peer review and formal QA/QC check.
Laboratory Chain of Custody	R	All	All sample containers	No deficiencies
Laboratory System Controls	A,R	All	During laboratory operations	Custody of sample within laboratory fully accounted for and documented
Holding Time	A,P,R	All	Each analysis	No deficiencies (USEPA Region III Modifications)
Method Blanks	A	All	Each lot/batch	No target analytes detected in the method blanks or <5% of the LOC or sample concentration
Matrix Spikes and Duplicates	A,P	All	Each lot/batch	Must meet USEPA criteria as defined in Tables 2-10 to 2-13.
Surrogates	A	Organics	Organic fractions, including QC samples	Required to meet the stricter of the USEPA criteria.
Serial dilution	A	Metals	Each lot/batch	Must meet USEPA criteria as defined in Table 2-12.

[a]A = Accuracy; C = Comparability; R = Representativeness; and P = Precision.

Table 2–10
Quality Control Method Criteria for Volatile Organic Compounds by SW-846 8260B

Procedure	Frequency	Acceptance Criteria			Corrective Action
Initial Calibration 5-pt curve	Set-up, major maintenance, and quarterly	RRF > 0.30 for SPCCs; except bromoform >0.25. RSD ≤ 30% for CCCs response factors.			If RSD of the average RRF for calibration check compounds > 30%, the initial calibration must be repeated. Data reviewer should review and judge all of the target compounds against the acceptance criteria.
Continuing calibration check	Every 12 hours	%Difference for RF of CCCs of continuing calibration compounds ±25% from initial calibration. RRF > 0.30 for SPCCs; except bromoform >0.25.			Samples cannot begin until this criterion is met. Data reviewer should review and judge all of the target compounds against the acceptance criteria.
Method blanks	Every 12 hours	No target analytes below 5% of the decision limit, 5% of the sample concentrations, or the MDL, whichever is higher.			Document source of contamination.
Tuning BFB	Prior to calibration	Must meet tuning criteria.			Re-tune, re-calibrated.
LCS (Advisory Limits)	Every batch	70-130% or as specified QC limits.			Qualify associated data biased high or biased low as appropriate.
Internal Standards	Every sample	Standards Bromochloromethane 1,4-difluorobenzene chlorobenzene	Retention time ±30 seconds of last CC Area changes by a factor of two (-50% to +100%)		Inspect for malfunction. Demonstrate that system is functioning properly. Reanalyze samples with standards outside criteria.
Surrogate (Advisory Limits)	Every sample	Standards 4-bromofluorobenzene 1,2-dichloroethane-d_4 toluene-d_8	Solid 74-113% 70-121% 84-117%	Aqueous 86-115% 76-114% 88-110%	If any surrogate compounds do not meet criteria, there should be a re-analysis to confirm that the non-compliance is due to the sample matrix effects rather than laboratory deficiencies.
Matrix Spike and Duplicate (Advisory Limits)	1 per 20 per matrix	Standards 1,1-dichloroethane trichloroethene benzene toluene chlorobenzene	Solid %Rec. %RPD 59-172% ≤22 62-137% ≤24 66-142% ≤21 59-139% ≤21 60-133% ≤21	Aqueous %Rec. %RPD 61-146% ≤14 71-120% ≤14 76-127% ≤11 76-125% ≤13 75-130% ≤13	If MS/MSD results do not meet criteria, the reviewer should review the data in conjunction with other QC results to determine if the problem is specific to the QC samples or systematic.

Table 2–11
Quality Control Method Criteria for Semivolatile Organic Compounds by SW8270C

Procedure	Frequency	Acceptance Criteria	Corrective Action
Initial calibration curve (5-pt curve)	Set-up, major maintenance	RRF > 0.05 for SPCCs; RSD ≤30% for CCC compounds.	Must meet criteria prior to sample analysis. Data reviewer should review and judge all of the target compounds against the acceptance criteria.
Continuing calibration standard	12 hours	RRF > 0.05 for SPCCs. The percent difference for CCCs must be ≤30%. If this criteria is met, the relative response factors of all compounds are calculated.	If criteria are not met, reanalyze the daily standard. If the daily standard fails a second time, calibration must be repeated. Data reviewer should review and judge all of the target compounds against the acceptance criteria.
Internal standards	Every sample	Retention time ±30 seconds of last CC Area changes by a factor of two (-50% to +100%)	Inspect for malfunction. Demonstrate that system is functioning properly. Reanalyze samples with standards outside criteria.
Tuning DFTPP	12 hours	Must meet tuning criteria.	Re-tune, re-calibrate.
Method blanks	Per extraction batch	No target analytes below 5% of the decision limit, 5% of the sample concentrations, or the MDL, whichever is higher.	Document source of contamination.
LCS (Advisory Limits)	Every batch	70-130% or as specified QC limits	Qualify associated data biased high or biased low as appropriate.
Surrogate spikes (Advisory Limits)	Every sample	Standards / Aqueous (%Rec.) / Solid (%Rec.) nitrobenzene-d_5 / 35-120% / 23-120% 2-fluorobiphenyl / 43-116% / 30-115% p-terphenyl-d14 / 33-141% / 18-137% phenol-d5 / 10-94% / 24-113% 2-fluoroprophenol-d6 / 21-110% / 25-121% 2,4,6-tribromophenol / 10-123% / 19-122% 2-chlorophenol / 33-110% / 20-130% 1,2-dichlorobenzene / 16-110% / 20-130%	If any two base/neutral or acid surrogates are out of specification, or if any one base/neutral or acid extractable surrogate has a recovery of less than 10%, then there should be a re-analysis to confirm that the non-compliance is due to sample matrix effects rather than laboratory deficiencies.
Matrix spike and duplicate (Advisory Limits)	1 per 20 samples per matrix	Standards / Aqueous Rec. / Aqueous %RPD / Solid Rec. / Solid %RPD Phenol / 12-172% / ≤42 / 26-90% / ≤35 2-chlorophenol / 27-123% / ≤50 / 25-102% / ≤50 1,4-dichlorobenzene / 36-97% / ≤28 / 28-104% / ≤27 n-nitroso-di-n-propylamine / 41-116% / ≤38 / 41-126% / ≤38 1,2,4-trichlorobenzene / 39-98% / ≤28 / 38-107% / ≤23 4-chloro-3-methylphenol / 23-97% / ≤42 / 26-103% / ≤33 acenaphthene / 46-118% / ≤31 / 31-137% / ≤19 4-nitrophenol / 10-80% / ≤50 / 11-114% / ≤50 2,4-dinitrotoluene / 24-96% / ≤38 / 28-89% / ≤47 pentachlorophenol / 9-103% / ≤50 / 17-109% / ≤47 pyrene / 26-127% / ≤31 / 35-142% / ≤36	If MS/MSD results do not meet criteria, the reviewer should review the data in conjunction with other QC results to determine if the problem is specific to the QC samples or systematic.

Table 2–12
Quality Control Method Criteria for Metals by SW-846 6010B/7470A/7471A

Procedure	Frequency of QC Procedure	Acceptance Criteria	Corrective Action
Initial calibration curve (3-pt curve Hg) (1-pt curve ICP)	Daily or major maintenance, instrument modification, replacement of the torch, replacement of the mirror	r > 0.995 for all elements r: linear correlation coefficient	If r < 0.995 for any element, the standards for that element must be prepared again and/or the lower/upper range standard must be used.
Continuing calibration verification (CCV)	Every 10 samples or 2 per 8 hr and end of run.	Recovery ±10% of true value for ICP Recovery ±20% of true value for Hg	Reanalyze CCV. If the CCV fails second time, the analysis must be terminated, the problem corrected, the instrument re-calibrated, and the calibration re-verified prior to continuing sample analyses.
Highest mixed standard	Before sample analysis	Recovery ±5% of true value for ICP NA for Hg	If criteria are not met, reanalyze the daily standards. If the daily standard fails a second time, initial calibration must be repeated.
Interference check	Beginning and end of each sample analytical run or 2 per 8 hr.	Recovery ±20% of true value.	Terminate the analysis, correct the problem, re-calibrate, re-verify the calibration, and reanalyze the samples.
Continuing calibration blank (CCB)	Every 10 samples, end of analytical run	Concentration < 3 X s of the background mean (ICP). No target analytes below 5% of the decision limit, 5% of the sample concentrations, or the MDL, whichever is higher.	If the average in not within criteria, terminate the analysis, correct the problem, re-calibrate, and reanalyze all samples analyzed since the last acceptable CCB.
Serial Dilution (ICP)	1 per 20 samples per matrix for samples >10x IDL	Difference between diluted and undiluted sample <10%.	Chemical or physical interference should be suspected. Investigate to determine cause.
Preparation blank	1 per batch per matrix	No target analytes below 5% of the decision limit, 5% of the sample concentrations, or the MDL, whichever is higher.	Documented source of contamination.
Laboratory Control Sample (Advisory Limits)	1 per 20 samples	90%≤%Rec.≤110%	Qualify associated data biased high or biased low as appropriate.
Matrix spike and duplicate and sample duplicate (Advisory Limits)	1 per 20 samples per matrix	75%≤%Rec.≤125%; %RPD<20%; If spike(s) outside of limits, analyze PDS.	If matrix spike recovery does not meet criteria (except Ag), a post digestion spike is required for all methods except GFAA. Qualify results in accordance with Regional criteria.

Table 2–13
Quality Control Method Criteria for TNT by SW-846 4050 and RDX by SW-846 4051 by Immunoassay Test Kit

Procedure	Frequency of QC Procedure	Acceptance Criteria	Corrective Action
Calibration	Daily or each time Dtechtor is turned on	Manufacturer calibrator as pass/fail.	If unit displays "ERR" or turns off, remove calibrator and retry holding firmly. If still fails use second calibrator.
Reference Check	Each Sample	Using Manufacturer Calibrator Reference: TNT: 210–250 RDX: 320–360	If outside reference range, re-calibrate and re-analyze. If the reference side reading is above target range, further color development time is required.
Preparation blank	1 per batch per matrix	No target analytes below 5% of the decision limit, 5% of the sample concentrations, or the MDL, whichever is higher.	Documented source of contamination.
Laboratory Control Sample	Every batch samples for all compounds (Advisory limits)	70%≤%Rec.≤130%	Re-calibrate, Qualify associated data biased high or biased low as appropriate.
Sample duplicate	1 per 10 samples per matrix (Advisory Limits)	%RPD<100% soil; <50% aqueous	If duplicate %RPD does not meet criteria, re-analyze or qualify data as applicable.

3.0 HEALTH AND SAFETY PLAN ADDENDUM

3.1 OBJECTIVE AND SCOPE

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

This addendum addresses site-specific training, 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

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

All IT Corporation 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 the Main Manufacturing Area and the NRU 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 IT Corporation personnel, USAEC, and subcontractor personnel of the hazards and control techniques associated with facility-wide background locations.

3.2.1 Hazard Information Training

Hazard information training will be presented to IT Corporation and subcontractor personnel to provide a description of the Hazardous, Toxic, Radioactive Waste (HTRW) with the potential to be found at the Main Manufacturing Area and the NRU. 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 RFAAP.

3.2.2 Project-Specific Hazard Analysis

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

Physical Hazards

- Heat stress—refer to Section 3.2.1 of the MWP;
- Manual lifting—refer to Section 3.2.4 of the MWP; and
- 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.

Biological Hazards (refer to Section 3.3 of the MWP)

- Insect bites and stings
- Tick bites
- Snake bites
- Plants

3.2.3 Hearing Conservation Training

All 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, IT Corporation 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 IT Corporation's HAZCOM program (HS060 in IT Corporation 1999) 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 all site personnel. All personnel on site will be required to follow safe work practices contained in this section, and immediately notify the SHSO of any 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

PPE will be required during all fieldwork. The minimum and initial level of PPE for these activities will be Modified Level D. An action level between 1 and 5 ppm above background will cause the level of PPE to be upgraded to Level C. 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, all personnel working on site will be required to participate in IT Corporation's written respiratory protection program (HS601 in IT Corporation 1999). All 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 all sampling activities, the SHSO will monitor the site initially and continuously for potentially hazardous airborne contaminants or physical hazards using a PID, which will be used to detect organic vapors. The PID will be calibrated in accordance with the manufacturer's calibration instructions. Draeger tubes may be used to monitor for specific contaminants based on the readings from the other instruments, as appropriate. The action levels for volatile organics at sustained concentrations in the breathing zone are as follows:

PID Readings	Action
Background to (background + 1 ppm)	Continue work, monitor
(Background + 1 ppm) to (background + 5 ppm)	Upgrade to Level C PPE
>(Background + 5 ppm)	Stop work, investigate

4.0 REFERENCES

Barbour, G.B., Burk, J.H., and Pitts, W.D. 1987. *Terrestrial Plant Ecology.* 2nd ed.

Dames & Moore. 1992. Final Draft Verification Investigation. Prepared for U.S. Army Toxic and Hazardous Materials Agency, Radford Army Ammunition Plant. October.

Dietrich, R.V. 1990. Geology and Virginia. Commonweath of Virginia Department of Mines, Minerals and Energy, Division of Mineral Resources. The University Press of Virginia.

Environmental Photographic Interpretation Center (EPIC). 1992. Installation Assessment, Radford, Army, Ammunition Plant, Radford, VA. Prepared for the U.S. Environmental Protection Agency.

ICF Kaiser Engineers, Inc. (ICF KE). 1998a. Master Work Plan, Draft Final, Radford Army Ammunition Plant. Prepared for the U.S. Army Environmental Center, Aberdeen Proving Ground, MD.

ICF Kaiser Engineers, Inc. (ICF KE). 1998b. Site Management Plan, Radford Army Ammunition Plant, Virginia. Prepared for the U.S. Army Environmental Center, Aberdeen Proving Ground, MD.

IT Corporation. 1999. Safety and Health Requirements Manual.

National Climatic Data Center (NCDC). 1999. Monthly Precipitation Data for U.S. Cooperative and NWS Sites.

New River Valley Planning District Commission (NRVPC). 1994. Virginia's New River Valley Regional Databook.

Parsons Engineering-Science, Inc. (Parsons). 1996. RCRA Facility Investigation Work Plan for Solid Waste Management Units 17, 31, and 48 and Corrective Measures Study Work Plan for Unit 54 at Radford Army Ammunition Plant. Prepared for the U.S. Army Environmental Center.

Schultz, A.P. 1986. Max Meadows Tectonic Breccia at Pepper, Virginia. Geolgoical Society of America Centennial Field Guide, Southeastern Section.

Soil Conservation Service (SCS). 1985. Soil Surveys of Montgomery and Pulaski Counties, Virginia. U.S. Department of Agriculture.

Thornbury, W.D. 1965. Regional Geomorphology of the United States. John Wiley and Sons, Inc.

U.S. Environmental Protection Agency (USEPA). 1996. Test Methods for Evaluating Solid Waste Physical/Chemical Methods, Update III. December.

Appendix A

Standard Operating Procedures

STANDARD OPERATING PROCEDURE 30.13
D TECH RDX/TNT EXPLOSIVES TEST KIT

1.0 SCOPE AND APPLICATION

The purpose of this standard operating procedure (SOP) is to delineate protocols for field operations of the D TECH RDX/TNT explosives field test kits. The screening kits are designed to provide quick, semi-quantitative, and reliable test results for making environmental decisions.

The D TECH system for analyzing trace amounts of RDX/TNT is based on immunoassay technology. This technique uses an antibody as an analytical reagent. An antibody specific for RDX/TNT compounds has been linked to solid particles which are collected on the membrane of the cup assembly. A color developing solution added to the surface of the cup assembly develops a color inversely proportional to the concentration of RDX/TNT equivalents in the sample (less color indicates more RDX/TNT present in the sample). RDX/TNT equivalents are measured in parts per million (ppm) in soil and parts per billion (ppb) in aqueous samples. The D TECH RDX test kit has a working range of 0.5 to 6.0 ppm in soil and 5 to 45 ppb in water, while the TNT test kit has a working range of 0.5 to 5.0 ppm in soil and 5 to 45 ppb in water.

2.0 MATERIALS

- D TECH RDX or TNT test kit
- D TECH RDX/TNT soil extraction pac
- DTECHTOR meter
- Timing device
- Latex or nitrile gloves
- Liquid and solid waste containers
- Marking pen

3.0 PROCEDURE

3.1 EXTRACTION PROCEDURE

The D TECH RDX/TNT Soil Extraction Pac measures sample size using an efficient and economical volumetric technique. As with weight-based measurements, volumetric measurements of soils in field testing applications are not absolute and are subject to the influence of moisture content, organic matter content, soil type, etc. Variation in sample size can be minimized be ensuring the soil sampling tube is evenly filled. The sample size of the sampling tube is 3 cubic centimeters, which is equivalent to an average of 4.5 grams of dry soil.

1. Break up the soil so that it is a **uniform** sample. To achieve a more homogenous distribution and to insure reproducible test results, the soil sample should be mixed thoroughly. Remove all debris, such as sticks, stones, and leaves, prior to using the D TECH soil sampling tube. Sandy soil requires a scooping action to fill the tube. Squeezing the barrel of the soil sampling tube will help to expel a tightly packed sample. Extraction of RDX and TNT is more effective if the soil is broken into sections during the addition to **Bottle 1**. **Bottle 1** contains acetone. Due to the volatile nature of acetone, bottles should be kept capped to minimize evaporation.

   Draw back the soil sampling tube plunger until it stops. Push the soil sampling tube into the soil several times with a twisting action to firmly pack and fill the tube. Remove excess soil from the external surface of the sampling tube and barrel end.

2. Dispense the soil into **Bottle 1** by positioning the barrel into the neck of the bottle and firmly pushing the plunger. If soil lodges in the neck of the bottle, use the sampling tube to push it into the bottle. If soil adheres to the threads of the bottle neck and cap, wipe clean before placing cap on the bottle. Cap bottle tightly.

3. Mix the soil and liquid in **Bottle 1** by shaking continuously over a 3-minute period. *Note:* Some soil, especially clays, may require extremely rigorous shaking during extraction. If after three minutes the soil plug is not uniformly dispersed, continue shaking with a rigorous top to bottom motion until the sample disperses. This may take up to five minutes.

4. Allow the soil to settle until a clear, liquid layer forms. Some soils will settle more slowly than others. *Note:* Certain clays and other soils may require up to thirty minutes to cleanly separate.

5. Remove cap from **Bottle 2.**

6. Place an unused tip on the pipetter.

7. Fully depress the plunger of the pipetter. With the plunger fully depressed, place the pipette tip into the clear, liquid layer and slowly release the plunger. Take care not to aspirate any soil.

8. Dispense the contents of the pipette tip into **Bottle 2** by placing the pipette tip into the liquid and depressing the plunger. Mix **Bottle 2** thoroughly. Replace the cap tightly on **Bottle 1** and return it to the tray. Place the used pipette tip in the right side tray compartment.

9. Use **Bottle 2** as a sample in Step 1 under Testing Procedure for analysis. If the last extraction has been performed, place the "Used Kit" label on the soil extraction pac box to seal it shut. *Helpful hint:* Cap **Bottle 2** tightly and return it to the tray. Red dot labels have been provided to indicate used **Bottle 2** components.

3.2 RDX TESTING PROCEDURE

1. Using a new calibrated pipette, transfer **1 mL** of **Bottle 2** solution from the soil extraction pac to **Bottle A**; snap filter tip on **Bottle A**. Gently mix. Re-cap **Bottle 2** and set aside. *Note:* The vials in the next two steps need to stand 5 minutes after dispensing the liquid. The solutions in these vials will remain hazy.

2. Squeeze **Bottle A** filling the **RDX** vial to a level between the two lines (approximately 13-14 drops). Gently mix.

3. Squeeze the contents of **Reagent C** (white cap) to fill the **RDX Reference** vial to a level between the 2 lines. Gently mix.

4. After 5 minutes, pour contents of **RDX** vial onto **T** (test) side of the cup assembly. Pour the contents of **Reference** vial onto the **R** side of the cup assembly. Allow liquid to drain completely through on both sides.

5. Add approximately 8-12 drops of **Reagent D** solution (yellow cap) into each side of the cup assembly. Drain completely.

6. Add approximately 5 drops of **Reagent E** solution (blue cap) to each side of the cup assembly. Be sure to add this solution immediately to the second well after addition to the first well. Drain completely.

7. Read results when color of **R** (left) side of cup assembly matches the color of the reference bar of the **Color Card**. *Note:* The color development time is approximately 10 minutes at 70° F. More time is required at lower temperatures and less time is required for higher temperatures.

   Color Card: Match the color on the **T** side of the cup assembly to the **Color Card**. *Note:* A red or pinkish tint in the acetone may indicate a very high level of TNT contamination. Extreme care should be used when handling these samples.

   DTECHTOR: Quantitate the result using the DTECHTOR Meter (see Instrument Operator's Guide for complete instructions).

   See Interpretation of the Test section (page 3) to determine concentration of RDX Equivalents. Record result on a **Cup Assembly** label and apply to the cup.

   Note: To preserve the color for up to 4 hours (optional), add approximately 8 drops of **Reagent F** solution (red cap) into each side of the cup assembly. Drain completely.

8. DTECHTOR Meter Set Up

   The DTECHTOR light sources must be calibrated whenever the meter is turned on. Calibrators are provided with the meter for this purpose. The **Calibrator** must be clean and white to insure valid results.

Step A: Insert **Calibrator** into the **Meter Head** and hold firmly in place. The meter should display....ZERO.

Step B: Press the Square Button 1 time. When the calibration is complete the meter will display....SET.

Step C: Remove Calibrator and return it to its protective canister.

Step D: Press the Square Button 2 times to select meter program **# 2 (Program to be used for D TECH RDX test kit).** Display will read....SET # 2.

Press the Square Button 1 time to select meter program **# 1 (the Program to be used for the D TECH TNT test).** Display will read....SET # 1.

Step E: Insert Cup Assembly (test) into the Meter Head and firmly hold in place. Display will read.... TEST # 1.

Step F: To read the reference color, double click the Red Square Button (as you would with a computer "mouse") to determine the color of the reference well.

Notes:

a) If the user either double-clicks too slowly or inadvertently presses the Square Button once, the meter will display – then the reading (e.g. 64%). This inadvertent result should be disregarded (considered erroneous). Note that the meter will however store this erroneous result into its memory. The user can return to Step E by removing the cup assembly and pressing the Red Square Button then the slide (on/off) switch.

b) Multiple cup assemblies can be monitored simultaneously. Removing a cup assembly when a reference value is being displayed returns the user to Step E.

Step G: If the reference reading is between 210 and 250 for TNT and 320 and 360 for RDX proceed to Step H. Otherwise, the device needs to develop longer. Wait approximately 30 seconds and repeat Step F. *Note:* If the reference side reading is below the target range, color development has proceeded too long. If this situation occurs, the test should be rerun. The most accurate result interpretation is achieved when the test is read when the reference side reading is within the target range.

Step H: Press the Square Button 1 time. *Note:* If the meter displays "WAIT," remove the Cup Assembly. Allow the reference color to develop further and try again.

Obtain the meter reading. Use the **DTECHTOR** Table (**Table 1**) and the meter reading to determine the concentration of RDX.

TABLE 1
RDX DTECHTOR TABLE

Sample	DTECHTOR Reading	RDX Equivalents
Water (ppb)	LO	< 5
	1 - 30	5 - 15
	30 - 50	15 - 25
	50 - 80	25 - 45
	HI	> 45
Soil (ppm)	LO	<0.5
	1 - 20	0.5 - 1.5
	20 - 45	1.5 - 2.5
	45 - 60	2.5 - 4.5
	60 - 80	4.5 - 6.0
	HI	> 6.0

Step I: Record result then press **Square Button** 1 time while holding the **Cup Assembly** in place.

Step J: (Optional) Key in a 4 digit sample ID code number. (This feature can be used for sample identification if the data is to be downloaded to a computer).

Step K: Remove **Cup Assembly**.

Step L: Insert next **Cup Assembly** (test) and repeat Steps E - K.

9. The results from the D TECH RDX Explosives Test Kit can be interpreted using either the Color Card supplied with the kit or the **DTECHTOR** and the table provided below. If the color of the test does not exactly match a panel of the color card, user interpretation is required.

10. A positive test result may be due to the presence of RDX, HMX or a mixture of these compounds (RDX Equivalents). Samples testing positive for RDX may be confirmed by standard methods. The D TECH RDX Explosives Test Kit has been designed to minimize the effect of environmental interferences. Sample pH, nitrate, nitrite and ammonium do not effect test results.

11. RDX concentrations greater than the upper limit of the test may be determined by diluting the extract with acetone. For example, an extract from a 100 ppm soil sample, processed using the D TECH TNT/RDX Soil Extraction Pac, may be diluted 1:25 in acetone and run in the D TECH RDX Explosives Test Kit. The concentration of the undiluted sample (100ppm) is determined by multiplying the RDX concentration of the diluted sample (4.0ppm) by the dilution factor (25). For further information, please call the technical service hot line 1-800-222- 0342.

3.3 TNT TESTING PROCEDURE

1. Using a clean calibrated pipette, transfer **1.0 mL** of **Bottle 2** solution from the soil extraction pac to **Bottle A**. Snap a filter tip on **Bottle A** and gently mix by inverting three times. Re-cap **Bottle 2** and set aside.

Note: The vials in the next two steps need to stand 2 minutes (+/- 15 minutes) after liquid is dispensed into them. The solutions in these vials will remain hazy.

2. Squeeze **Bottle A** filling the **TNT Test Vial** (gray stopper) to a level between the two lines (approximately 13 - 14 drops). Gently mix by shaking the vial in a back and forth motion. Immediately proceed to step 3.

3. Squeeze the contents of **Reagent C** (white cap) to fill the **TNT Reference** vial (red stopper) to a level between the 2 lines. Gently mix. *Note:* Reconstitute the REFERENCE VIAL IMMEDIATELY after sample addition to the test vial. If analyzing several samples simultaneously, reconstitute a reference vial at the same time each test (sample) vial is filled.

4. After 2 minutes (+/- 15 seconds) pour contents of the TNT Test Vial into the **T** (test) side of the cup assembly. Immediately pour the contents of the **Reference Vial** into the **R** side of the cup assembly. Drain completely. *Note:* The next four steps use dropper-tipped bottles. When dispensing these reagents, do not allow any dropper tip to contact any solution(s) or surface in the cup assembly. To assure uniform color development across the cup assembly, dispense the drop onto the sloped side of the well to lesson its impact. Do not allow the drop to fall into the middle of the well.

5. Add 10 drops (+/- 2 drops) of **Reagent D** solution (yellow cap) into each side of the cup assembly. Drain completely.

6. Add 5 drops (+/- 1 drop) of **Reagent E** solution (blue cap) to each side of the cup assembly. Be sure to add this solution immediately to the second well after addition to the first well. Drain completely.

7. Read the Reference Color. If using the **DTECHTOR** meter, proceed directly to **DTECHTOR** Meter Set Up, Section 3.2, Step 8 of RDX testing procedure.

   If using the Color Card, compare the color of the **R** (left) side of the cup assembly to the reference bar of the **Color Card**. When the color of the **R** Side matches the reference bar, the color development process should be stopped. Proceed to Step 8.

8. Add 8 drops (+/- 2 drops) of **Reagent F** solution (red cap) into each side of the cup assembly. Drain completely. Now determine the TNT concentration of the sample. *Note:* The color in both wells is stable for approximately four hours.

9. The results from the D TECH TNT Explosives Test Kit can be interpreted using either the **Color Card** supplied with the kit or the **DTECHTOR** and **Table 2** provided below. If the color of the test does not exactly match a panel of the color card, user interpretation is required.

   To use the **Color Card**, match the color on the **T** side of the cup assembly to the **Color Card** using the appropriate soil and water color bars. If the color of the test does not exactly match a panel of the color card, user interpretation is required. *Note:* A red or pinkish tint in the acetone may indicate a very high level of TNT contamination. Extreme care should be used when handling these samples.

Determine the % relative reflectance using the **DTECHTOR** (see Instrument Operator's Guide for complete instructions). Use the conversion table to determine the concentration range of TNT Equivalents in the sample.

TABLE 2
TNT DTECHTOR TABLE

Sample	DTECHTOR Reading	Total TNT Equivalents
Water (ppb)	LO	< 5
	1 - 30	5 - 15
	30 - 50	15 - 25
	50 - 75	25 - 45
	HI	> 45
Soil (ppm)	LO	<0.5
	1 - 15	0.5 - 1.5
	15 - 45	1.5 - 3.0
	45 - 60	3.0 - 4.0
	60 - 75	4.0 - 5.0
	HI	> 5.0

Important Notes:

a) The D TECH TNT Test Kit has been tested for cross-reactivity with structurally similar compounds, degradation products, other explosives, and priority pollutants. A positive test result may be due to the presence of TNT, cross reactants or mixtures of these compounds. Samples testing positive for TNT may be confirmed by standard methods. The D TECH TNT Test Kit has been designed to minimize the effect of environmental interferences.

b) All enzyme immunoassays are temperature dependent. At cooler temperatures, the color development step of the D TECH TNT test will take longer 10 minutes. At 60° F, color development will take approximately 20 minutes. All tests should be run until the color produced by the reference matches the bar on the color card or the target reflectance range of 210 - 250 on the DTECHTOR.

c) The TNT Test Coefficient of Variation (CV), also known as the Relative Standard Deviation (RSD), has been evaluated at various concentrations. The data indicate the average test RSD, based on the concentration, is 9%.

10. Refer to Steps A - K of the RDX testing procedure in Section 3.2 for DTECHTOR Meter set up.

4.0 HEALTH AND SAFETY

Material Safety Data Sheets (MSDS) have been supplied with the purchase of this product. The MSDS should be read before using this test. During the execution of the test, any excess RDX and TNT is absorbed into the **Cup Assembly** absorbent plug. It is not retained on the surface of the **Cup Assembly**. When all kit components have been used, apply the warning label to seal the box and set it aside for proper disposal. Protect eyes with safety glasses and protect skin with protective gloves when using these solutions. Refer to MSDS to review associated hazards, symptoms of exposure, and first aid measures that may result from the use and handling of these associated solutions. Refer to Master Health and Safety Plan (ICF KE, 1998) for health and safety measures associate with sampling procedures.

5.0 QUALITY CONTROL

Refer to Master Quality Assurance Plan (ICF KE, 1998) for quality control measures associated with sampling guidelines.

6.0 PRECAUTIONS

1. This test should be run at a temperature range of 45° to 100° F (7° to 38° C).

2. The kit may be stored at a temperature range of 40° to 100° F (4° to 38° C). Storage at higher temperatures may irreversibly damage the reagents. Do not store the kit in direct sunlight. See the lot number label for additional storage information.

3. Check the expiration date on the bottom of the kit prior to use. The expiration date is dependent on the storage temperature of the kits.

4. Reagents from different kits CANNOT be mixed.

5. Once initiated, the test should be run as quickly as possible. DO NOT STOP BETWEEN STEPS.

6. The diluted sample extract and the reference reconstitution diluent should be at approximately the same temperature prior to adding either to their respective test or reference vial.

7. This test is temperature dependent. The reference serves as an incubation time indicator. DO NOT stop the test until the color intensity produced in the reference well matches the color bar on the Color Card or the reference range equals 210 - 250 units using the DTECHTOR meter for TNT and 320 - 360 units for RDX. At 75° F, this reaction will take approximately ten minutes. The warmer the temperature, the quicker the development occurs.

7.0 REFERENCES

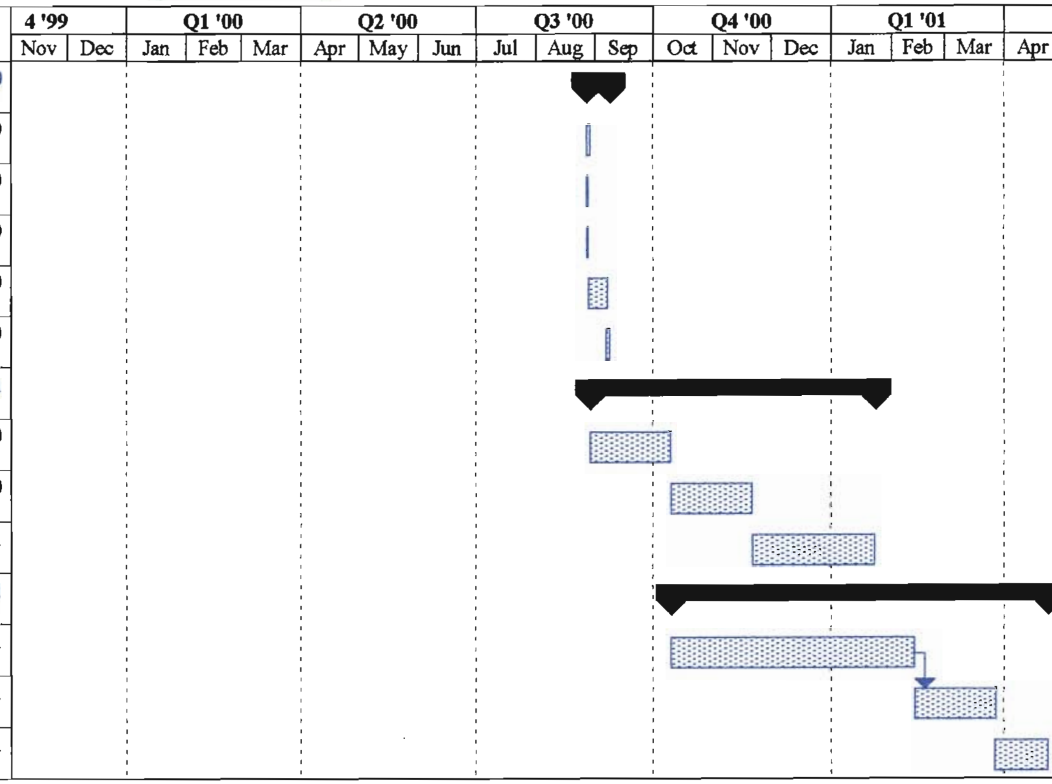
1. USEPA, 1996. Test Methods for Evaluating Solid Waste Physical/Chemical Methods, Update III. Method 4050. December, 1996.
2. USEPA, 1996. Test Methods for Evaluating Solid Waste Physical/Chemical Methods, Update III, Method 4051. December, 1996.
3. Strategic Diagnostic, Inc. D TECH TNT/RDX Soil Extraction Pac Instruction Guide.
4. Strategic Diagnostic, Inc. D TECH TNT Explosive Test Kit Instruction Guide.
5. Strategic Diagnostic, Inc. D TECH RDX Explosives Test Kit Instruction Guide.

Appendix B

Field Schedule

Radford Army Ammunition Plant
Facility-Wide Background Study

ID	Task Name	Duration	Start	Finish
1	**Investigation Program**	**10d**	**Mon 8/28/00**	**Fri 9/8/00**
2	Mobilization	2d	Mon 8/28/00	Tue 8/29/00
3	Subcontractor Badging	1d	Mon 8/28/00	Mon 8/28/00
4	Grubbing and Clearing	1d	Mon 8/28/00	Mon 8/28/00
5	Sampling	8d	Tue 8/29/00	Thu 9/7/00
6	Demobilization	2d	Thu 9/7/00	Fri 9/8/00
7	**Data Management**	**105d**	**Wed 8/30/00**	**Tue 1/23/01**
8	Sample Analysis	30d	Wed 8/30/00	Tue 10/10/00
9	Data Validation	30d	Wed 10/11/00	Tue 11/21/00
10	Data Evaluation	45d	Wed 11/22/00	Tue 1/23/01
11	**Background Report**	**139d**	**Wed 10/11/00**	**Mon 4/23/01**
12	Draft Background Study	90d	Wed 10/11/00	Tue 2/13/01
13	EPA Review	30d	Wed 2/14/01	Tue 3/27/01
14	Final Background Study	20d	Tue 3/27/01	Mon 4/23/01

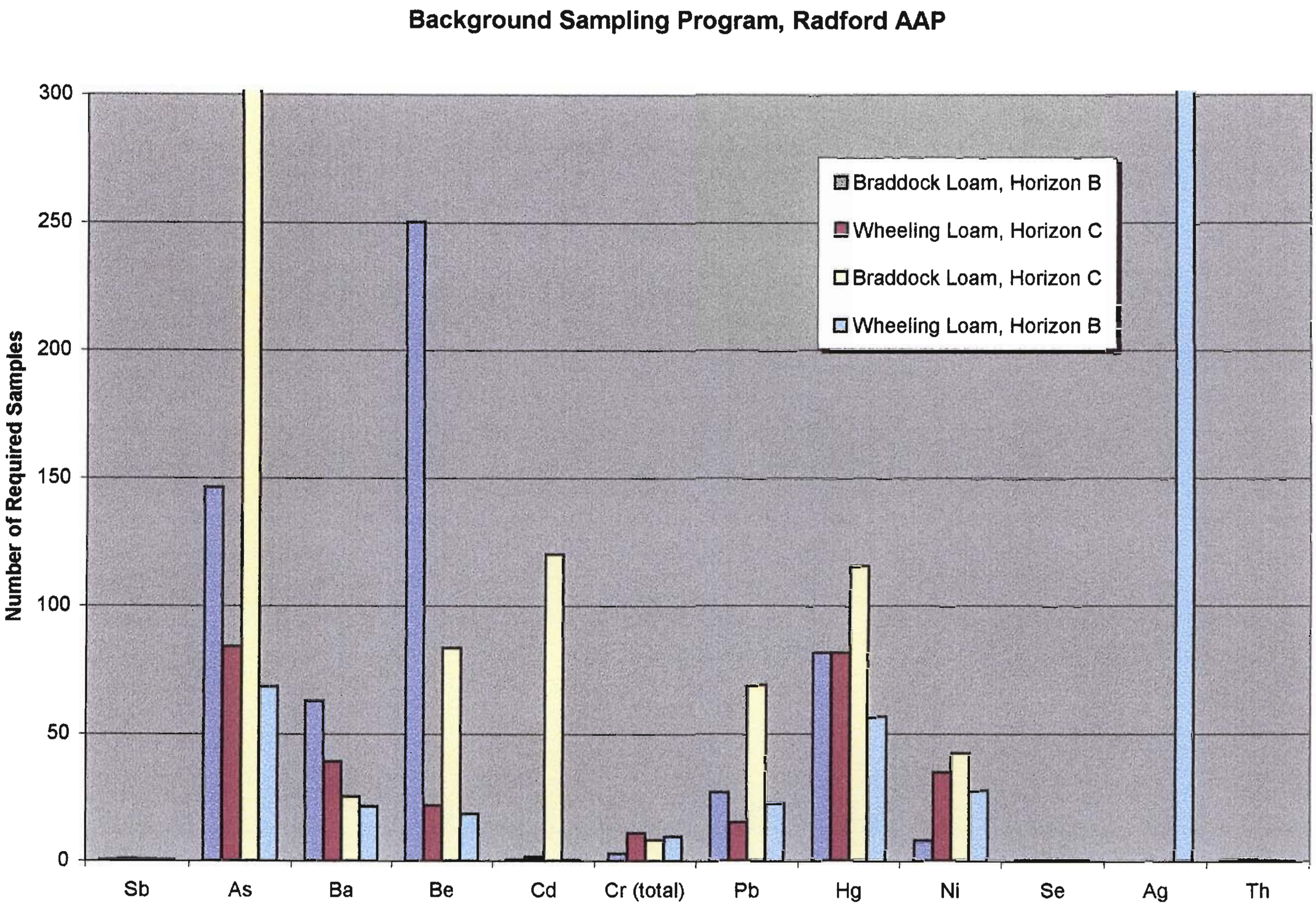


Project: RFAAP
Facility-Wide Background Study
Date: Thu 9/28/00

Task
Progress
Milestone
Summary
Rolled Up Task
Rolled Up Milestone
Rolled Up Progress

Appendix C

Evaluation of Previous Background Data



Background Sampling Program, Radford AAP
Number of Required Samples
300
250
200
150
100
50
0
Braddock Loam, Horizon B
Wheeling Loam, Horizon C
Braddock Loam, Horizon C
Wheeling Loam, Horizon B
Sb
As
Ba
Be
Cd
Cr (total)
Pb
Hg
Ni
Se
Ag
Th

3

Radford Background Data
Wheeling Loam, Horizon B

Metal	Mean	Stdev.	CV	MDRD	D	Number of Required Samples 80% C 90% P	80% C 80% P
Sb	11.78	0.22	2%	20%	10.7091	0	0
As	2.31	1.27	55%	20%	0.3638	69	43
Ba	147.2	45.09	31%	20%	0.6529	22	14
Be	1.3	0.37	28%	20%	0.7027	19	12
Cd	0.72	0.01	1%	20%	14.4000	0	0
Cr (total)	43.76	8.91	20%	20%	0.9823	10	6
Pb	19.17	6.02	31%	20%	0.6369	23	14
Hg	0.04	0.02	50%	20%	0.4000	57	36
Ni	20.86	7.25	35%	20%	0.5754	28	17
Se	0.27	0.01	4%	20%	5.4000	1	1
Ag	0.10	0.22	220%	20%	0.0909	1092	687
Th	20.61	0.38	2%	20%	10.8474	0	0

CV for chemicals with low quantitation limits (QLs) are higher than they should be because non-detects were set at 1/2 of the QL.
* Number of samples with 90% power and confidence 80%
* Number of samples with 80% power and confidence 80%

Radford Background Data
Wheeling Loam, Horizon C

						Number of Required Samples	
						80% C	80% C
Metal	**Mean**	**Stdev.**	**CV**	**MDRD**	**D**	**90% P**	**80% P**
Sb	11.55	0.55	5%	20%	4.2000	1	1
As	2.38	1.45	61%	20%	0.3283	84	53
Ba	98.82	40.95	41%	20%	0.4826	39	25
Be	0.94	0.29	31%	20%	0.6483	22	14
Cd	0.70	0.05	7%	20%	2.8000	2	1
Cr (total)	35.6	7.75	22%	20%	0.9187	11	7
Pb	16.36	4.18	26%	20%	0.7828	15	10
Hg	0.05	0.03	60%	20%	0.3333	82	51
Ni	15.57	6.09	39%	20%	0.5113	35	22
Se	0.27	0.01	4%	20%	5.4000	1	1
Ag	0.01	0.00	0%	20%	NA	NA	NA
Th	20.20	0.97	5%	20%	4.1649	1	1

CV for chemicals with low quantitation limits (QLs) are higher than they should be because non-detects were set at 1/2 of the QL.
* Number of samples with 90% power and confidence 80%
* Number of samples with 80% power and confidence 80%
NA = Division by zero

Radford Background Data
Braddock Loam, Horizon B

Metal	Mean	Stdev.	CV	MDRD	D	Number of Required Samples 80% C 90% P	80% C 80% P
Sb	11.94	0.22	2%	20%	10.8545	0	0
As	2.55	2.05	80%	20%	0.2488	146	92
Ba	117.61	61.89	53%	20%	0.3801	63	40
Be	0.57	0.6	105%	20%	0.1900	250	157
Cd	0.73	0.02	3%	20%	7.3000	1	0
Cr (total)	42.41	4.56	11%	20%	1.8601	3	2
Pb	17.08	5.86	34%	20%	0.5829	27	17
Hg	0.05	0.03	60%	20%	0.3333	82	51
Ni	12.59	2.31	18%	20%	1.0900	8	5
Se	0.28	0.01	4%	20%	5.6000	1	1
Ag	0.01	0.00	0%	20%	NA	NA	NA
Th	20.89	0.38	2%	20%	10.9947	0	0

CV for chemicals with low quantitation limits (QLs) are higher than they should be because non-detects were set at 1/2 of the QL.
* Number of samples with 90% power and confidence 80%
* Number of samples with 80% power and confidence 80%
NA = Division by zero

Radford Background Data
Braddock Loam, Horizon C

						Number of Required Samples	
						80% C	80% C
Metal	**Mean**	**Stdev.**	**CV**	**MDRD**	**D**	**90% P**	**80% P**
Sb	12.17	3.00E-01	2%	20%	8.1133	0	0
As	4.26	5.45	128%	20%	0.1563	370	232
Ba	135.34	45.04	33%	20%	0.6010	25	16
Be	1.58	0.96	61%	20%	0.3292	84	53
Cd	1.18	0.86	73%	20%	0.2744	120	76
Cr (total)	43.15	8.11	19%	20%	1.0641	8	5
Pb	24.07	13.28	55%	20%	0.3625	69	44
Hg	0.07	0.05	71%	20%	0.2800	115	73
Ni	26.42	11.39	43%	20%	0.4639	42	27
Se	0.28	0.01	4%	20%	5.6000	1	1
Ag	0.01	0.00	0%	20%	NA	NA	NA
Th	21.30	0.52	2%	20%	8.1923	0	0

CV for chemicals with low quantitation limits (QLs) are higher than they should be because non-detects were set at 1/2 of the QL.
* Number of samples with 90% power and confidence 80%
* Number of samples with 80% power and confidence 80%
NA = Division by zero

Appendix D

Statement of Qualifications

STATEMENTS OF QUALIFICATIONS

Rick Swahn, is a registered professional geologist with more than sixteen years experience managing large Army HTRW environmental projects throughout the USACE North Atlantic District (NAD), most of them cost reimbursable. Mr. Swahn has managed as well as performed all aspects of these projects to include preliminary assessments, site investigations, RI/FS studies, proposed plan and ROD decision documents, remedial action planning and design, and military installation compliance activities. Throughout his career, Mr. Swahn's responsibilities have included scoping, estimating, scheduling, and managing numerous multi-tasked, multi-disciplined projects most budgeted in the multi-million dollar range. Currently, Mr. Swahn is managing the preparation of an EE/CA decision document of the Colonie FUSRAP site, located in Albany, NY for the NAD under the Baltimore TERC.

Davida Trumbo, CQE, CQA, is a Project Manager with 16 years of quality assurance/quality control experience associated with installation restoration, hazardous waste characterization and management, remedial investigation and feasibility studies, chemical analyses, data validation, and development and validation of analytical methodologies. Ms. Trumbo has directed quality assurance program activities in support of the Department of Defense (AEC, AFCEE, NEESA), Environmental Protection Agency (OERR, OGWDW, OPP), Department of Energy (HQ), state and private clients. Additionally, Ms. Trumbo has planned, coordinated, and managed financial and human resources for AEC Base Realignment and Closure (BRAC) projects. Work assignments included defining the nature, magnitude, and extent of environmental contamination; developing sufficient information to adequately assess health and environmental risks associated with closure and transfer of Army real property for other uses; determining the necessity for remedial actions; and developing and evaluating remedial action alternatives to the level necessary for the Army to make rational decisions regarding preparation of real property for release. Ms. Trumbo has been selected to present quality assurance papers at the American Chemical Society (ACS) regional meetings, EPA QA symposia and work groups, and the Superfund conference.

Sue Reinhardt is a Contract Specialist with six years of experience in finance, contracts, and business planning. She holds a B.B.A. in finance from James Madison University, Harrisonburg, Virginia, and a M.S.B. in International Business from Johns Hopkins University, Baltimore, Maryland. At the IT Corporation, Ms. Reinhardt is currently working under two multi-task order projects for the U.S. Army. The contracts total over $50M and work is performed at various Army installations in the U.S. Ms. Reinhardt is the contract, subcontract, and financial manager for these programs. Ms. Reinhardt also provides the property and warehouse management for these programs. In addition, she provides business unit financial support for the Abingdon/Edgewood office. Ms. Reinhardt has recently increased her responsibilities by assisting the Director of Finance in the EEG Southeast reporting capacity.

Jeffrey Hutchens, CSP is a Health and Safety Manager with over seventeen years of experience. Following nine years of naval service, he continued to expand his safety experience to include the identification, handling, and disposal of multiple hazard, radioactive and chemically hazardous materials; ergonomic injuries, loss control management and safe behavior management. These projects have encompassed commercial production/manufacturing and government facilities. Areas of responsibility have been in the fields of industrial and construction safety, industrial hygiene, health physics, and environmental regulatory compliance. In addition to health and safety responsibilities, he has provided management for disposal of mixed and radioactive wastes from characterization through waste acceptance to permitting variances. Mr. Hutchens is currently serving as the program health and safety manager for the US Army Corps of Engineers Baltimore District TERC and ESPS contracts.

Mark Thomas is a Biologist and has been involved in the field of biology for the past nine years. His academic background includes a strong emphasis on both wildlife and fisheries management. Mr. Thomas has gained considerable and valuable field experience during his tenure with the ICF Kaiser and the IT Corporation. He has served as the Field Operations Leader, Field Team Leader and Site Health and Safety Officer for the sampling of sediment, sludge, surface soil, subsurface soil, surface water, groundwater, air, fish, and crabs. Mr. Thomas is skilled in the areas of technical report writing, water quality analysis, Global Positioning System (GPS) and LORAN operation, necropsy techniques, and motor boat operation, navigation, and maintenance. Mr. Thomas is also experienced in the collection and identification of estuarine fish, plants, and invertebrates. Before joining the IT Corporation, Mr. Thomas was employed by the Maryland Department of Natural Resources under the Fisheries Division where he gained valuable field sampling and research experience.

Dave Kateley is a Construction Quality Control Systems Manager, has over twenty years of experience in environmental management. He has served as a Site Safety Officer, Hazardous Materials Specialist, Construction Superintendent/Site Safety Officer, and Construction Engineer. Mr. Kateley acted as the Safety Officer at the Hunter Army Airfield tank removal and site remediation project at Fort Drum, New York. The project demanded close interactions with the U.S. Army Corps of Engineers and implementation of all related safety concerns. Duties included daily safety meetings, site sampling, and keeping all records and logs pertaining to the safety program. As a Construction Superintendent and Site Safety Officer, Mr. Kateley supervised the construction of the out buildings and fencing at the G Street Superfund project on Aberdeen Proving Grounds, Edgewood Area. He incorporated procedures dealing with Superfund and hazardous waste sites, as in air monitoring, donning/doffing levels A through C PPE, and writing the Site Specific Safety Plan. As a Construction Engineer, Mr. Kateley was responsible for all construction layout procedures, including the use of transits and building levels for grade and line. He also coordinated subcontract work for various multi-million dollar contracts.

Eric Malarek is a Chemist for the IT Corporation. His primary responsibilities include project chemical management, consulting, and technical support for a variety of public and private environmental projects. He has over 10 years of professional experience in the environmental testing field including laboratory management, quality assurance and quality control, data management, field sampling, and methods development. This includes three years of managing a laboratory and seven years as Quality Assurance Officer. His experience with the laboratory covers environmental analysis for sample matrices including groundwater, surface water, drinking water, soil, sediment, sludge, and waste. His familiarity with laboratory methods includes CLP Statements of Work, USEPA 500- and 600-Series Organic Methods, SW-846 Test Methods for Evaluating Solid Waste, Standard Methods for the Examination of Water and Wastes, and Methods for Chemical Analysis of Water and Waste. As QA Officer, he has written and implemented FLDEP Laboratory Quality Assurance Plans and Site-Specific Quality Assurance Project Plans. He has served as the Laboratory CLP Coordinator for Inorganics with the USEPA CLP Program. Mr. Malarek has performed system and performance audits and implemented corrective action procedures. In addition, he was involved in data reduction, review, and validation to ensure date integrity to meet the data quality objectives. He also was employed by the USEPA to perform inorganic analysis on environmental samples. He holds a Bachelor's degree in Chemistry from Rutgers University and a MBA degree from the University of Central Florida.

Kweku Acquah is a Chemist with the IT Corporation, Edgewood, Maryland office. His primary responsibility includes project chemical data management and validation, consulting, and technical support for a variety of environmental projects. He has over twenty years of industrial experience in various capacities with responsibilities for process and quality control management, research and development, instrumental and wet chemical analysis, laboratory management, environmental compliance, environmental site assessment and characterization, chemical waste characterization, lab-packing, manifesting and coordinating hazardous waste disposal activities. He has worked for such reputable companies as General Electric Company in Liverpool, NY, Polaroid Corporation in New Bedford and Norwood, MA, SGS/Commercial Testing & Engineering in Dundalk, MD, Chem Clear of Baltimore (Clean Harbor) in Baltimore, MD and Chemical Waste Management at DOD sites at APG, Aberdeen, MD, Bermuda, Puerto Rico and the US Virgin Islands. He holds a Bachelor's degree in Chemistry and Environmental Science from Syracuse University and also undertook some graduate studies in Analytical Chemistry and Economics at Northeastern University in Boston, MA.

Greg Zynda is a Geologist with four years experience with IT Corporation performing environmental site investigations. His experience has included oversight for UST, dry well, and contaminated soil excavation, and sampling of groundwater, surface water, soil, sediment, sludge, and investigative derived waste. He has collected soil and groundwater samples using geoprobe techniques. Mr. Zynda has performed oversight for the installation of monitoring wells in unconsolidated materials and shale bedrock using hollow stem auger, mud rotary, and air rotary techniques. He has assisted with the delineation of VOC contamination in unconsolidated aquifer materials and in shale bedrock. Mr. Zynda has worked at nine DOD sites located in New Jersey, New York, Maryland, Tennessee, and Nebraska. He has worked on work plans and reports for site investigations, site remediation, and UST closures, including data management and data analysis. Prior to joining IT Corporation, Mr. Zynda was employed by Malcolm Pirnie, Inc. for three years as a soil laboratory and field technician where responsibilities included testing of physical soil properties, assisting with a pilot leachate treatability study for a municipal landfill, and groundwater and soil sampling.