Final
Site Inspection
CC RVAAP-77 Building 1037 Laundry Waste Water Sump
Revision 0

Former Ravenna Army Ammunition Plant
Portage and Trumbull Counties, Ohio

February 11, 2015

Contract No. W912QR-04-D-0039
Delivery Order: 0004

Prepared for:

US Army Corps of Engineers®

United States Army Corps of Engineers
Louisville District
600 Martin Luther King Jr. Place
Louisville, Kentucky 40202-2267

Prepared by:

Environmental Chemical Corporation
33 Boston Post Road West
Suite 420
Marlborough, Massachusetts 01752

This page intentionally left blank.

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

1. REPORT DATE *(DD-MM-YYYY)*	**2. REPORT TYPE**	**3. DATES COVERED** *(From - To)*
11-02-2015	Technical	December 2011 - February 2015

4. TITLE AND SUBTITLE
Final Site Inspection
CC RVAAP-77 Building 1037 Laundry Waste Water Sump
Former Ravenna Army Ammunition Plant
Portage and Trumbull Counties, Ohio

5a. CONTRACT NUMBER
W912QR-04-D-0039

5b. GRANT NUMBER
NA

5c. PROGRAM ELEMENT NUMBER
NA

6. AUTHOR(S)
Easterday, Al (Environmental Chemical Corporation)
Gina Calderone (Environmental Chemical Corporation)

5d. PROJECT NUMBER
5161.004

5e. TASK NUMBER
Delivery Order No. 0004

5f. WORK UNIT NUMBER
NA

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
Environmental Chemical Corporation
33 Boston Post Road West
Suite 420
Marlborough, Massachusetts 01752

8. PERFORMING ORGANIZATION REPORT NUMBER
NA

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)
United States Army Corps of Engineers
Louisville District
600 Martin Luther King Jr. Place
Louisville, Kentucky 40202-0059

10. SPONSOR/MONITOR'S ACRONYM(S)
USACE

11. SPONSORING/MONITORING AGENCY REPORT NUMBER
NA

12. DISTRIBUTION AVAILABILITY STATEMENT
Reference distribution page.

13. SUPPLEMENTARY NOTES
None.

14. ABSTRACT
This Site Inspection (SI) report documents the SI activities conducted at CC RVAAP-77 Building 1037 Laundry Waste Water Sump at the former Ravenna Army Ammunition Plant, Portage and Trumbull counties, Ohio. The purpose of the SI was to determine the presence or absence of contamination and whether the Building 1037 Laundry Waste Water Sump Area of Concern (AOC) warranted further investigation pursuant to the Comprehensice Environmental Response, Compensation and Liability Act (CERCLA) of 1980. The sampling completed for this SI indicates there is no contamination present at Building 1037 Laundry Waste Water Sump AOC that would warrant further investigation. This SI report recommends No Further Action.

15. SUBJECT TERMS
Site Inspection, Building 1037, waste water sump, CERCLA, No Further Action

16. SECURITY CLASSIFICATION OF:			**17. LIMITATION OF ABSTRACT**	**18. NUMBER OF PAGES**	**19a. NAME OF RESPONSIBLE PERSON**
a. REPORT	**b. ABSTRACT**	**c. THIS PAGE**	SAR	19,630	Al Easterday
U	U	U			**19b. TELEPONE NUMBER (*Include area code*)** 508-229-2270 x22109

INSTRUCTIONS FOR COMPLETING SF 298

1. REPORT DATE. Full publication date, including day, month, if available. Must cite at least the year and be Year 2000 compliant, e.g. 30-06-1998; xx-06-1998; xx-xx-1998.

2. REPORT TYPE. State the type of report, such as final, technical, interim, memorandum, master's thesis, progress, quarterly, research, special, group study, etc.

3. DATES COVERED. Indicate the time during which the work was performed and the report was written, e.g., Jun 1997 - Jun 1998; 1-10 Jun 1996; May - Nov 1998; Nov 1998.

4. TITLE. Enter title and subtitle with volume number and part number, if applicable. On classified documents, enter the title classification in parentheses.

5a. CONTRACT NUMBER. Enter all contract numbers as they appear in the report, e.g. F33615-86-C-5169.

5b. GRANT NUMBER. Enter all grant numbers as they appear in the report, e.g. AFOSR-82-1234.

5c. PROGRAM ELEMENT NUMBER. Enter all program element numbers as they appear in the report, e.g. 61101A.

5d. PROJECT NUMBER. Enter all project numbers as they appear in the report, e.g. 1F665702D1257; ILIR.

5e. TASK NUMBER. Enter all task numbers as they appear in the report, e.g. 05; RF0330201; T4112.

5f. WORK UNIT NUMBER. Enter all work unit numbers as they appear in the report, e.g. 001; AFAPL30480105.

6. AUTHOR(S). Enter name(s) of person(s) responsible for writing the report, performing the research, or credited with the content of the report. The form of entry is the last name, first name, middle initial, and additional qualifiers separated by commas, e.g. Smith, Richard, J, Jr.

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES). Self-explanatory.

8. PERFORMING ORGANIZATION REPORT NUMBER. Enter all unique alphanumeric report numbers assigned by the performing organization, e.g. BRL-1234; AFWL-TR-85-4017-Vol-21-PT-2.

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES). Enter the name and address of the organization(s) financially responsible for and monitoring the work.

10. SPONSOR/MONITOR'S ACRONYM(S). Enter, if available, e.g. BRL, ARDEC, NADC.

11. SPONSOR/MONITOR'S REPORT NUMBER(S). Enter report number as assigned by the sponsoring/ monitoring agency, if available, e.g. BRL-TR-829; -215.

12. DISTRIBUTION/AVAILABILITY STATEMENT. Use agency-mandated availability statements to indicate the public availability or distribution limitations of the report. If additional limitations/ restrictions or special markings are indicated, follow agency authorization procedures, e.g. RD/FRD, PROPIN, ITAR, etc. Include copyright information.

13. SUPPLEMENTARY NOTES. Enter information not included elsewhere such as: prepared in cooperation with; translation of; report supersedes; old edition number, etc.

14. ABSTRACT. A brief (approximately 200 words) factual summary of the most significant information.

15. SUBJECT TERMS. Key words or phrases identifying major concepts in the report.

16. SECURITY CLASSIFICATION. Enter security classification in accordance with security classification regulations, e.g. U, C, S, etc. If this form contains classified information, stamp classification level on the top and bottom of this page.

17. LIMITATION OF ABSTRACT. This block must be completed to assign a distribution limitation to the abstract. Enter UU (Unclassified Unlimited) or SAR (Same as Report). An entry in this block is necessary if the abstract is to be limited.

CONTRACTOR'S STATEMENT OF INDEPENDENT TECHNICAL REVIEW

Environmental Chemical Corporation has completed the *Final Site Inspection at CC RVAAP-77 Building 1037 Laundry Waste Water Sump, Revision 0, Former Ravenna Army Ammunition Plant, Portage and Trumbull Counties, Ohio.* Notice is hereby given that an independent technical review has been conducted that is appropriate to the level of risk and complexity inherent in the project. During the independent technical review, compliance with established policy principles and procedures, utilizing justified and valid assumptions, was verified. This included review of project data quality objectives, technical assumptions, methods, procedures, and materials used. The appropriateness of the data used, level of data obtained, and reasonableness of the results, including whether the product meets the customer's needs, are consistent with law and existing U.S. Army Corps of Engineers policy.

Michael J. Goydas

February 2, 2015

Michael Goydas, P.G.
Senior Hydrogeologist

Date

Debra MacDonald

February 3, 2015

Debra MacDonald, P.E., PMP
Project Manager

Date

Kim Bigelow

February 4, 2015

Kim Bigelow
Technical Writer

Date

This page intentionally left blank.

OhioEPA

John R. Kasich, Governor
Mary Taylor, Lt. Governor
Craig W. Butler, Director

February 19, 2015

Re: **US Army Ravenna Ammunition Plt RVAAP**
Assessment
Remedial Response
Portage County
267000859

Mr. Mark Leeper, P.G., MBA
Restoration/Cleanup Program Manager
ARNG Directorate
111 S. George Mason Dr
Arlington, VA 22204

Subject: Ohio EPA's Review of the Final Site Inspection Report, CC-RVAAP-77 Laundry Waste Water Sump, February 12, 2014, Project No. 267-000859-155

Dear Mr. Leeper:

On February 12, 2015, the Ohio Environmental Protection Agency (Ohio EPA), Northeast District Office (NEDO), received a copy of the Final Site Inspection Report for CC-RVAAP-77, Building 1037, Laundry Wastewater Sump. The document was prepared by ECC under contract no. W912QR-04-D-0039.

Ohio EPA has reviewed the document. It is hereby approved.

If you have any questions or concerns related to this review or would like to schedule a meeting or conference call, please free feel to contact me at (330) 963-1170.

Sincerely,

Edward D'Amato
Project Coordinator
Ohio EPA - Division of Environmental Response and Revitalization

ED/nvr

ec: Rodney Beals, DERR, NEDO
Justin Burke, DERR-CO

cc: Katie Tait, OHARNG RTLS
Gregory F. Moore, USACE
Gail Harris, Vista Sciences Corp.
Kevin Sedlak, ARNG
Mark Nichter, USACE
Rebecca Haney, Vista Sciences Corp.

This page intentionally left blank.

Final
Site Inspection
CC RVAAP-77 Building 1037 Laundry Waste Water Sump
Revision 0

Former Ravenna Army Ammunition Plant
Portage and Trumbull Counties, Ohio

February 11, 2015

Contract No. W912QR-04-D-0039
Delivery Order: 0004

Prepared for:

United States Army Corps of Engineers
Louisville District
600 Martin Luther King Jr. Place
Louisville, Kentucky 40202-2267

Prepared by:

Environmental Chemical Corporation
33 Boston Post Road West
Suite 420
Marlborough, Massachusetts 01752

This page intentionally left blank.

DOCUMENT DISTRIBUTION
for the
Final Site Inspection
CC RVAAP-77 Building 1037 Laundry Waste Water Sump
Revision 0
Former Ravenna Army Ammunition Plant
Portage and Trumbull Counties, Ohio

Name	Organization	Number of Printed Copies	Number of Electronic Copies
TBD	Ohio Environmental Protection Agency–Northeast District Office	Transmittal letter only	
Rod Beals	Ohio Environmental Protection Agency–Northeast District Office	Transmittal letter only	
Justin Burke	Ohio Environmental Protection Agency–Central District Office Division of Environmental Response and Remediation	0	1
Ed D’Amato	Ohio Environmental Protection Agency–Northeast District Office	1	2
Mark Leeper	Army National Guard	0	1
Kevin Sedlak	Army National Guard	1	1
Katie Tait	Ohio Army National Guard	1	1
Eric Cheng	U.S. Army Corps of Engineers–Louisville District	2	2
Administrative Records Manager	Ravenna Army Ammunition Plant	2	2
Ravenna Environmental Information Management System		0	1
Al Easterday	Environmental Chemical Corporation	1	1

This page intentionally left blank.

TABLE OF CONTENTS

TABLE OF CONTENTS (CONTINUED)

TABLE OF CONTENTS (CONTINUED)

LIST OF FIGURES

LIST OF FIGURES (CONTINUED)

LIST OF TABLES

LIST OF APPENDICES

ACRONYMS AND ABBREVIATIONS

ºF	Degrees Fahrenheit
µg/kg	Microgram per kilogram
amsl	Above mean sea level
AOC	Area of concern
ARNG	Army National Guard
bgs	Below ground surface
BHC	Hexachlorocyclohexane
BTEX	Benzene, toluene, ethylbenzene, and xylene
CC	Army Environmental Compliance-Related Cleanup Program
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CI	Cast iron
cm	Centimeter
CR	Compliance Restoration
DDD	Dichlorodiphenyldichloroethane
DDE	p,p′-Dichlorodiphenyldichloroethylene
DDT	1,1,1-Trichloro-2,2-di(4-chlorophenyl)ethane
DI	Deionized
DRO	Diesel Range Organics
DSB	Deep soil boring
DU	Decision unit
DUP	Duplicate
ECC	Environmental Chemical Corporation
EQM	Environmental Quality Management, Inc.
ER	Equipment rinsate
FD	Field duplicate
ft	Feet
FWCUG	Facility-Wide Cleanup Goal
FWSAP	Facility-Wide Sampling and Analysis Plan
gpm	Gallon per minute
GRO	Gasoline range organics

ACRONYMS AND ABBREVIATIONS (CONTINUED)

HQ	Hazard Quotient
HMX	Octahydro-1,3,5,7-Tetranitro-1,3,5,7-Tetrazocine
HRR	Historical Records Review
ID	Identification
IDW	Investigation-derived waste
IRP	Installation Restoration Program
ISM	Incremental sampling methodology
J	Estimated value
km	Kilometer
km^2	Square kilometer
LOD	Limit of Detection
m	Meter
mg/kg	Milligram per kilogram
MgA	Mahoning silt loam, 0-2 percent Slopes
MIBK	4-Methyl-2-pentanone
MS	Matrix spike
MSD	Matrix spike duplicate
MTBE	Methyl tertiary butyl ether
NA	Not applicable
ND	Not detected
NFA	No Further Action
OHARNG	Ohio Army National Guard
Ohio EPA	Ohio Environmental Protection Agency
PAH	Polycyclic aromatic hydrocarbon
PCB	Polychlorinated biphenyl
PWS	Performance Work Statement

ACRONYMS AND ABBREVIATIONS (CONTINUED)

QA	Quality assurance
QC	Quality control
R	Result not usable
RDX	Hexahydro-1,3,5-Trinitro-1,3,5-Triazine
RI	Remedial investigation
RSL	Regional Screening Level
RVAAP	Ravenna Army Ammunition Plant
SAIC	Science Applications International Corporation
SB	Soil boring
SI	Site inspection
SorW	Source water
sq ft	Square feet
SRC	Site-related chemical
SS	Surface sample
SVOC	Semi-volatile organic compound
TAL	Target Analyte List
TB	Trip blank
TCE	Trichloroethene
TCR	Target Cancer Risk
THQ	Target Hazard Quotient
TPH	Total petroleum hydrocarbons
U	Not detected
UJ	Not detected, Reporting Limit estimated
USACE	United States Army Corps of Engineers
USDA	United States Department of Agriculture
USEPA	United States Environmental Protection Agency
UXO	Unexploded ordnance
VOC	Volatile organic compound
VP	Vitrified pipe

ACRONYMS AND ABBREVIATIONS (CONTINUED)

WOE	Weight-of-evidence

EXECUTIVE SUMMARY

Environmental Chemical Corporation (ECC) has been contracted by the United States Army Corps of Engineers (USACE)–Louisville District to complete a Site Inspection (SI) at the Compliance Restoration (CR) Site CC (Army Environmental Compliance-Related Cleanup Program) RVAAP-77 Building 1037 Laundry Waste Water Sump at the former Ravenna Army Ammunition Plant (RVAAP), in Portage and Trumbull counties, Ohio. This SI was completed under Contract Number W912QR-04-D-0039, Delivery Order Number 0004, Modification Number 1.

This SI was completed in accordance with the *Final SI/Remedial Investigation (RI) Work Plan at CR Sites* (ECC 2012), and the United States Environmental Protection Agency's (USEPA) *Interim Final Guidance for Performing Site Inspections Under CERCLA* (USEPA 1992).

This SI was conducted to investigate the former waste water sump that received discharge (rinse) water from the former laundry operations within Building 1037. The waste water sump was used from World War II through 1954. Based on the findings of the *Historical Records Review (HRR) Report for the 2010 Phase I RI Services at CR Sites (9 Areas of Concern [AOCs])* (Science Applications International Corporation [SAIC]. 2011a), an SI was recommended because past operations may have resulted in a release of contaminants from the waste water sump to subsurface soil at this AOC. As stated in the HRR (SAIC 2011a), the former laundry building was used from World War II through 1992 to launder workers' overalls that were potentially contaminated with explosives and propellants used during munitions production.

The laundry rinse water discharged to the sump located on the exterior, north side, of Building 1037 prior to entering the sanitary sewer. The waste water sump was used as a settling basin to remove solids from discharged laundry operations water prior to entering the sanitary sewer. The size of the waste water sump was 13 feet (ft) by 16 ft with an area of 208 square feet (sq ft). The top of the waste water sump was at ground surface and the bottom of the waste water sump was at approximately 11.5 ft below ground surface (bgs). The sump was excavated between October and September 2009. However, no confirmation soil samples were collected from the sump excavation during the time the sump was removed to determine if the subsurface soil was contaminated.

The water level in the sump was approximately 4 ft bgs (due to the elevation of the discharge pipe to the sanitary sewer); therefore, any contamination released from the waste water sump would have entered into surrounding subsurface soil below this depth. Based on the past operations in the building and history of the sump, further investigation, specifically for explosive and propellant chemicals in the subsurface soil around the waste water sump area, was recommended in the HRR to determine the presence or absence of contamination (SAIC 2011a).

As the water level in the waste water sump was below the ground surface, no surface soil contamination is expected; therefore, this SI focuses on investigating the subsurface soil.

One decision unit (DU) was defined as the soil sampling area. The DU was sized to encompass the former waste water sump area and is smaller than a typical one-quarter acre exposure unit (USACE 2005). The DU was centered on the waste water sump area (208 sq ft) and extended approximately 2-8 ft outside of the original sump boundaries where contamination may have been released to the subsurface soil. The DU area is 478 sq ft. This smaller DU (less than one-quarter acre) was established around the waste water sump area to increase the likelihood of identifying potential contamination. Therefore, the footprint of the former laundry sump occupied approximately 208 sq ft of the 478-sq ft area that was sampled.

In addition to the subsurface soil sample collection, one surface soil sample and a duplicate surface soil sample were collected as part of this SI. Sediment and surface water are not present at this AOC, and groundwater is being evaluated on a facility-wide basis (RVAAP-66 Facility-Wide Groundwater). Therefore, samples were not collected from sediment, surface water, or groundwater during this SI.

The objectives of this SI were as follows:

The primary objective of this SI was to determine the presence of potential contamination in soil at the AOC. In order to determine potential contamination, the following steps were included as part of this SI:

- Collect soil samples for laboratory analysis at CC RVAAP-77.

- Identify whether Site-Related Chemicals (SRCs) are present in the soil at the AOC. SRCs are identified following the process outlined in the Facility-wide Human Health Cleanup Goals document (SAIC 2010).

- Compare the maximum reported concentrations of the SRCs to the most stringent Resident Receptor Facility-Wide Cleanup Goals (FWCUGs), between the adult and the child receptor, using the Target Cancer Risk (TCR) level of 10^{-6} and the Target Hazard Quotient (THQ) for non-carcinogenic risks of THQ = 0.1. For the purposes of this SI, potential contamination at CC RVAAP-77 is defined by an exceedance of the most stringent Resident Receptor FWCUG.

- Complete a weight-of-evidence (WOE) approach to further evaluate the SRCs reported at concentrations exceeding the most stringent Resident Receptor FWCUG using the TCR level of 10^{-6} or the THQ for non-carcinogenic risks at THQ = 0.1.

- Provide a recommendation for either further investigation under CERCLA, in the form of an RI, if potential contamination has been identified, or No Further Action (NFA) if no potential contamination has been identified at this AOC.

The soil sampling was conducted at Building 1037 Laundry Waste Water Sump at CC RVAAP-77 within an approximate 478-sq ft sampling area encompassing the waste water sump area. One surface soil sample and a duplicate sample were also collected and analyzed for volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), Target Analyte List (TAL) metals, explosives, polychlorinated biphenyls (PCBs), pesticides, and propellants. The subsurface soil samples were only analyzed for explosive and propellant chemicals. The following surface and subsurface soil samples were collected during this SI:

- One surface soil incremental sampling method (ISM) sample (0-1 ft bgs) was collected.

- Two horizontal subsurface soil ISM samples were collected (depths of 1-4 and 4-7 ft bgs).

- Five vertical subsurface soil ISM samples were collected (1-7 ft bgs).

- One subsurface soil sample was collected as a composite sample between 7 and 13 ft bgs to characterize the soil to 13 ft bgs.

The analytical results from the SI samples were used to determine if potential contamination was present by first identifying the SRCs. Per the *RVAAP's Facility-Wide Human Health Risk Assessment Manual* (USACE 2005), a chemical detected at a concentration greater than the established background value, is not an essential nutrient, and has not been screened out through a frequency of detection, is identified as an SRC. An SRC may, or may not be, related to the former operations at the site. The resulting maximum detected concentration of each SRC identified in this SI was compared to the most stringent FWCUG for the Resident Receptor (between the adult and child receptors) using the TCR level of 10^{-6} or the THQ for non-carcinogenic risks of THQ = 0.1 for each SRC to determine the presence of potential contamination.

The SRCs that exceeded the most stringent value (between adult and child receptors) Resident Receptor FWCUG, using a TCR level of 10^{-6} or the THQ = 0.1 for non-carcinogenic risks, were then evaluated using a WOE approach. The WOE evaluation considers the SRCs that exceed their Resident Receptor FWCUGs, as described above, to determine if the chemical should be identified as potential contamination.

A summary of the SI results for CC RVAAP-77 Building 1037 Laundry Waste Water Sump is as follows.

Surface Soil Results

- SRCs were identified in the one surface soil sample. A total of 529 constituents were analyzed and the following SRCs were identified in surface soil: one VOC (4-methyl-2-pentanone); fifteen SVOCs (polycyclic aromatic hydrocarbon [PAH] compounds); one pesticide (p,p′-dichlorodiphenyldichloroethylene [p,p′-DDE]); seven metals (cadmium, chromium, mercury, nickel, silver, thallium, and zinc); one explosive, tetryl; and two propellants (nitroglycerin and nitroguanidine).

- No metals, explosives, propellants, VOCs, PCBs, or pesticides were detected at concentrations which exceed their respective Resident Receptor FWCUGs in the ISM surface soil samples collected.

- One SVOC (benzo[a]pyrene) was reported at a concentration of 88 micrograms per kilogram (µg/kg), exceeding the Resident Receptor FWCUG of 22 µg/kg. A WOE evaluation determined that the presence of this PAH is not related to the historical activities and operations conducted at the former laundry building specifically used for washing overalls potentially contaminated with explosives and/or propellants, as stated in the HRR report (SAIC 2011a). The reported concentration of benzo(a)pyrene in surface soil is expected to be associated with overland drainage from adjacent asphalt roadways and other potential sources nearby this AOC. Therefore, benzo(a)pyrene is not identified as a potential contaminant in surface soil at this AOC.

- Therefore, no potential contaminants related to site operations were identified in the surface soil at this AOC.

Subsurface Soil Results

- No SRCs were identified in subsurface soil sampled to a maximum depth of 13 ft bgs. All subsurface soil were non-detect for explosives and propellants.

- No explosive derivative or propellant chemicals were detected in the vertical or horizontal subsurface soil ISM samples collected at this AOC. No other organic chemicals detected in the subsurface soil ISM samples exceeded their respective Resident Receptor FWCUGs.

- No potential contaminants related to site operations were identified in subsurface soil at this AOC.

The conclusions of this SI are as follows:

- No potential contaminants were identified in the surface or subsurface soil sampled at this AOC.

- The results of this SI indicate that the subsurface soil is not contaminated; therefore, soil is not a source of groundwater contamination at this AOC.

The results of this SI indicate that NFA is warranted for soil at CC RVAAP-77 Building 1037 Laundry Waste Water Sump.

This page intentionally left blank.

1.0 INTRODUCTION

Environmental Chemical Corporation (ECC) was contracted by the United States Army Corps of Engineers (USACE)–Louisville District to complete a Site Inspection (SI) for Compliance Restoration (CR) Site CC (Army Environmental Compliance-Related Cleanup Program) RVAAP-77 Building 1037 Laundry Waste Water Sump at the former Ravenna Army Ammunition Plant (RVAAP) in Portage and Trumbull counties, Ohio. The location of the former RVAAP is provided in Figure 1-1 and the location of the CR sites at the facility is shown in Figure 1-2. This SI was completed and this document was prepared under Contract Number W912QR-04-D-0039, Delivery Order Number 0004, Modification Number 1.

Planning and performance of all elements of this contract are in accordance with the requirements of the *Ohio Environmental Protection Agency (Ohio EPA) Director's Final Findings and Orders for RVAAP* (Ohio EPA 2004). The *Director's Final Findings and Orders* require conformance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and the National Oil and Hazardous Substances Pollution Contingency Plan to complete this SI for Area of Concern (AOC) CC RVAAP-77. The location of CC RVAAP-77 is shown on Figure 1-3.

This SI for CC RVAAP-77 was conducted in accordance with the United States Environmental Protection Agency's (USEPA) *Interim Final Guidance for Performing Site Inspection Under CERCLA* (USEPA 1992), as well as the *Final SI and Remedial Investigation (RI) Work Plan at CR Sites (Revision 0), RVAAP, Ravenna, Ohio* (ECC 2012).

This SI includes the following components:

- Site descriptions and operational histories
- Waste characteristics and management practices
- Summary of field investigation and pre-mobilization activities
- Summary of the analytical data and results of the field investigation activities
- Determination of Site-Related Chemicals (SRCs)
- Comparison of SRC maximum concentrations to the most stringent Resident Receptor Facility-Wide Cleanup Goals (FWCUGs)

- A weight-of-evidence (WOE) evaluation of the SRCs to determine if potential contamination is present
- Evaluation of the exposure pathways for surface soil, subsurface soil, air, surface water, and groundwater
- Conclusions
- References.

1.1 PURPOSE AND SCOPE

ECC is submitting this SI report to the Army in accordance with the Performance Work Statement (PWS), Multiple Award Remediation Contract Number W912QR-04-D-0039, Delivery Order Number 0004 under a firm-fixed price Performance-Based Acquisition to provide environmental investigation and remediation services at 14 CR sites at the RVAAP, Ravenna, Ohio (Figures 1-1 and 1-2). The Delivery Order was issued by the USACE–Louisville District on August 15, 2011.

Environmental work at the former RVAAP under the Installation Restoration Program began in 1989, with 32 environmental AOCs. The U.S. Army Center for Health Promotion and Preventive Medicine collected environmental samples at each AOC and performed a Relative Risk Site Evaluation, which prioritized each AOC into one of three groups: low, medium, and high priorities. Environmental restoration work has proceeded primarily by addressing the highest priority sites first. In 1998, the number of environmental AOCs was increased from 32 to 51. Relative risk rankings were conducted to further prioritize those additional environmental AOCs. Since 1998, new environmental AOCs have been added. This SI discusses one of these AOCs: CC RVAAP-77 Building 1037 Laundry Waste Water Sump.

Historical information for CC RVAAP-77 is presented in the *Final Historical Records Review (HRR) Report for the 2010 Phase I RI Services at CR Sites (9 AOCs) at the RVAAP, Ravenna, Ohio*, dated December 22, 2011 (Science Applications International Corporation [SAIC]. 2011a). The HRR followed the U.S. EPA guidance document that establishes the minimum requirements for conducting an Abbreviated Preliminary Assessment, as outlined in *Improving Site Assessment: Abbreviated Preliminary Assessments* (USEPA 1999).

1.2 FACILITY DESCRIPTION

The facility, consisting of 21,683 acres, is located in northeastern Ohio within Portage and Trumbull counties, approximately 4.8 kilometers (km) (3 miles) east/northeast of the City of Ravenna and approximately 1.6 km (1 mile) northwest of the City of Newton Falls. The facility, previously known as the RVAAP, was formerly used as a load, assemble, and pack facility for munitions production. As of September 2013, administrative accountability for the entire acreage of the facility has been transferred to the United States Property and Fiscal Office for Ohio and subsequently licensed to the Ohio Army National Guard (OHARNG) for use as a military training site (Camp Ravenna). References in this document to the former RVAAP relate to previous activities at the facility as related to former munitions production activities or to activities being conducted under the restoration/cleanup program.

1.3 DEMOGRAPHY AND LAND USE

The facility consists of 21,683 acres in northeastern Ohio, approximately 37 km (23 miles) east-northeast of Akron and 30 miles (48.3 km) west-northwest of Youngstown. The facility occupies east-central Portage County and southwestern Trumbull County. The 2010 Census reports that the populations of Portage and Trumbull counties are 161,419 and 210,312, respectively. Population centers closest to the facility are Ravenna, with a population of 11,724, and Newton Falls, with a population of 4,795.

The facility is located in a rural area and is not close to any major industrial or developed areas. Approximately 55 percent of Portage County, in which the majority of the facility is located, consists of either woodland or farmland acreage. The closest major recreational area, the Michael J. Kirwan Reservoir (also known as West Branch Reservoir), is south of the facility.

The facility is licensed to the OHARNG for use as a military training site. Training and related activities at Camp Ravenna include field operations and bivouac training, convoy training, equipment maintenance, C-130 aircraft drop zone operations, helicopter operations, and storage of heavy equipment.

1.4 FACILITY ENVIRONMENTAL SETTING

This section describes the physical features, topography, geology, hydrogeology, and environmental characteristics of the facility. The environmental setting specific to Building 1037 Laundry Waste Water Sump CC RVAAP-77 is included in Section 6.0.

1.4.1 Physiographic Setting

The facility is located within the Southern New York Section of the Appalachian Plateaus physiographic province (U.S. Geological Survey 1968). This province is characterized by elevated uplands underlain primarily by Mississippian and Pennsylvanian-age bedrock units that are horizontal or gently dipping. The province is characterized by its rolling topography with incised streams having dendritic drainage patterns. The Southern New York Section has been modified by glaciation, which rounded ridges, filled major valleys, and blanketed many areas with glacially-derived unconsolidated surficial deposits (e.g., sand, gravel, and finer-grained outwash deposits). As a result of glacial activity, old stream drainage patterns were disrupted in many locales, and extensive wetland areas developed.

1.4.2 Surface Features and Topography

The topography of the facility is gently undulating with an overall decrease in ground surface elevation from a topographic high of approximately 1,220 feet (ft) above mean sea level (amsl) in the far western portion of the facility to low areas at approximately 930 ft amsl in the far eastern portion of the facility. The average surface elevation for CC RVAAP-77 is 1,025 ft amsl.

USACE mapped the facility topography in February 1998 using a 2-ft (60.1-centimeter [cm]) contour interval with an accuracy of 0.02 ft (0.61 cm). USACE based the topographic information on aerial photographs taken during the spring of 1997. The USACE survey is the basis for the topographical information illustrated in figures included in this report.

1.4.3 Soil and Geology

1.4.3.1 Regional Geology

The regional geology at the facility consists of horizontal to gently dipping bedrock strata of Mississippian and Pennsylvanian-age overlain by unconsolidated glacial deposits of varying thicknesses. The unconsolidated surficial deposits and bedrock geology are described in the following subsections.

1.4.3.2 Soil and Glacial Deposits

Bedrock at the facility is overlain by deposits of the Wisconsin-age Lavery Till in the western portion of the facility and the younger Hiram Till and associated outwash deposits in the eastern two-thirds of the facility (Figure 1-4). Unconsolidated glacial deposits vary considerably in thickness across the facility, from non-existent in some of the eastern portions of the facility to an estimated 150 ft (46 meters [m]) in the south-central portion.

Thin surface glacial deposits have been completely removed as a consequence of human activities at locations such as Ramsdell Quarry. Bedrock is present at or near the ground surface in locations such as Load Line 1 and the Erie Burning Grounds (USACE 2001).

Where glacial sediments remain, their distribution and character indicate their origin as a ground moraine. These tills consist of laterally discontinuous assemblages of yellow-brown, brown, and gray silty clays to clayey silts, with sand and rock fragments. Lacustrine sediment from bodies of glacial-age standing water has also been encountered in the form of deposits of uniform light gray silt greater than 50 ft thick in some areas (USACE 2001).

Soil at the facility is generally derived from the Wisconsin-age silty clay glacial till. Distributions of soil types are discussed and mapped in the *Soil Survey of Portage County, Ohio,* which describes soil as nearly level to gently sloping and poor to moderately well drained (U.S. Department of Agriculture [USDA] 1978). Much of the native soil was disturbed during construction activities in former production and operational areas of the facility.

Several soil types are present at the facility as shown in Figure 1-5 and described in Figure 1-6. The primary soil type present at CC RVAAP-77 is shown in Figure 1-7 and summarized in Table 1-1.

Table 1-1: Soil Type at CC RVAAP-77

Soil Series Classification	Parent Material	Geographic Setting	Slope Percent	Drainage	Surface Runoff	Permeability
Mahoning silt loams (MgA)	Silty clay loam or clay loam glacial till, generally where bedrock is greater than 6 ft below ground surface (bgs)	Gently sloping highland areas	0-2	Poorly drained	Rapid and seasonal wetness	Low

1.4.3.3 Bedrock Geology

The Sharon Sandstone Member, informally referred to as the Sharon Conglomerate, of the Pennsylvanian Pottsville Formation, is the primary bedrock beneath the facility (Figure 1-8). The Sharon Sandstone Member, the lowest unit of the Pottsville Formation, is a highly porous, loosely cemented, permeable, cross-bedded, frequently fractured and weathered, orthoquartzite sandstone, which is locally conglomeratic. Thin shale lenses occur in the upper portion of the unit (Winslow and White 1966).

In the western portion of the facility, the upper members of the Pottsville Formation, including the Sharon Member, Connoquennissing Sandstone Member, Mercer Member, and uppermost

Homewood Sandstone Member, are present (Figure 1-8). The regional dip of the Pottsville Formation measured in the west portion of the facility is between 1.5 and 3.5 m per 1.6 km (5-11.5 ft per mile) to the south.

The Sharon Member is a gray to black, sandy to micaceous shale containing thin coal, underclay, and sandstone lenses. The Mercer Member of the Pottsville Formation consists of silty to carbonaceous shale with abundant thin, discontinuous sandstone lenses in the upper portion. Regionally, the Mercer Member has also been noted to contain interbeds of coal.

The Homewood Sandstone Member is the uppermost unit of the Pottsville Formation. It typically occurs as a caprock on bedrock highs in the subsurface, and ranges from well-sorted, coarse-grained, white quartzose sandstone to a tan, poorly sorted, clay-bonded, micaceous, medium- to fine-grained sandstone. Thin shale layers are prevalent in the Homewood member as indicated by a darker gray color.

1.4.4 Hydrogeology

1.4.4.1 Regional Hydrogeology

Sand and gravel aquifers are present in the buried-valley and outwash deposits in Portage County, as described in the *Phase I RI Report for High Priority AOCs at the RVAAP, Ravenna, Ohio* (USACE 1998). Generally, these saturated zones are too thin and localized to provide large quantities of water for industrial or public water supplies; however, yields are sufficient for residential water supplies. Lateral extent and continuity of these aquifers are unknown. Recharge of these units is derived from surface water infiltration of precipitation and surface streams. Specific groundwater recharge and discharge areas at the facility have not been delineated. The regional potentiometric surface at the facility for unconsolidated surficial deposits and bedrock are presented in Figures 1-9 and 1-10, respectively (Environmental Quality Management, Inc. [EQM] 2013).

The thickness of unconsolidated surficial deposits at the facility ranges from thin to absent in the eastern and northeastern portion of the facility to an estimated 150 ft (46 m) in the central portion of the facility. The water table (Figure 1-9) is encountered within the unconsolidated zone in many areas of the facility. Because of the heterogeneous nature of the unconsolidated glacial material, groundwater flow patterns are difficult to determine. Laterally, most groundwater flow in the surficial deposits likely follows topographic contours and stream drainage patterns (Figure 1-9), with preferential flow along pathways (e.g., sand seams, channel deposits, or other stratigraphic discontinuities) having higher permeability than surrounding clay or silt-rich material. Aquifer recharge from precipitation likely occurs via infiltration along root zones, desiccation cracks, and partings within the soil column.

Beneath the facility, the principal bedrock aquifer is within the Sharon Sandstone Conglomerate Unit (referred to as the Sharon Conglomerate Aquifer) (Figure 1-11) (EQM 2013). Depending on overburden thickness, the Sharon Conglomerate aquifer ranges from an unconfined to a leaky artesian aquifer hydraulically. According to one source, yields from on-site supply wells completed within the Sharon Conglomerate range from 30 to 400 gallons per minute (gpm) (United States Army Toxic and Hazardous Materials Agency 1978). Yields of 5-200 gpm have also been reported for on-site bedrock wells completed in the Sharon Conglomerate.

Other, less important, local bedrock aquifers include the Homewood Sandstone (Figure 1-10), which is generally thinner and only capable of well yields less than 10 gpm, and the Connoquennissing Sandstone. Wells completed in the Connoquennissing Sandstone in Portage County yield from 5 to 100 gpm, but are typically less productive than the Sharon Conglomerate due to lower permeability in the sandstone.

In general, the hydraulic gradient in the Sharon Conglomerate aquifer results in a regional eastward flow of groundwater (Figure 1-11) that appears to be more uniform than flow directions in unconsolidated deposits (Figure 1-9) because local surface topography influences the latter. Due to the lack of well data in the western portion of the facility, general flow patterns are difficult to discern. For much of the eastern half of the facility, hydraulic head elevations in bedrock are higher than those in overlying unconsolidated deposits, indicating an upward vertical hydraulic gradient. These data suggest there is a confining layer separating the two aquifers in some areas. In the far eastern area, there is little difference in the head elevations, suggesting a hydraulic connection exists between the two.

1.4.4.2 Groundwater Usage and Domestic Water Supply

The former RVAAP historically used groundwater for both domestic and industrial supplies. Groundwater utilized at the former RVAAP during past operations was obtained from production wells located throughout the facility, with most wells screened in the Sharon Conglomerate. The Army discontinued use of most of the groundwater production wells prior to 1993, when the facility was placed in modified caretaker status. Currently, one of the four original groundwater production wells remains in use by the OHARNG. This well, located in the former Administration Area, is not used as a potable water source, but supplies non-potable water for sanitary purposes for active-use buildings on the facility.

In addition, as of 2011, the OHARNG has installed two bedrock aquifer production wells at the facility. These two OHARNG supply wells were completed in the Sharon Conglomerate near Buildings 1067 and 1068 within the former Administration Area. There is also one inactive non-potable supply well just south of Winklepeck Burning Grounds along the east side of George Road, which was formerly used to supply water for environmental restoration activities.

The closest population center to the facility, the City of Newton Falls, obtains municipal water supplies from the east branch of the Mahoning River. Currently, most groundwater use in the area surrounding the facility is for domestic and livestock supply, with the Sharon Conglomerate acting as the major producing aquifer in the area. The Connoquennissing Sandstone Member and Homewood Sandstone Member also provide limited groundwater supplies, primarily to the western half of the facility. Unconsolidated deposits can also be an important source of groundwater. Many of the domestic wells and small public water supplies located near the facility obtain sustainable quantities of water from wells completed in unconsolidated, surficial deposits.

In the unconsolidated aquifer, groundwater flows predominantly eastward; however, the unconsolidated zone shows numerous local flow variations influenced by topography and drainage patterns (Figure 1-9). The local variations in flow direction suggest the following: (1) groundwater in the unconsolidated deposits is generally in direct hydraulic communication with surface water, and (2) surface water drainage ways may also act as groundwater discharge locations. In addition, topographic ridges between surface water drainage features act as groundwater divides in the unconsolidated deposits.

Local groundwater within and surrounding the facility contains proportionately high levels of iron, manganese, and naturally occurring carbonate compounds. As such, it is classified as "hard" water. Hard water has an associated metallic taste that can be unpalatable if not properly treated for human consumption (OHARNG 2008).

1.4.4.3 Regional Surface Water

The facility resides within the Mahoning River watershed, which is part of the Ohio River basin. The west branch of the Mahoning River is the main surface stream in the area. The west branch flows adjacent to the west end of the facility, generally north to south, before flowing into the Michael J. Kirwan Reservoir south of State Route 5 (Figure 1-1). The west branch flows out of the reservoir and parallels the southern facility boundary before joining the Mahoning River east of the facility.

The western and northern portions of the facility display low hills and a dendritic surface drainage pattern. The eastern and southern portions are characterized by an undulating to moderately level surface, with less dissection of the surface drainage. The facility is marked with marshy areas and flowing and intermittent streams whose headwaters are located in the upland areas of the facility.

The three primary watercourses that drain the facility are as follows (Figure 1-3):

- South fork of Eagle Creek
- Sand Creek
- Hinkley Creek.

All of these watercourses have many associated tributaries. Sand Creek, with a drainage area of 13.9 square miles (36 square kilometers [km^2]), flows generally in a northeast direction to its confluence with the south fork of Eagle Creek. In turn, the south fork of Eagle Creek continues in a northerly direction for 2.7 miles (4.3 km) to its confluence with Eagle Creek. The drainage area of the south fork of Eagle Creek is 26.2 square miles (67.8 km^2), including the area drained by Sand Creek. Hinkley Creek originates just southeast of the intersection between State Route 88 and State Route 303 to the north of the facility. Hinkley Creek, with a drainage area of 11.0 square miles (28.5 km^2), flows in a southerly direction through the facility, and converges with the west branch of the Mahoning River south of the facility (USACE 2001).

Approximately one-third of the facility meets the regulatory definition of a wetland, with the majority of the wetland areas located in the eastern portion of the facility. Wetland areas at the facility include seasonal wetlands, wet fields, and forested wetlands. Many of the wetland areas are the result of natural drainage or beaver activity; however, some wetland areas are associated with anthropogenic settling ponds and drainage areas.

Approximately 50 ponds are scattered throughout the facility. Many were constructed within natural drainage ways to function as settling ponds or basins for process effluent and runoff. Others are natural in origin, resulting from glacial action or beaver activity. Water bodies at the facility support aquatic vegetation and biota. Storm water runoff is controlled primarily by natural drainage, except in former operations areas where an extensive storm sewer network helps to direct runoff to drainage ditches and settling ponds. Additionally, the storm sewer system was one of the primary drainage mechanisms for process effluent during the period that production facilities were in operation.

1.4.5 Climate

The general climate of the area where the facility is located is continental and characterized by moderately warm and humid summers, reasonably cold and cloudy winters, and wide variations in precipitation from year to year. Climate data for the facility, presented below, were obtained from available National Weather Service records for the 30-year period of record from 1981 to 2010 at the Youngstown Regional Airport, Ohio (*http://www.nws.noaa.gov/climate/xmacis.php?wfo=cle*). Wind speed data for Youngstown, Ohio, are from the National Climatic Data Center (*http://www.ncdc.noaa.gov/data-access/quick-links#wind*) for the available 66-year period of record from 1930 through 1996.

Average annual rainfall in the area is 38.86 inches (98.7 cm), with the highest monthly average occurring in July (4.31 inches [10.9 cm]) and the lowest monthly average occurring in February (2.15 inches [5.46 cm]). Average annual snowfall totals approximately 63.4 inches (161.0 cm) with the highest monthly average occurring in January (17.1 inches [43.43 cm]). Due to the influence of lake-effect snowfall events associated with Lake Erie, located approximately 35 miles (56.3 km) northwest of the facility, snowfall totals vary widely throughout northeastern Ohio.

The average annual daily temperature in the area is 49.3 degrees Fahrenheit (ºF), with an average daily high temperature of 59.0ºF and an average daily low temperature of 39.7ºF. The record high temperature of 100ºF occurred in July 1988, and the record low temperature of -22ºF occurred in January 1994. The prevailing wind direction at the former RVAAP is from the west-southwest, with the highest average wind speed occurring in January (12 miles [19.3 km] per hour) and the lowest average wind speed occurring in August (7 miles [11.3 km] per hour). As per the National Climatic Data Center, 20 storm events (category Thunderstorm Wind) were reported between January 1, 1996 and July 31, 2013 *(http://tinyurl.com/k2kn47o).* The area is susceptible to tornadoes; minor structural damage to several buildings on facility property occurred as the result of a tornado in 1985.

1.5 REPORT ORGANIZATION

This SI report is organized into the following sections:

- Chapter 1 (Introduction) – Provides an overview of the purpose and scope of this SI, a general facility description, demography, and land use of the facility. This section provides an overview of the environmental setting at the facility.

- Chapter 2 (Site Description and Operational History) – Provides the site descriptions and land use history of the site. The physical property characteristics, military operations, and summary of past investigations are included.

- Chapter 3 (Historical Operations) – Summarizes the historical operations, investigations, and removal actions at the AOC.

- Chapter 4 (Field Investigation) – Addresses the scope of activities performed under this SI. This section discusses sampling rationale for placement of environmental media sampling locations, field activity procedures, laboratory methods, and protocols. Included in this section are descriptions of the pre-mobilization activities and field sampling methodologies for surface and subsurface soil incremental sampling methodology (ISM) sampling. Deviations from the work plan are outlined. Site surveying and collection and characterization of investigation-derived wastes (IDW) generated during this SI are discussed.

- Chapter 5 (Data Evaluation and Summary of Analytical Results) – Provides the data evaluation process used for this SI, a summary of surface and subsurface soil sampling results, and a presentation of the comparison of the SRCs to the most stringent Resident Receptor FWCUGs to identify the presence of potential contamination. The results of the WOE evaluation are provided in this section, as well as a discussion of the IDW characterization results.

- Chapter 6 (Exposure Pathways) – Summarizes physical conditions, and hydrological and hydrogeological settings; and provides conclusions for the exposure pathways identified for soil, air, surface water, and groundwater.

- Chapter 7 (Summary and Conclusions) – Summarizes findings and conclusions of this SI.

- Chapter 8 (References) – Lists references used for this report.

Report appendices contain the summarized investigation data as follows:

- Appendix A – Historical Aerial Photographs

- Appendix B – Activity Field Logs

- Appendix C – Boring Logs

- Appendix D – Data Verification Report

- Appendix E – Laboratory Analytical Results, Laboratory Data, and Chain-of-Custody Forms

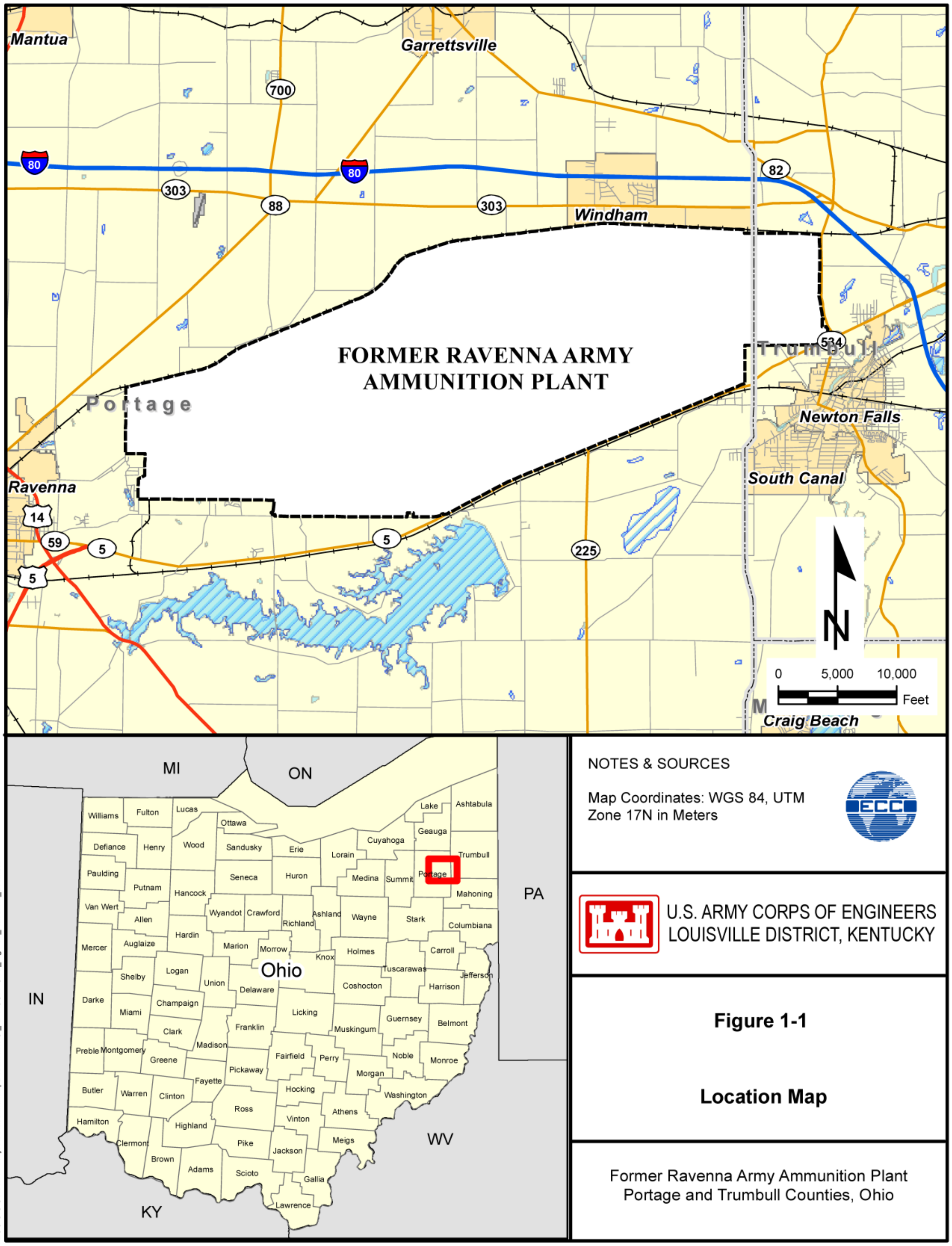
- Appendix F – Data Validation Report

- Appendix G – IDW Disposal Letter Report

- Appendix H – Site Photographs

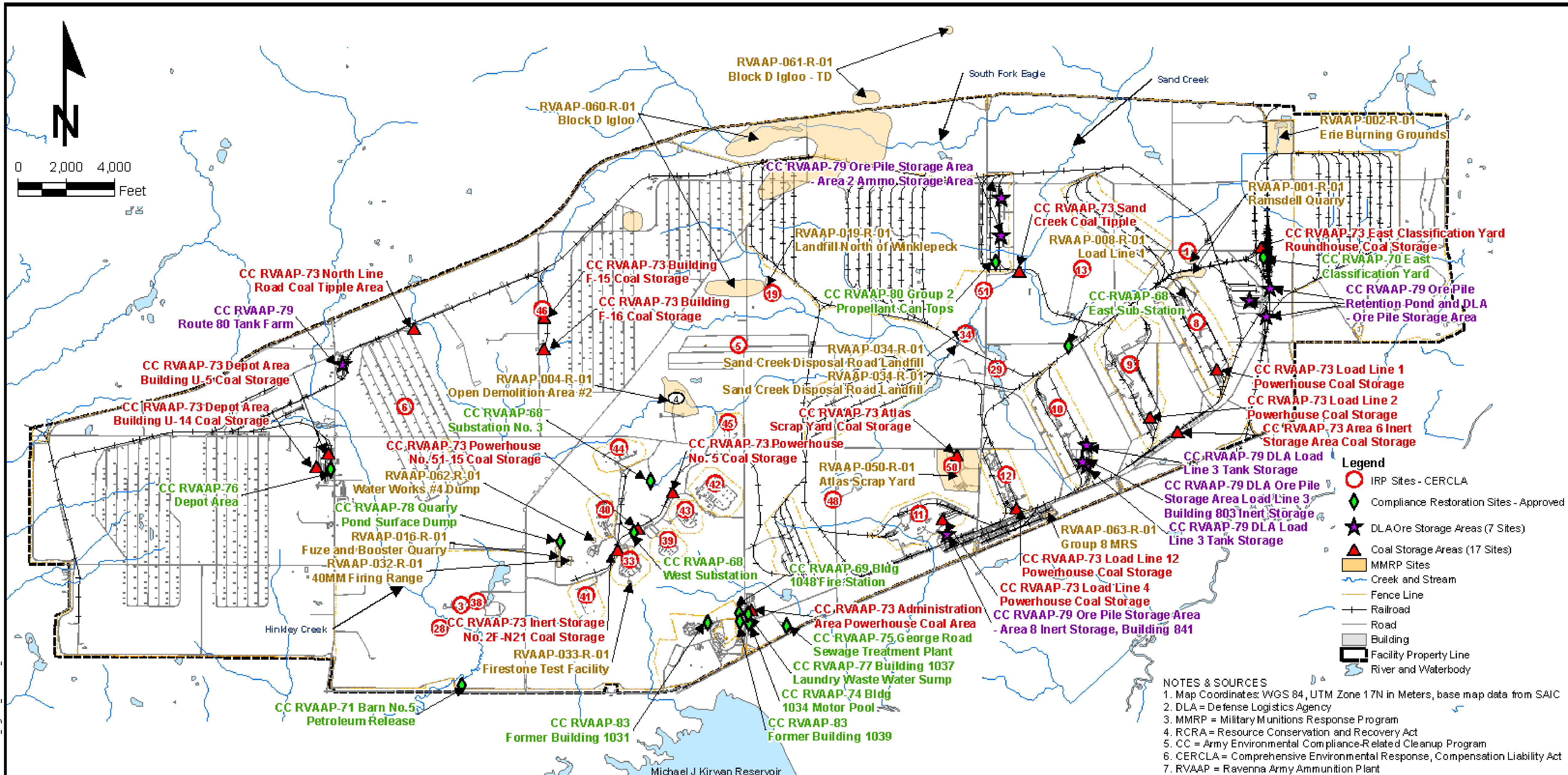
- Appendix I – Regulatory Correspondence.

This page intentionally left blank



ECC GIS Server: F:\Projects\Ravenna\MapDocuments\SI_RPT\CC77\SI77_Fig1-01_Ravenna_Loc.mxd

This page intentionally left blank.



IRP SITES - CERCLA

1	RVAAP-01	Ramsdell Quarry Landfill
3	RVAAP-03	Open Demolition Area #1
5	RVAAP-05	Winklepeck Burning Grounds
6	RVAAP-06	C Block Quarry
8	RVAAP-08	Load Line 1
9	RVAAP-09	Load Line 2
10	RVAAP-10	Load Line 3
11	RVAAP-11	Load Line 4
12	RVAAP-12	Load Line 12
13	RVAAP-13	Building 1200 - Dilution\Settling Pond
19	RVAAP-19	Landfill North of Winklepeck Burning Grounds
28	RVAAP-28	Mustard Agent Burial Site
29	RVAAP-29	Upper and Lower Cobbs Ponds
33	RVAAP-33	Load Line 6
34	RVAAP-34	Sand Creek Disposal Road Landfill
38	RVAAP-38	NACA Test Area
39	RVAAP-39	Load Line 5
40	RVAAP-40	Load Line 7
41	RVAAP-41	Load Line 8
42	RVAAP-42	Load Line 9
43	RVAAP-43	Load Line 10
44	RVAAP-44	Load Line 11
45	RVAAP-45	Wet Storage Area
46	RVAAP-46	Building F-15 and F-16
48	RVAAP-48	Anchor Test Area
50	RVAAP-50	Atlas Scrap Yard
51	RVAAP-51	Dump Along Paris Windham Rd.
	RVAAP-66	Facility-Wide Groundwater
	RVAAP-67	Facility-Wide Sewer

COMPLIANCE RESTORATION SITES (14 SITES)

CC RVAAP-68	Electronic Substations (E, W, No.3)
CC RVAAP-69	Former Building 1048 Fire Station
CC RVAAP-70	East Classification Yard
CC RVAAP-71	Barn No. 5 Petroleum Release
CC RVAAP-72	Facility-Wide USTs (45 Sites)
CC RVAAP-73	Facility-Wide Coal Storage
CC RVAAP-74	Building 1034 Motor Pool Hydraulic Lift
CC RVAAP-75	George Road Sewage Treatment Plant
CC RVAAP-76	Depot Area
CC RVAAP-77	Building 1037 - Laundry Waste Water Sump
CC RVAAP-78	Quarry Pond Surface Dump
CC RVAAP-79	DLA Ore Storage Sites
CC RVAAP-80	Group 2 Propelant Can Tops
CC RVAAP-83	Former Building 1031 and 1039

MMRP SITES (14 SITES)

RVAAP-001-R-01	DLA Ore Storage Sites
RVAAP-002-R-01	Erie Burning Grounds MRS
RVAAP-004-R-01	Open Demolition Area #2 MRS
RVAAP-008-R-01	Load Line 1 MRS
RVAAP-016-R-01	Fuze and Booster Quarry MRS
RVAAP-019-R-01	Landfill North of Winklepeck MRS
RVAAP-032-R-01	40 mm Firing Range MRS
RVAAP-033-R-01	Firestone Test Facility MRS
RVAAP-034-R-01	Sand Creek Dump MRS
RVAAP-050-R-01	Atlas Scrap Yard MRS
RVAAP-060-R-01	Block D Igloo MRS
RVAAP-061-R-01	Block D Igloo - TD MRS
RVAAP-062-R-01	Water Works #4 Dump MRS
RVAAP-063-R-01	Group 8

OTHER REGULATORY - RCRA

4	RVAAP-04	Open Demolition Area #2

U.S. ARMY CORPS OF ENGINEERS
LOUISVILLE DISTRICT, KENTUCKY

Figure 1-2

Location of Compliance Restoration Sites

Former Ravenna Army Ammunition Plant
Portage and Trumbull Counties, Ohio

This page intentionally left blank.

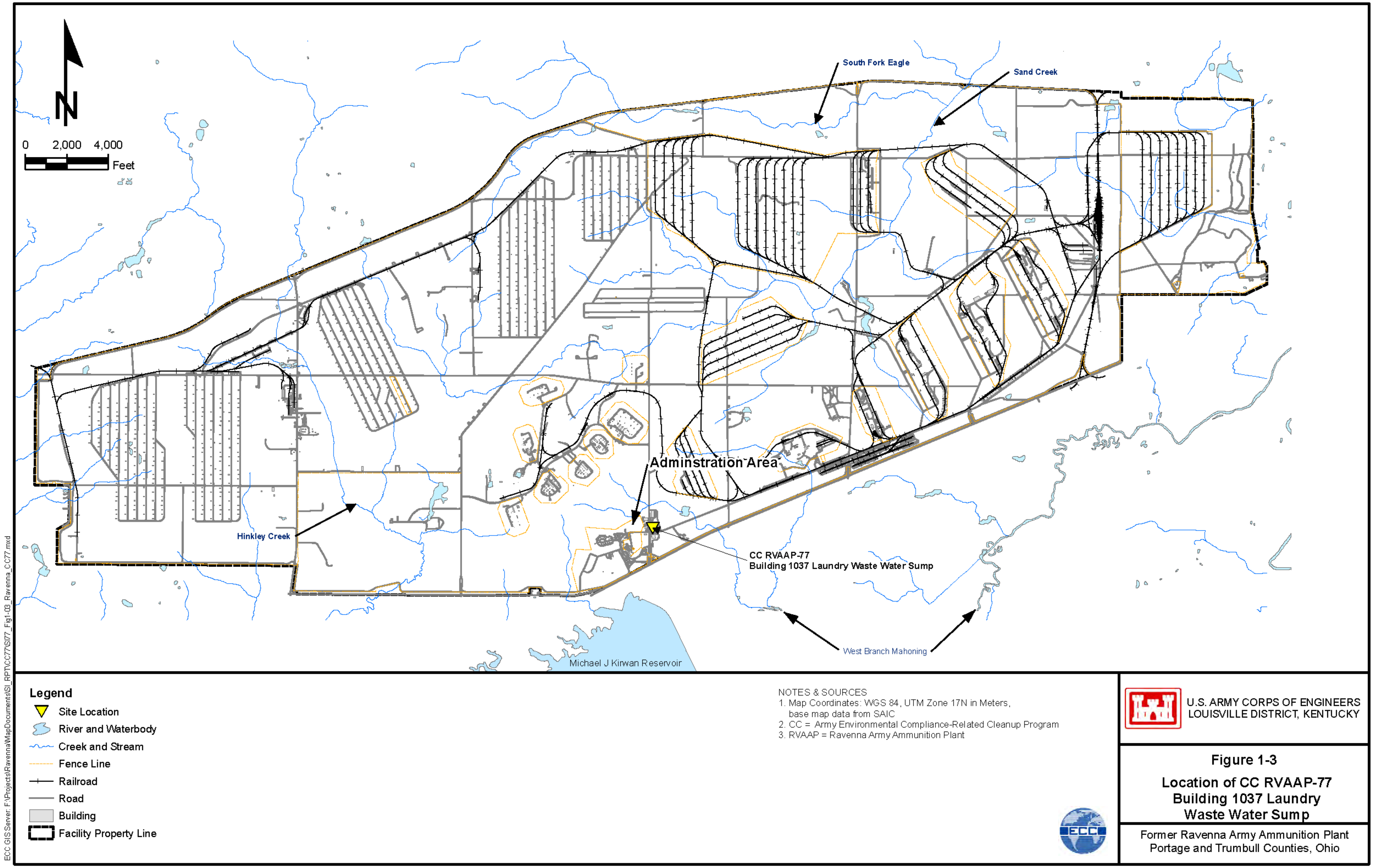
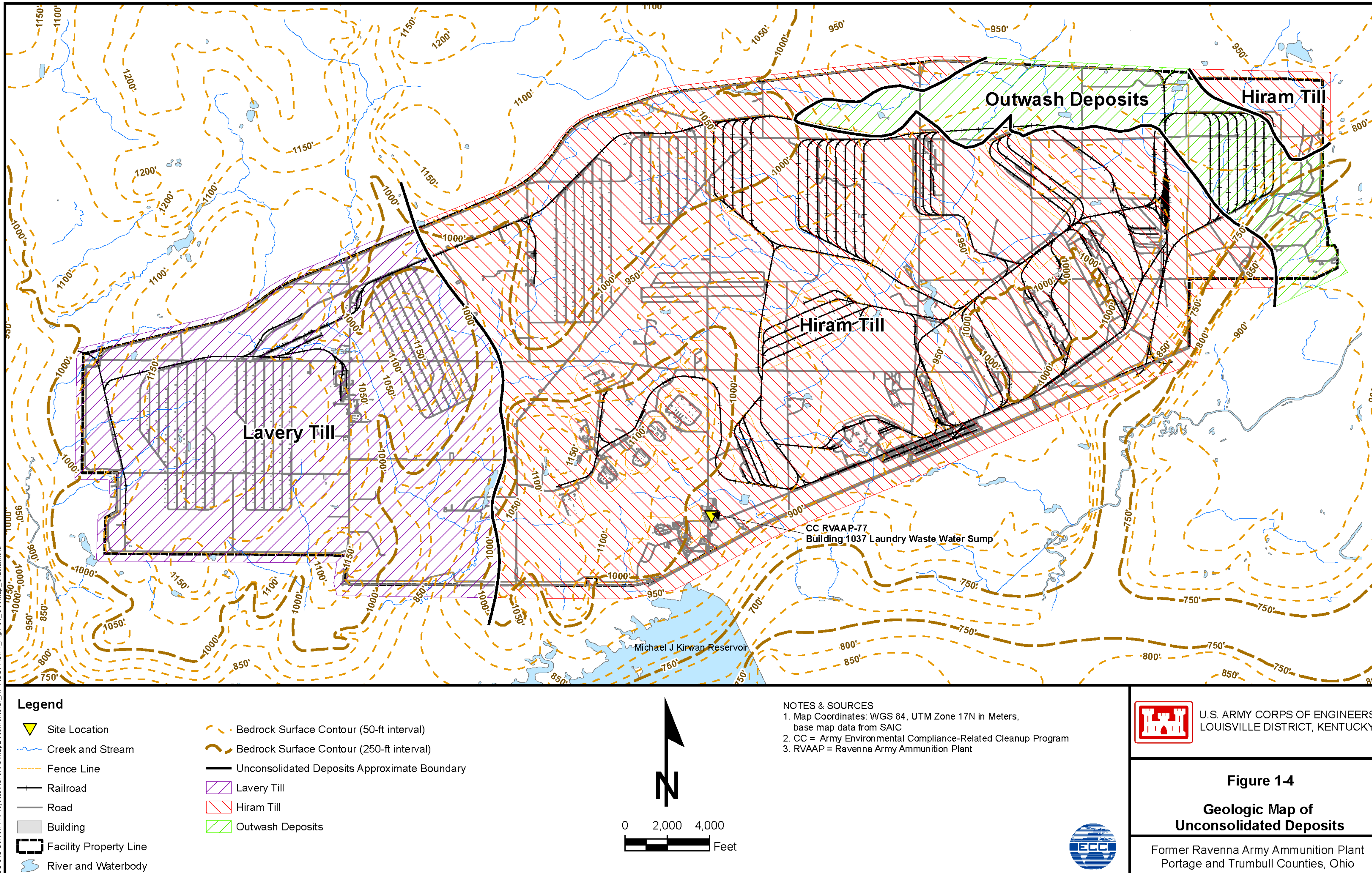
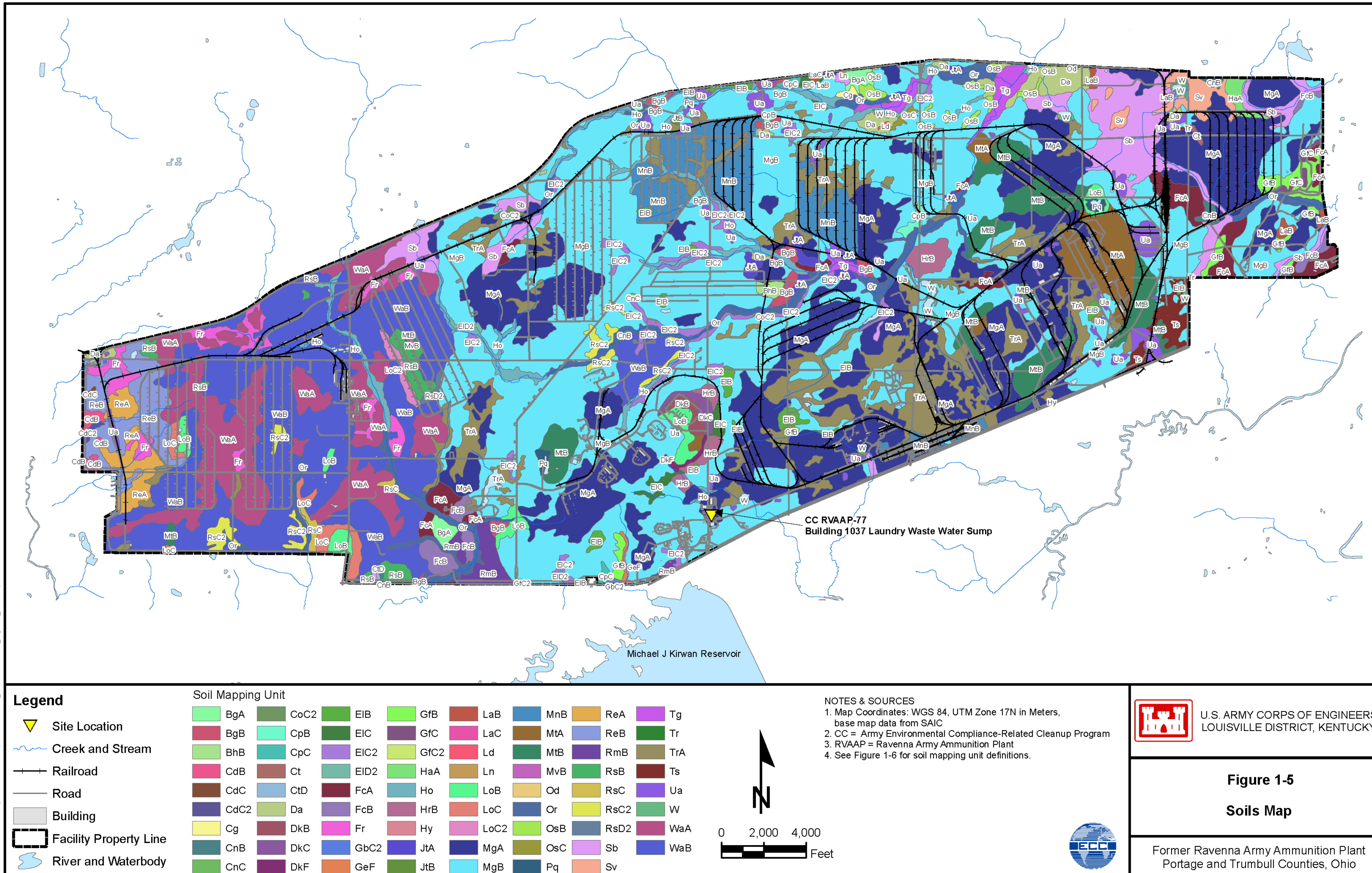


Figure 1-3
Location of CC RVAAP-77 Building 1037 Laundry Waste Water Sump
Former Ravenna Army Ammunition Plant
Portage and Trumbull Counties, Ohio

This page intentionally left blank.


Outwash Deposits
Hiram Till
Hiram Till
Lavery Till
CC RVAAP-77
Building 1037 Laundry Waste Water Sump
Michael J Kirwan Reservoir
Legend
Site Location
Creek and Stream
Fence Line
Railroad
Road
Building
Facility Property Line
River and Waterbody
Bedrock Surface Contour (50-ft interval)
Bedrock Surface Contour (250-ft interval)
Unconsolidated Deposits Approximate Boundary
Lavery Till
Hiram Till
Outwash Deposits
N
0 2,000 4,000
Feet
NOTES & SOURCES
1. Map Coordinates: WGS 84, UTM Zone 17N in Meters, base map data from SAIC
2. CC = Army Environmental Compliance-Related Cleanup Program
3. RVAAP = Ravenna Army Ammunition Plant
U.S. ARMY CORPS OF ENGINEERS
LOUISVILLE DISTRICT, KENTUCKY
Figure 1-4
Geologic Map of Unconsolidated Deposits
Former Ravenna Army Ammunition Plant
Portage and Trumbull Counties, Ohio

This page intentionally left blank.


CC RVAAP-77
Building 1037 Laundry Waste Water Sump
Michael J Kirwan Reservoir
Legend
Site Location
Creek and Stream
Railroad
Road
Building
Facility Property Line
River and Waterbody
Soil Mapping Unit
BgA BgB BhB CdB CdC CdC2 Cg CnB CnC
CoC2 CpB CpC Ct CtD Da DkB DkC DkF
ElB ElC ElC2 ElD2 FcA FcB Fr GbC2 GeF
GfB GfC GfC2 HaA Ho HrB Hy JtA JtB
LaB LaC Ld Ln LoB LoC LoC2 MgA MgB
MnB MtA MtB MvB Od Or OsB OsC Pq
ReA ReB RmB RsB RsC RsC2 RsD2 Sb Sv
Tg Tr TrA Ts Ua W WaA WaB
0 2,000 4,000
Feet
N
NOTES & SOURCES
1. Map Coordinates: WGS 84, UTM Zone 17N in Meters,
base map data from SAIC
2. CC = Army Environmental Compliance-Related Cleanup Program
3. RVAAP = Ravenna Army Ammunition Plant
4. See Figure 1-6 for soil mapping unit definitions.
U.S. ARMY CORPS OF ENGINEERS
LOUISVILLE DISTRICT, KENTUCKY
Figure 1-5
Soils Map
Former Ravenna Army Ammunition Plant
Portage and Trumbull Counties, Ohio

This page intentionally left blank.

Legend

Soil Mapping Unit

- BgA, Bogart silt loam, 0-2% slopes
- BgB, Bogart silt loam, 2-6% slopes
- BhB, Bogart-Haskins complex, 2-6% slopes
- CdB, Canfield silt loam, 2-6% slopes
- CdC, Canfield silt loam, 6-12% slopes
- CdC2, Canfield silt loam, 6-12% slopes, moderately eroded
- Cg, Carlisle muck
- CnB, Chili loam, 2-6% slopes
- CnC, Chili loam, 6-12% slopes
- CoC2, Chili gravelly loam, 6-12% slopes, moderately eroded
- CpB, Chili silt loam, 2-6% slopes
- CpC, Chili silt loam, 6-12% slopes
- Ct, Chili-Oshtemo complex
- CtD, Chili-Oshtemo complex, 12-18% slopes
- Da, Damascus loam
- DkB, Dekalb channery loam, 2-6% slopes
- DkC, Dekalb channery loam, 6-12% slopes
- DkF, Dekalb channery loam, 25-70% slopes
- ElB, Ellsworth silt loam, 2-6% slopes
- ElC, Ellsworth silt loam, 6-12% slopes
- ElC2, Ellsworth silt loam, 6-12% slopes, moderately eroded
- ElD2, Ellsworth silt loam, 12-18% slopes, moderately eroded
- FcA, Fitchville silt loam, 0-2% slopes
- FcB, Fitchville silt loam, 2-6% slopes
- Fr, Frenchtown silt loam
- GbC2, Geeburg silt loam, 6-12% slopes, moderately eroded
- GeF, Geeburg and Glenford silt loams, steep
- GfB, Glenford silt loam, 2-6% slopes
- GfC, Glenford silt loam, 6-12% slopes
- GfC2, Glenford silt loam, 6-12% slopes, moderately eroded
- HaA, Haskins loam, 0-2% slopes
- Ho, Holly silt loam
- HrB, Hornell silt loam, 3-8% slopes
- Hy, Holly silt loam, frequently flooded
- JtA, Jimtown loam, 0-2% slopes
- JtB, Jimtown loam, 2-6% slopes
- LaB, Lakin loamy sand, 2-6% slopes
- LaC, Lakin loamy sand, 6-12% slopes
- Ld, Linwood muck
- Ln, Lorain silty clay loam
- LoB, Loudonville silt loam, 2-6% slopes
- LoC, Loudonville silt loam, 6-12% slopes
- LoC2, Loudonville silt loam, 6-12% slopes, moderately eroded
- MgA, Mahoning silt loam, 0-2% slopes
- MgB, Mahoning silt loam, 2-6% slopes
- MnB, Mahoning-Urban land complex, undulating
- MtA, Mitiwanga silt loam, 0-2% slopes
- MtB, Mitiwanga silt loam, 2-6% slopes
- MvB, Mitiwanga silt loam, 2-6% slopes, moderately well drained variant
- Od, Olmsted loam
- Or, Orrville silt loam
- OsB, Oshtemo sandy loam, 2-6% slopes
- OsC, Oshtemo sandy loam, 6-12% slopes
- Pq, Pits, quarries
- ReA, Ravenna silt loam, 0-2% slopes
- ReB, Ravenna silt loam, 2-6% slopes
- RmB, Remsen silt loam, 2-6% slopes
- RsB, Rittman silt loam, 2-6% slopes
- RsC, Rittman silt loam, 6-12% slopes
- RsC2, Rittman silt loam, 6-12% slopes, moderately eroded
- RsD2, Rittman silt loam, 12-18% slopes, moderately eroded
- Sb, Sebring silt loam
- Sv, Sebring silt loam, dark surface variant
- Tg, Tioga loam
- Tr, Trumbull silt loam
- TrA, Trumbull silt loam, 0-2% slopes
- Ts, Trumbull silty clay loam
- Ua, Udorthents
- W, Water
- WaA, Wadsworth silt loam, 0-2% slopes
- WaB, Wadsworth silt loam, 2-6% slopes

NOTES & SOURCES

1. Soil Survey Staff, Natural Resources Conservation Service, United States Department of Agriculture. Web Soil Survey. Available online at http://websoilsurvey.nrcs.usda.gov/. Accessed 12/28/2012.
2. See Figure 1-5 for soils map.

U.S. ARMY CORPS OF ENGINEERS
LOUISVILLE DISTRICT, KENTUCKY

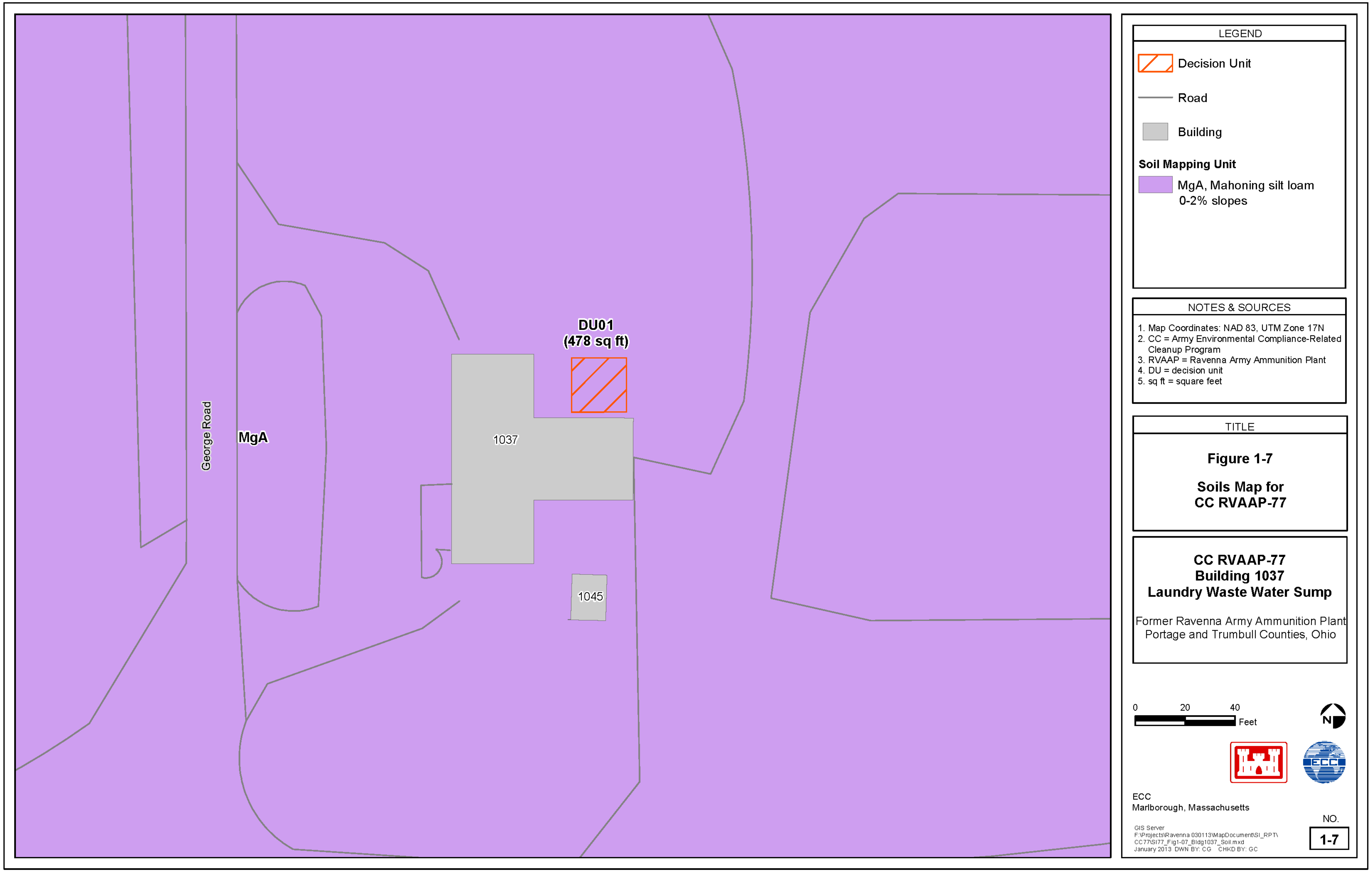
Figure 1-6

Description of Soil Mapping Units

Former Ravenna Army Ammunition Plant
Portage and Trumbull Counties, Ohio

ECC GIS Server: F:\Projects\Ravenna\MapDocuments\SI_RPT\CC77\SI77_Fig1-06_SoilsMapLegend.mxd

This page intentionally left blank.


DU01
(478 sq ft)
1037
1045
George Road
MgA
LEGEND
Decision Unit
Road
Building
Soil Mapping Unit
MgA, Mahoning silt loam
0-2% slopes
NOTES & SOURCES
1. Map Coordinates: NAD 83, UTM Zone 17N
2. CC = Army Environmental Compliance-Related Cleanup Program
3. RVAAP = Ravenna Army Ammunition Plant
4. DU = decision unit
5. sq ft = square feet
TITLE
Figure 1-7
Soils Map for
CC RVAAP-77
CC RVAAP-77
Building 1037
Laundry Waste Water Sump
Former Ravenna Army Ammunition Plant
Portage and Trumbull Counties, Ohio
0
20
40
Feet
N
ECC
Marlborough, Massachusetts
NO.
1-7

This page intentionally left blank.

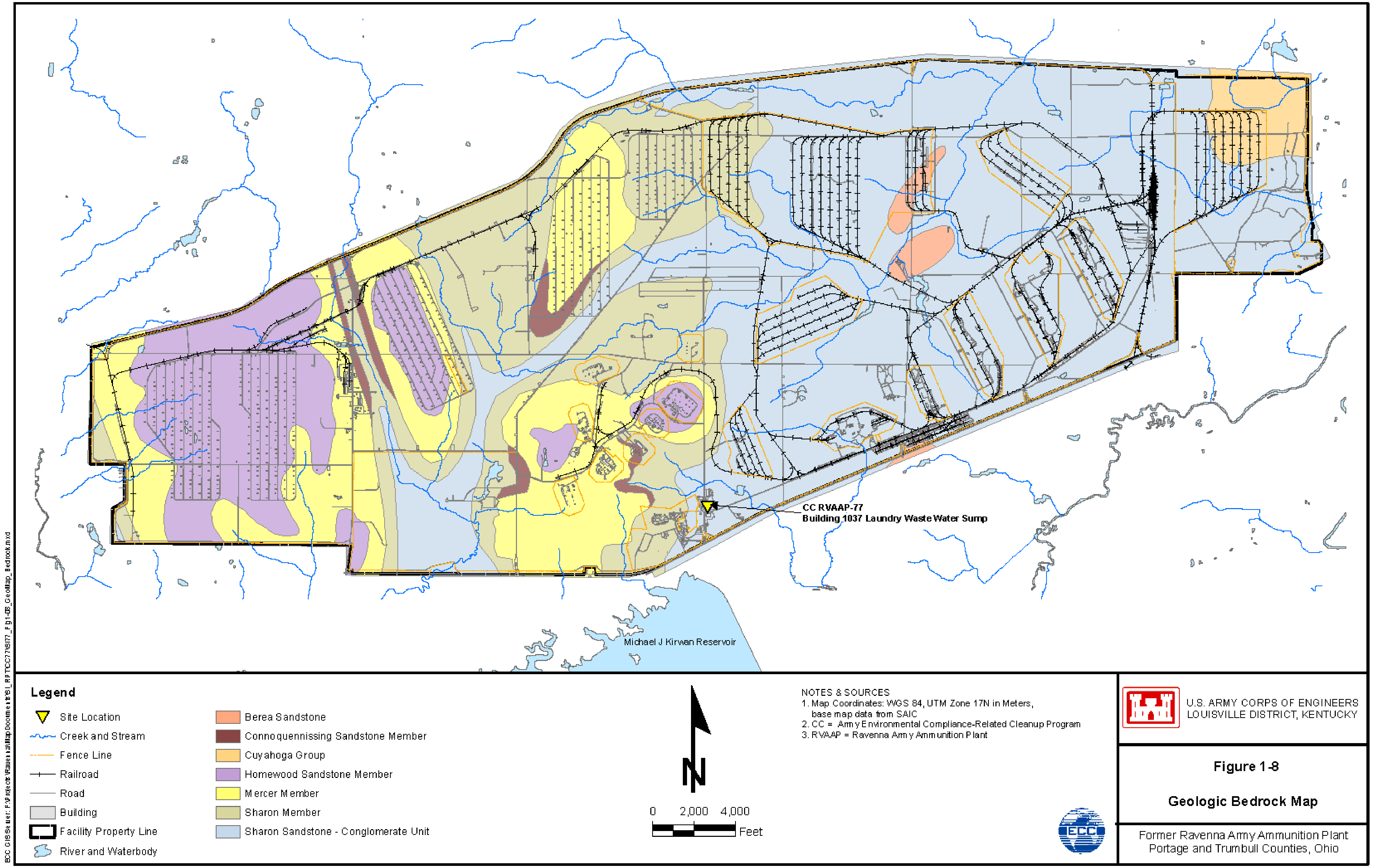
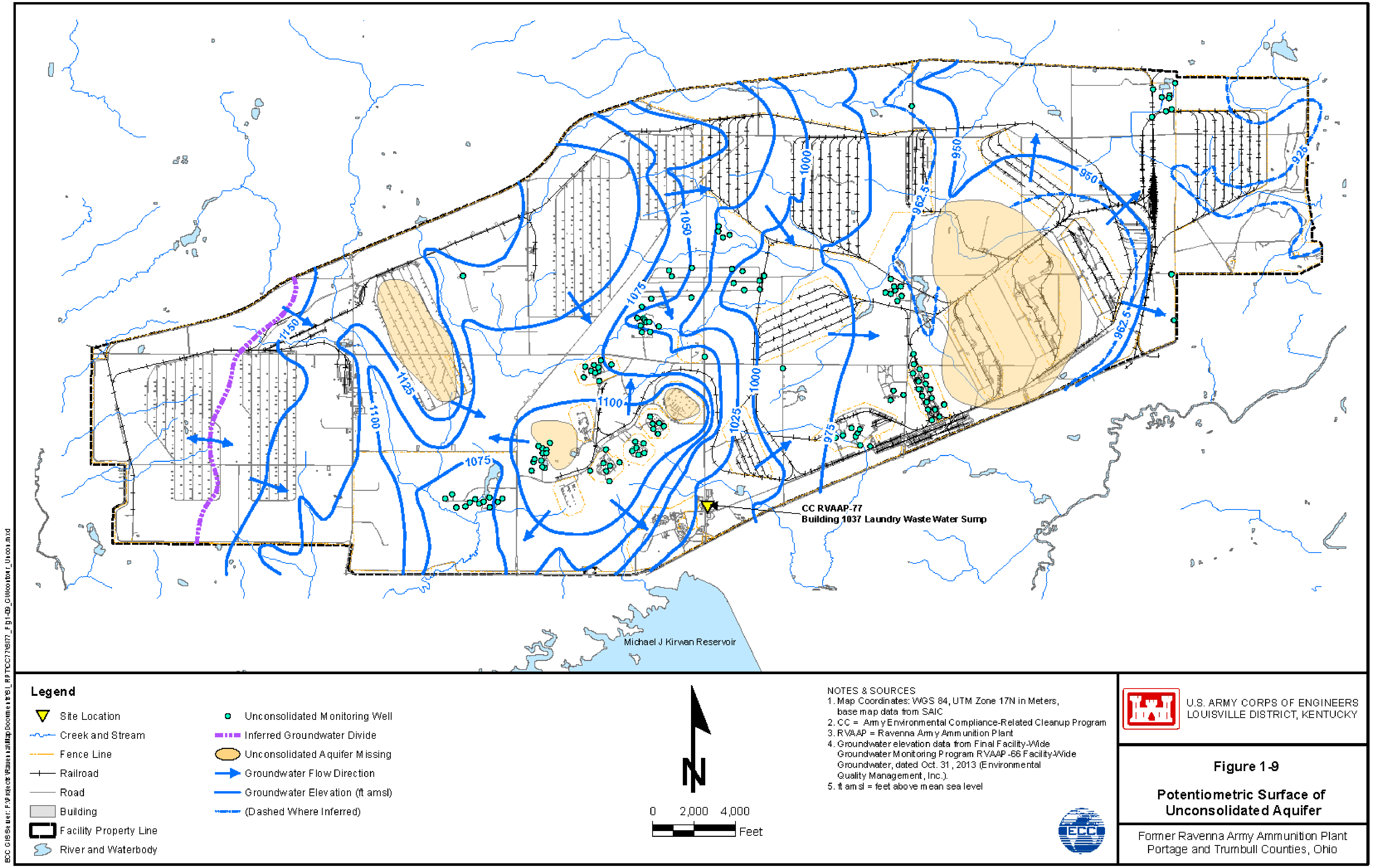


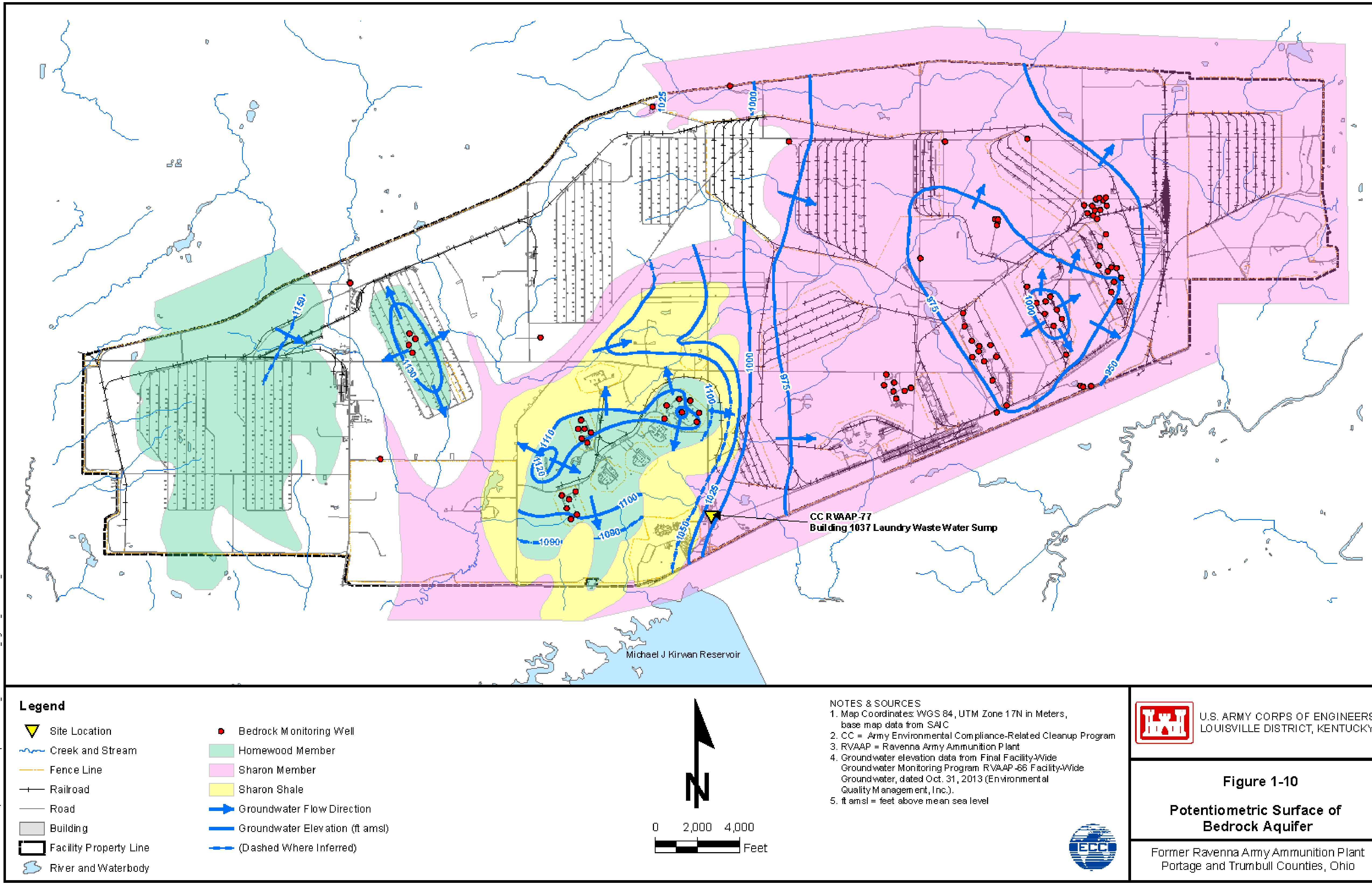
Figure 1-8

Geologic Bedrock Map

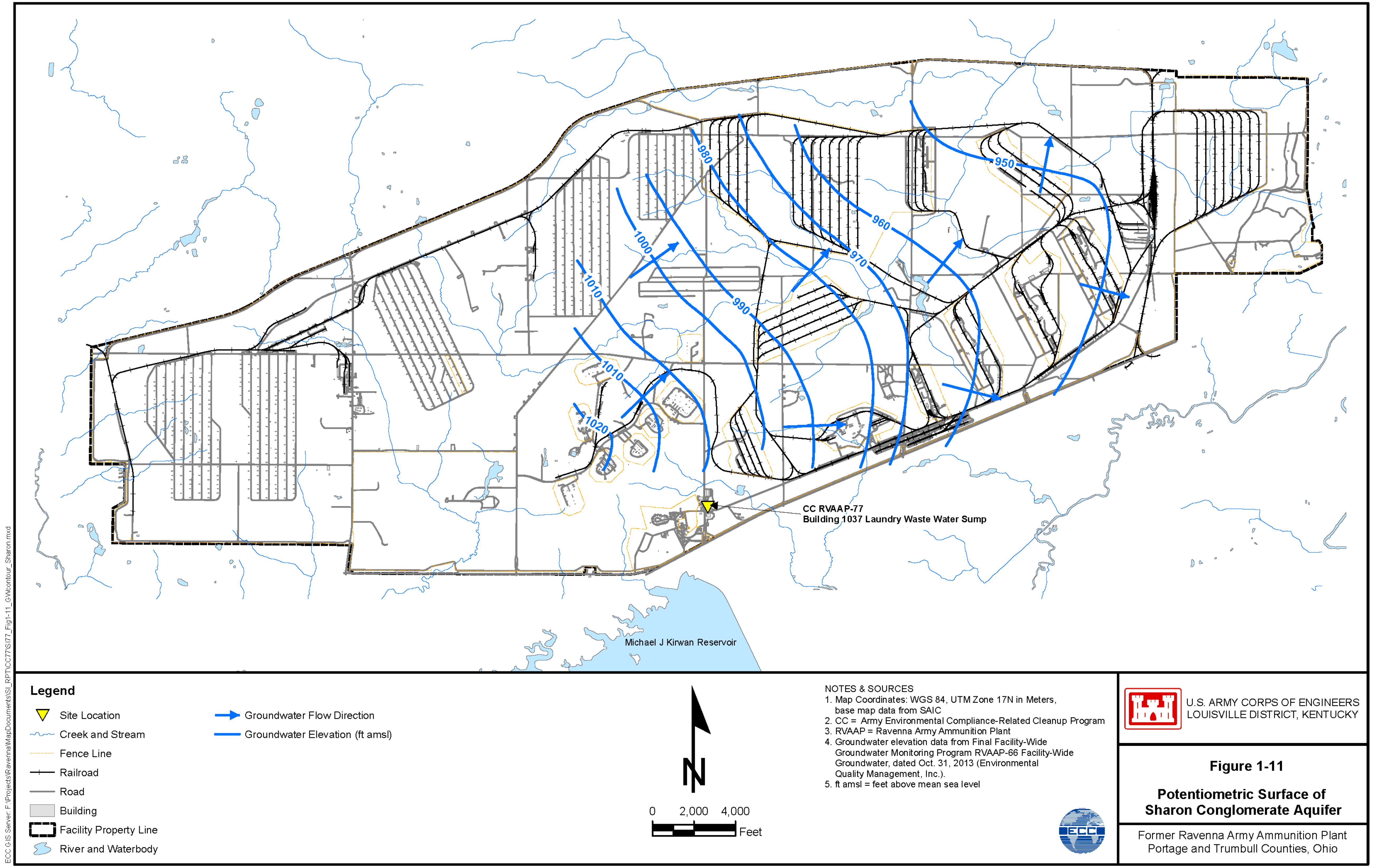
This page intentionally left blank.


1150
1125
1100
1075
1050
1025
1000
975
962.5
950
925
CC RVAAP-77
Building 1037 Laundry Waste Water Sump
Michael J Kirwan Reservoir
Legend
Site Location
Creek and Stream
Fence Line
Railroad
Road
Building
Facility Property Line
River and Waterbody
Unconsolidated Monitoring Well
Inferred Groundwater Divide
Unconsolidated Aquifer Missing
Groundwater Flow Direction
Groundwater Elevation (ft amsl)
(Dashed Where Inferred)
N
0 2,000 4,000
Feet
NOTES & SOURCES
1. Map Coordinates: WGS 84, UTM Zone 17N in Meters, base map data from SAIC
2. CC = Army Environmental Compliance-Related Cleanup Program
3. RVAAP = Ravenna Army Ammunition Plant
4. Groundwater elevation data from Final Facility-Wide Groundwater Monitoring Program RVAAP-66 Facility-Wide Groundwater, dated Oct. 31, 2013 (Environmental Quality Management, Inc.).
5. ft amsl = feet above mean sea level
U.S. ARMY CORPS OF ENGINEERS
LOUISVILLE DISTRICT, KENTUCKY
Figure 1-9
Potentiometric Surface of Unconsolidated Aquifer
Former Ravenna Army Ammunition Plant
Portage and Trumbull Counties, Ohio

This page intentionally left blank.


CC RVAAP-77
Building 1037 Laundry Waste Water Sump
Michael J Kirwan Reservoir
1150
1130
1120
1110
1100
1090
1050
1025
1000
975
950
Legend
Site Location
Creek and Stream
Fence Line
Railroad
Road
Building
Facility Property Line
River and Waterbody
Bedrock Monitoring Well
Homewood Member
Sharon Member
Sharon Shale
Groundwater Flow Direction
Groundwater Elevation (ft amsl)
(Dashed Where Inferred)
N
0 2,000 4,000
Feet
NOTES & SOURCES
1. Map Coordinates: WGS 84, UTM Zone 17N in Meters, base map data from SAIC
2. CC = Army Environmental Compliance-Related Cleanup Program
3. RVAAP = Ravenna Army Ammunition Plant
4. Groundwater elevation data from Final Facility-Wide Groundwater Monitoring Program RVAAP-66 Facility-Wide Groundwater, dated Oct. 31, 2013 (Environmental Quality Management, Inc.).
5. ft amsl = feet above mean sea level
U.S. ARMY CORPS OF ENGINEERS
LOUISVILLE DISTRICT, KENTUCKY
Figure 1-10
Potentiometric Surface of Bedrock Aquifer
Former Ravenna Army Ammunition Plant
Portage and Trumbull Counties, Ohio

This page intentionally left blank.


980
950
960
970
1000
990
1010
1010
1020
CC RVAAP-77
Building 1037 Laundry Waste Water Sump
Michael J Kirwan Reservoir
Legend
Site Location
Creek and Stream
Fence Line
Railroad
Road
Building
Facility Property Line
River and Waterbody
Groundwater Flow Direction
Groundwater Elevation (ft amsl)
N
0 2,000 4,000
Feet
NOTES & SOURCES
1. Map Coordinates: WGS 84, UTM Zone 17N in Meters, base map data from SAIC
2. CC = Army Environmental Compliance-Related Cleanup Program
3. RVAAP = Ravenna Army Ammunition Plant
4. Groundwater elevation data from Final Facility-Wide Groundwater Monitoring Program RVAAP-66 Facility-Wide Groundwater, dated Oct. 31, 2013 (Environmental Quality Management, Inc.).
5. ft amsl = feet above mean sea level
U.S. ARMY CORPS OF ENGINEERS
LOUISVILLE DISTRICT, KENTUCKY
Figure 1-11
Potentiometric Surface of Sharon Conglomerate Aquifer
Former Ravenna Army Ammunition Plant
Portage and Trumbull Counties, Ohio

This page intentionally left blank.

2.0 SITE DESCRIPTION AND OPERATIONAL HISTORY

2.1 SITE DESCRIPTION

The CR site, CC RVAAP-77 Building 1037 Laundry Waste Water Sump AOC (Figure 2-1), consists of the former concrete sump location at Building 1037. The building was used from World War II until 1992 as the laundry for the facility. As stated in the HRR (SAIC 2011a), "*the former laundry was used to launder workers' overalls that were potentially contaminated with explosive and propellant chemicals used during munitions production."* The laundry area occupied the entire footprint (approximately 3,181 square feet [sq ft]) of Building 1037. The concrete sump was located outside the former laundry building. The size of the waste water sump was 13 ft by 16 ft. The top of the waste water sump was at ground surface and the bottom of the waste water sump was at approximately 11.5 ft bgs. According to the *Final Project Completion Report Disposal of Discarded Munitions Debris & Components; Demolition of RVAAP-35 Building 1037 – Laundry Waste Water Sump and Laundry Flame Proofing Building and Evaluation and Recommendations for Closure of Clean-Hard Fill Sites,* completed by PIKA International, Inc. (PIKA), demolition and removal of the sump occurred between September and October 2009 (PIKA 2010).

The concrete sump served as a settling basin for discharged laundry rinse water prior to entering the sanitary sewer at manhole MH-1-3, as shown in Figure 2-1. The sump was used to capture solids carried by the rinse water, including potentially explosive-contaminated residues, prior to the water being discharged to the sewer. In approximately 1954, the concrete sump was emptied of its contents (sawdust) and backfilled in place with clean soil. The concrete sump was replaced by a small, above ground, stainless steel settling tank. The settling tank was housed inside a small annex attached to the north side of Building 1037 known as the Laundry flame Proofing Building, as shown in the photographs on Figure 2-1 (PIKA 2010).

Building 1037 is located east of George Road and north of South Service Road in the former Administration Area (Figure 2-1). Building 1037 was the former laundry building from World War II through 1992 and used from 1992 to 2013 by the Army Base Realignment and Closure Division for administrative offices. Site topography is generally flat (Figure 2-1). Surface water runoff from Building 1037 Laundry Waste Water Sump drains into the storm sewer system. The acreage of the CR site has not been defined, but is estimated to be less than 1 acre.

2.2 LAND USE AND OWNERSHIP HISTORY

CC RVAAP-77 Building 1037 Laundry Waste Water Sump is located within the former RVAAP. Camp Ravenna is used for military training. Building 1037 is currently used for administrative purposes and meeting space by the OHARNG. Appendix A contains historical aerial photographs (1940-2009) of the CR site.

2.3 PREVIOUS INVESTIGATIONS

Demolition and removal of the concrete sump was conducted in 2009. Analytical samples of the demolition debris, wood, and concrete slab were collected. These samples were analyzed to certify that the structure and all components could be classified as decontaminated meeting the 5X certification, per Industrial Operations Command (Pamphlet 385-1), Classification and Remediation of Explosive Contamination (United States Army Industrial Operations Command 2008), meaning that the debris is free of explosive residue. All of the 5X certification sampling results verified that no explosive hazards existed for any of the building debris material. The soil excavated from under the floor slab, footer, and basin was inspected by an unexploded ordnance (UXO) technician for bulk explosives. No bulk explosives were identified. No confirmatory soil samples were collected for laboratory analysis in 2009. Following the demolition and removal of the concrete sump, the excavated soil from the site was used as backfill. In addition, 94.5 tons of additional backfill, approved for use by the Ohio EPA, was used to complete the work (PIKA 2010).

An HRR was conducted in 2010 (SAIC 2011a) for this CR site. The report contained the following observations and conclusions:

- The concrete waste water sump was used as a settling basin. The purpose of the concrete sump was to remove solids from the laundry rinse water prior to discharge to the sanitary sewer. Solids were periodically removed from the concrete sump and burned to remove explosive residues, presumably at either Erie Burning Grounds or the Winklepeck Burning Grounds. The concrete sump was used for laundry operations until approximately 1954, and was demolished in 2009 and removed from Building 1037.

- The samples of the resultant wood, concrete, and soil from the demolition debris were collected. The samples were tested to determine if debris could be classified as being decontaminated to 5X certification meaning that the debris is free of explosive residue. All 5X certification sampling results verified that no explosive hazards were associated with any of the building debris material. The excavated soil from under the floor slab, footer, and basin was visually inspected by a UXO technician for bulk explosives. No bulk explosives were identified.

- No confirmatory soil samples were collected for laboratory analysis during the demolition in 2009.

- The excavated site soil was used as backfill, along with approximately 94.5 tons of additional off-site fill material, which was sampled and approved by the Ohio EPA.

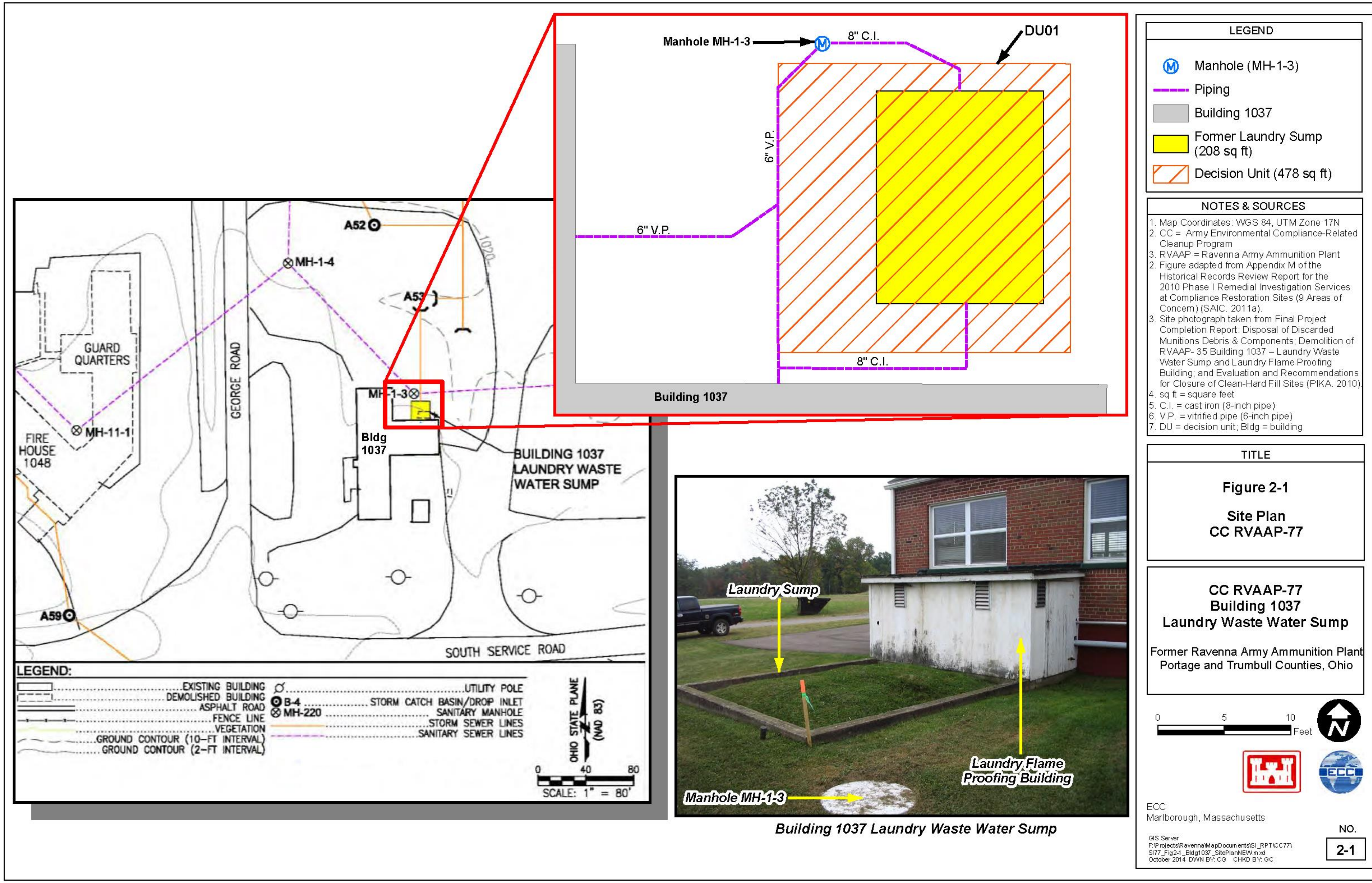
- No documented evidence of a spill or release at the laundry building was found during the HRR.

- No visual evidence of impacts (e.g., stained soil, stressed vegetation) were observed during the site visit.

- Further investigation was recommended based on the findings of the HRR, which recommended subsurface soil sampling at the waste water sump location at CC RVAAP-77, specifically for explosive and propellant chemicals (SAIC 2011a).

This SI was completed based on the information and recommendations provided in the HRR report for the former laundry sump located at Building 1037 Laundry Waste Water Sump AOC.

This page intentionally left blank.



Building 1037 Laundry Waste Water Sump

This page intentionally left blank.

3.0 HISTORICAL OPERATIONS

As stated in the HRR report (SAIC 2011a), "*the laundry building was used to launder workers' overalls that were potentially contaminated with explosive and propellant chemicals used during munitions production*." The potential contaminants at this AOC are explosive and propellant chemicals.

The concrete sump was used between WWII and approximately 1954 as a settling basin to remove the solids from laundry rinse water prior to entering the sanitary sewer. The system included the use of sawdust to trap explosives. Solids were periodically removed from the sump and burned to remove explosive residues, presumably at either the Erie Burning Grounds or Winklepeck Burning Grounds. The filtered water was discharged to the sanitary sewer for treatment at the George Road Sewage Treatment Plant (CC RVAAP-75). No other information related to historical operations, spills, or releases of chemicals was reported or identified during the completion of the HRR.

The previous operations, investigations, and removal actions at Building 1037 are summarized in Table 3-1, which includes descriptions of potential contaminants associated with these activities.

Table 3-1: Summary of Previous Operations, Investigations, and Removal Actions at CC RVAAP-77

Previous Operations – CC RVAAP-77		
Operations	**Documentation Provided**	**Description/Potential Contaminants**
Operations Involving Hazardous, Toxic, or Radioactive Waste	Yes	– Laundry service provided for workers' overalls potentially contaminated with explosive and propellant chemicals.

Previous Investigations/Removal Actions – CC RVAAP-77		
Year	**Type Investigation/Action**	**Findings**
1954	Abandonment of concrete sump in place	– Concrete waste water sump was emptied and backfilled (in place) with clean soil. – The waste water sump was replaced with a new, stainless steel, settling tank which was then used from 1954 until 1992 for removal of solids from the rinse water.
2009	Removal of concrete sump	– 5X certification sampling indicated no explosive hazards existed in building material. – Visual inspection of excavated soil showed no evidence of bulk explosives.
2011	HHR	– Facility was used to launder workers' overalls that were potentially contaminated with explosive and propellant chemicals used during munitions production. – CC RVAAP-77 Building 1037 Laundry Waste Water Sump was recommended for further investigation.

Source: HRR (SAIC 2011a).

This page intentionally left blank.

4.0 FIELD INVESTIGATION

Work for this SI was conducted in accordance with the Final SI/RI Work Plan (ECC 2012) and the *Facility-Wide Sampling and Analysis Plan for Environmental Investigations at the RVAAP, Ravenna, Ohio* (SAIC 2011b) dated February 24, 2011, unless specifically noted otherwise (Section 4.4). The surface and subsurface soil samples collected and analyzed for this SI are summarized in Table 4-1.

4.1 SAMPLING RATIONALE

Surface and subsurface soil sampling was conducted at the CC RVAAP-77 to determine the presence of potential contamination associated with the waste water sump area, as described in the Final SI/RI Work Plan (ECC 2012). Although the sump was removed in 2009, no confirmatory soil samples were collected at that time to verify whether the sump contents had impacted the surrounding subsurface soil (SAIC 2011a). As no confirmation soil samples were collected during the removal of the sump, the soil sampling area for this SI (Decision Unit [DU01]) was established to encompass the former laundry sump area as shown on Figure 4-1. The DU was sized specifically to encompass the waste water sump area and is smaller than a typical one-quarter acre exposure unit (Facility-Wide Human Health Risk Assessment Manual, 2005). The DU was centered on the waste water sump area (208 sq ft) and extended approximately 2-8 ft outside of the original sump boundaries where contamination may have been released to the subsurface soil. The DU area is 478 sq ft. This smaller DU (less than one-quarter acre) was established around the waste water sump area to increase the likelihood of identifying potential contamination.

The Final SI/RI Work Plan (ECC 2012) included collection of a discrete sediment sample from the bottom of the manhole adjacent to DU01 in the event that sediment was found. However, when the manhole was inspected on November 11, 2012, no sediment was observed at the bottom of the manhole; therefore, no sediment samples were collected as part of this SI. During this sampling event, water (approximately 1 inch deep) was observed in the manhole flowing eastward toward the George Road Sewage Treatment Plant. It was also observed that the drainage pipe from the former laundry sump leading to the manhole was sealed with concrete. No historical documents were found that documented the sealing of the pipe; however, it is assumed that the pipe was sealed during the removal of the sump in September 2009. Table 4-2 provides a summary of the sampling rationale for each of the surface and subsurface soil samples collected at CC RVAAP-77.

4.2 PRE-MOBILIZATION ACTIVITIES

Prior to the field investigation, a series of pre-mobilization activities were undertaken to ensure that all applicable requirements were met. These included providing any necessary notifications to the Army, Ohio EPA, and other stakeholders.

ECC personnel mobilized to the facility on October 22, 2012 to conduct a site walk and pre-mark the DU and direct-push boring locations at CC RVAAP-77. The pre-mobilization tasks included the following activities:

- Conducting a site walk
- Locating the DU
- Locating the soil borings
- Decontaminating the sampling equipment.

4.2.1 Site Walk

ECC conducted a site walk at CC RVAAP-77 on October 22, 2012 to assess current site conditions and to note any potential health and safety hazards that could affect the SI field work.

4.2.2 Soil Sampling Locations

For this SI, one DU (DU01) was established as the soil sampling area as shown on Figure 4-1. A surface soil ISM sample (0-1 ft bgs), and two horizontal subsurface soil ISM samples from intervals of 1-4 and 4-7 ft bgs were collected at DU01. Five vertical subsurface soil ISM samples were also collected from the interval of 1-7 ft bgs. In addition, one boring (referred to as a “deep” soil boring [DSB]) was advanced to 7-13 ft bgs to identify potential chemicals in the soil down to 13 ft bgs. After the DU was located and marked, the direct-push soil boring locations were marked with wooden stakes with high visibility paint and flagging.

4.2.3 Munitions and Explosives of Concern and Utility Clearance Surveys

Based on HRR findings (SAIC 2011a) and documentation from the sump removal project, munitions and explosives of concern clearances were not required or conducted at the Building 1037 Laundry Waste Water Sump CC RVAAP-77. No documentation of military munitions being historically located or stored on-site was discovered.

ECC met with VISTA Sciences Corporation representatives on October 23, 2012 at Building 1037. During this meeting, ECC inquired of Mr. James D. McGee, VISTA Sciences Corporation Project Manager for the former RVAAP, about utility clearance protocols at the facility.

Mr. McGee initially suggested that ECC contact the OHARNG regarding utility clearance. However, after his review of the sites, Mr. McGee reported that any utility located within these areas would either have been removed or, if still in place, inactive and not energized. Active utilities were not encountered during any of the drilling activities conducted at CC RVAAP-77.

4.2.4 Site Clearing Activities

Site clearing activities were not required at the AOC. This AOC is located in an area with low brush, tall grass, and an access road adjacent to the AOC. Therefore, the site was easily accessible by vehicles and drilling equipment.

4.2.5 Site Security

No specific site security was needed at CC RVAAP-77. However, each work day prior to mobilizing to the AOC, Camp Ravenna Range Control was notified that ECC and subcontractor personnel would be working at the AOC.

4.2.6 Equipment Decontamination

Prior to beginning surface soil sampling, all sampling equipment was decontaminated at a pre-designated area within Building 1036. For this purpose, a 5-sq ft piece of plastic sheeting was placed on the concrete floor of the building in the designated decontamination area.

Five-gallon buckets were used to contain brushes, potable water with Alconox® wash, and potable water rinse. Other decontamination fluids consisted of pesticide grade isopropyl alcohol, a 10 percent nitric acid solution, and laboratory supplied deionized (DI) water contained in spray bottles. Following the Alconox® wash with brushes and potable water rinse, sampling equipment was sprayed with isopropyl alcohol, sprayed with the 10 percent nitric acid solution, rinsed with DI water, and then wrapped in aluminum foil. Sufficient sampling equipment was brought to the site each morning to allow for sampling of the DU area without the need to decontaminate equipment. All sampling equipment was decontaminated inside Building 1036 at the end of each work day in preparation for sampling the following day.

Prior to commencing subsurface soil sampling, all direct-push drilling rods and equipment were decontaminated using a high pressure steam cleaner and brushes. A temporary decontamination pad was constructed outside of Building 1036 and lined with plastic sheeting. The drilling equipment was then placed on a temporary steel rack within the decontamination pad, and the equipment was thoroughly cleaned. Following conclusion of subsurface soil sampling, drilling equipment was decontaminated using a high pressure steam cleaner.

During subsurface soil sampling at the Building 1037 Laundry Waste Water Sump CC RVAAP-77, direct-push steel samplers were decontaminated as necessary using 5-gallon buckets, Alconox® wash and brushes, potable water rinse, pesticide grade isopropyl alcohol, a 10 percent nitric acid solution, and laboratory-supplied DI water contained in spray bottles. The decontamination area was set up on plastic sheeting off the eastern side of Building 1037. All decontamination fluids were containerized in a Department of Transportation-approved 55-gallon closed steel drum located within secondary containment inside Building 1036. The drum was labeled with contents, date of initial generation, and contact information.

All sampling equipment was decontaminated in accordance with the procedures outlined in Section 5.6.2.9 of the *Facility-Wide Sampling and Analysis Plan* (FWSAP) (SAIC 2011b).

4.3 FIELD SAMPLING

At CC RVAAP-77 Building 1037 Former Laundry Waste Water Sump, ISM soil samples were collected to determine whether contamination was present within the AOC. Between November 11 and December 3, 2012, both surface (0-1 ft bgs) and subsurface soil (1-4, 4-7, and 1-7 ft bgs) ISM samples were collected within DU01. One composite subsurface soil sample was also collected from 7 to 13 ft bgs at the AOC, as summarized in Table 4-1.

The subsurface soil samples were analyzed for explosive and propellant chemicals. The surface soil samples were analyzed for the RVAAP full suite, which includes the parameters summarized in Table 4-1 and listed below:

- Volatile organic compounds (VOCs)
- Semi-volatile organic compounds (SVOCs)
- Polychlorinated biphenyls (PCBs)
- Explosives
- Propellants
- Pesticides
- Target Analyte List (TAL) Metals.

Table 4-1 provides a summary of the soil samples collected between November and December 2012. Table 4-2 summarizes the sampling rationale for each sample collected at Building 1037 Laundry Waste Water Sump CC RVAAP-77.

Table 4-1: Summary of Samples Collected Between November and December 2012 at CC RVAAP-77

Location	Decision Unit	Sample ID	Matrix	Depth (ft)	Date	Sampling Method	VOC	BTEX/MTBE	SVOC	TPH GRO	TPH DRO	TAL Metals	PCB	Pesticides	Herbicides	Explosives	Propellants
Surface Soil Analytical Program																	
Building 1037 Laundry Sump	DU01	077SS-0001M-0001-SO	SS	0-1	11-Nov-12	ISM	X		X			X	X	X		X	X
Building 1037 Laundry Sump	MS/MSD of 0001M	077SS-0001M-0002-SO	SS	0-1	11-Nov-12	ISM	X		X			X	X	X		X	X
Building 1037 Laundry Sump	Dup of 0001M	077SS-0002M-0001-SO	SS	0-1	11-Nov-12	ISM	X		X			X	X	X		X	X
Subsurface Soil Analytical Program																	
Building 1037 Laundry Sump	DU01 SB-01	077SB-0004M-0001-SO	SB	1-4	3-Dec-12	ISM										X	X
Building 1037 Laundry Sump	DU01 SB-01	077SB-0005M-0001-SO	SB	4-7	3-Dec-12	ISM										X	X
Building 1037 Laundry Sump	DU01 SB-01	077SB-0006M-0001-SO	SB	1-7	3-Dec-12	ISM										X	X
Building 1037 Laundry Sump	DU01 SB-02	077SB-0007M-0001-SO	SB	1-7	3-Dec-12	ISM										X	X
Building 1037 Laundry Sump	DU01 SB-03	077SB-0008M-0001-SO	SB	1-7	3-Dec-12	ISM										X	X
Building 1037 Laundry Sump	DU01 SB-04	077SB-0009M-0001-SO	SB	1-7	3-Dec-12	ISM										X	X
Building 1037 Laundry Sump	DU01 SB-05	077SB-0010M-0001-SO	SB	1-7	3-Dec-12	ISM										X	X
Building 1037 Laundry Sump	DU01 SB-02	077SB-0011-0001-SO	SB	7-13	3-Dec-12	Composite										X	X

Table 4-1: Summary of Samples Collected Between November and December 2012 at CC RVAAP-77 (continued)

Location	Decision Unit	Sample ID	Matrix	Depth (ft)	Date	Sampling Method	VOC	BTEX/MTBE	SVOC	TPH GRO	TPH DRO	TAL Metals	PCB	Pesticides	Herbicides	Explosives	Propellants
Field Quality Control – Trip Blanks																	
TB-1	TB	077SS-0003-0001-TB	QC	NA	11-Nov-12	NA	X										
TB-2	TB	072SB-0006-0001-TB	QC	NA	3-Dec-12	NA	X										
TB-3	TB	072SB-0020-0001-TB	QC	NA	3-Dec-12	NA	X										
QC TB-1	TB	070-0060-0001-TB	QC	NA	12-Dec-12	NA	X										
QC TB-2	TB	070SB-0055-0001-TB	QC	NA	12-Dec-12	NA				X							
QC TB-7	TB	076-0068-0001-TB	QC	NA	15-Nov-12	NA	X										
QC TB-8	TB	076-0141-0001-TB	QC	NA	9-Dec-12	NA	X			X							
QC TB-9	TB	076-0142-0001-TB	QC	NA	9-Dec-12	NA	X			X							
Field Quality Control - Source Water																	
SorW-1	SorW (ECC bottled decontamination water)	070-0057-0001-SorW	QC	Non-dedicated hand sampling tools	12-Dec-12	NA	X	X	X	X	X	X	X	X	X	X	X

Table 4-1: Summary of Samples Collected in November and December 2012 at CC RVAAP-77 (continued)

Location	Decision Unit	Sample ID	Matrix	Depth (ft)	Date	Sampling Method	VOC	BTEX/MTBE	SVOC	TPH GRO	TPH DRO	TAL Metals	PCB	Pesticides	Herbicides	Explosives	Propellants
Field Quality Control - Source Water																	
SorW-2	SorW (Driller decontamination water)	070-0056-0001-SorW	QC	Direct-Push Tools	12-Dec-12	NA	X	X	X	X	X	X	X	X	X	X	X
Field Quality Control - Equipment Rinsate																	
ER-1	ER Blank	076-0067-0001-ER	QC	Non-dedicated hand sampling tools during sampling event	15-Nov-12	NA	X	X	X	X	X	X	X	X	X	X	X
ER-2	ER Blank	076-0140-0001-ER	QC	Non-dedicated hand sampling tools during sampling event	9-Dec-12	NA	X	X	X	X	X	X	X	X	X		X

Notes:

Field Duplicate Sample	Matrix Spike/Matrix Spike Duplicate Sample	RVAAP Full Suite Sample

VOC and TPH-GRO soil samples were collected as discrete samples.
Propellants include nitroguanidine, nitrocellulose, and nitroglycerin

BTEX = Benzene, toluene, ethylbenzene, and xylene
DRO = Diesel range organics
DU = Decision Unit
ECC = Environmental Chemical Corporation
ER = Equipment rinsate
FD = Field duplicate
ft = Feet
GRO = Gasoline range organics
ID = Identification
ISM = Incremental sampling methodology
MS = Matrix spike
MSD = Matrix spike duplicate
MTBE = Methyl tertiary butyl ether
NA = Not applicable
PCB = Polychlorinated biphenyl
QC = Quality control
SB = Soil boring
SorW = Source water
SS = Surface sample
SVOC = Semi-volatile organic compound
TAL = Target Analyte List
TB = Trip blank
TPH = Total petroleum hydrocarbons
VOC = Volatile organic compound

This page intentionally left blank.

Table 4-2: Summary of Soil Sampling Rationale, November and December 2012 at CC RVAAP-77

Sample Type	Depth (ft bgs)	Location (DU/SB)	Sample ID	Date Sampled	Rationale
ISM	0-1	DU01	077SS-0001M-0001-SO	11-Nov-12	Determine presence or absence of potential contamination in surface soil around the waste water sump location not previously sampled. Analyzed for Ravenna Army Ammunition Plant Full-suite analysis.
ISM	0-1	DU01	077SS-0001M-0002-SO	11-Nov-12	Quality Control. Matrix spike/matrix spike duplicate sample of 077SS-0001M-0001-SO.
ISM	0-1	DU01	077SS-0002M-0001-SO	11-Nov-12	Quality Control. Field duplicate sample of 077SS-0001M-0001-SO.
ISM	1-4	DU01	077SB-0004M-0002-SO	3-Dec-12	Determine presence or absence of potential contamination in soil around the waste water sump location not previously sampled.
ISM	4-7	DU01	077SB-0005M-0001-SO	3-Dec-12	Determine presence or absence of potential contamination in soil around the waste water sump location not previously sampled.
ISM	1-7	SB01	077SB-0006M-0001-SO	3-Dec-12	Determine presence or absence of potential contamination in soil around the waste water sump location not previously sampled.
ISM	1-7	SB02	077SB-0007M-0001-SO	3-Dec-12	Determine presence or absence of potential contamination in soil around the waste water sump location not previously sampled.
ISM	1-7	SB03	077SB-0008M-0001-SO	3-Dec-12	Determine presence or absence of potential contamination in soil around the waste water sump location not previously sampled.
ISM	1-7	SB04	077SB-0009M-0001-SO	3-Dec-12	Determine presence or absence of potential contamination in soil around the waste water sump location not previously sampled.
ISM	1-7	SB05	077SB-0010M-0001-SO	3-Dec-12	Determine presence or absence of potential contamination in soil around the waste water sump location not previously sampled.
Composite	7-13	SB02	077SB-0011M-0001-SO	3-Dec-12	Determine presence or absence of potential contamination in soil around the waste water sump location not previously sampled.
Grab	NA	NA	077SS-0003-0001-TB	11-Nov-12	Quality Control. Trip Blank.

Notes:
bgs = Below ground surface
DU = Decision Unit
ft = Feet
ID = Identification
ISM = Incremental sampling methodology
SB = Soil boring

This page intentionally left blank.

Samples collected during this SI at CC RVAAP-77 were analyzed at TestAmerica Laboratories, Inc. of North Canton, Ohio. Quality Control (QC) samples were also collected during this SI, as summarized in Tables 4-1 and 4-2.

All analytical procedures were completed in accordance with applicable professional standards, USEPA requirements, government regulations and guidelines, Department of Defense Quality Systems Manual Version 4.2, USACE–Louisville District analytical Quality Assurance (QA) standards, and specific project goals and requirements. Preparation and analyses for chemical parameters in field samples were completed using the methods listed in Table 4-3.

Table 4-3: Sample Preparation and Analytical Methods November and December 2012, CC RVAAP-77

Parameter	Soil		Aqueous	
	Preparation	Method	Preparation	Method
Metals	SW-846 3050B	SW-846 6020	NA	NA
Mercury	SW-846 7471A	SW-846 7471A	NA	NA
Explosives	SW-846 8830B	SW-846 8330B	NA	NA
Propellants: - Nitrocellulose - Nitroguanidine	E353.2 Modified SW-846 8330 Modified	E353.2 Modified SW-846 8330 Modified	NA	NA
SVOCs and PAHs	SW-846 3540C	SW-846 8270C	NA	NA
VOCs	SW-846 5035	SW-846 8260B	SW-846 5030B	SW-846 8260B
Pesticides	SW-846 3540C	SW-846 8081A	NA	NA
PCBs	SW-846 3540C	SW-846 8082	NA	NA

Notes:
NA = Not applicable
PAH = Polycyclic aromatic hydrocarbon
PCB = Polychlorinated biphenyl
SVOC = Semi-volatile organic compound
VOC = Volatile organic compound

4.3.1 Surface Soil Incremental Soil Methodology Sampling

One surface soil ISM sample and a duplicate sample were collected at CC RVAAP-77. The surface soil samples (aliquots) were collected from 0 to 1 ft bgs using ISM methods as detailed in the Final SI/RI Work Plan (ECC 2012) in order to identify the presence of contamination in surface soil. Thirty individual soil aliquots were collected to comprise the ISM sample. The surface soil samples were collected using an AMS® Soil Probe which is a 40-inch one-piece soil step probe with a "T" handle attached to the top that collects a soil core sample that is approximately 12 inches in length. The sampler was advanced to 1 ft bgs and then withdrawn. The soil core from the step probe was then transferred into the appropriate sample container. VOC soil samples were collected as discrete soil samples from the center of the DU.

4.3.2 Horizontal Incremental Soil Methodology Soil Sampling

Two horizontal subsurface soil ISM samples were collected. The ISM subsurface soil sample was comprised from five soil borings advanced in the DU. At least 30 aliquots of soil were collected from each sample interval from each soil boring to generate the minimum 1 kilogram of soil for the ISM sample. The first ISM subsurface horizontal soil sample was collected from 1 to 4 ft bgs, and the second from 4 to 7 ft bgs.

Subsurface soil samples were collected using a Geoprobe® Model 6620DT direct-push drill rig. The procedures for hydraulic direct-push sampling were performed in accordance with Section 5.5.2.5.3 of the FWSAP (SAIC 2011b). Samples were collected using 5-ft long stainless steel sampling rods lined with acetate Macro-core® samplers. Each sample was collected using a dedicated liner specific for that interval. The 5-ft stainless steel sampler was advanced twice at each boring location to reach the depth of 7 ft bgs (and three times at one boring location to reach the depth of 13 ft bgs, as described below). The sampler was then retrieved from the desired depth and the liner removed. The liner was cut open length-wise and the soil was immediately field-screened with a photoionization detector. Samples for headspace field screening were collected at 2-ft intervals along the entire sampler using stainless steel scoopulas and placed in 8-ounce glass jars. The jars were then capped with aluminum foil and a plastic lid and allowed to warm for approximately 10 minutes. The tip of the photoionization detector was then inserted into the jar through the aluminum foil and the reading recorded on the boring log.

The liner containing the soil was photographed and soil characteristics for each interval were recorded on a soil boring log. A summary of sampling information was recorded on the field log forms. Field log forms and boring logs from the site investigation are presented in Appendices B and C, respectively. Photographs are presented in Appendix H.

4.3.2.1 Vertical Incremental Soil Methodology Soil Sampling

Five vertical ISM samples were collected from five borings (SB1 through SB5) at CC RVAAP-77. Vertical ISM samples were collected from 1 to 7 ft bgs. The 5-ft stainless steel sampler was advanced twice at each boring location to reach the final depth of 7 ft. A sample consisting of 30 aliquots of soil was collected by cutting open the acetate liner length-wise and running a stainless steel scoopula along the length of the sample from 1 to 5 ft and from 5 to 7 ft to collect a representative ISM vertical sample from that boring.

4.3.3 Deep Soil Boring Sampling

One soil boring (referred to as the DSB) was advanced at CC RVAAP-77 in order to characterize the soil to a depth of 13 ft bgs. The boring was advanced to a depth of 13 ft bgs and a sample was collected from the 7- to 13-ft bgs interval. Soil was collected by running a stainless steel scoopula along the length of the liner from 7 to 10 ft and from 10 to 13 ft. The soil was then mixed with a stainless steel spoon in a stainless steel bowl to collect a representative composite sample. These samples were collected in accordance with sampling procedures as described in Section 5.5.2.5.1 in the FWSAP (SAIC 2011b) and as presented in Appendix A, Section A.4, of the *Final SI/RI Work Plan* (ECC 2012). The DSB sample was collected from soil boring SB2 within DU01.

4.4 DEVIATIONS FROM WORK PLAN

The one deviation from the Final SI/RI Work Plan (ECC 2012) for fieldwork conducted at CC RVAAP-77 is described below:

– No sediment samples were collected at CC RVAAP-77. A discrete sediment sample was originally proposed for collection from the bottom of the manhole adjacent to DU01. However, when the manhole cover was removed on November 11, 2012, no sediment was observed at the bottom of the manhole. It was also noted during this inspection that the drainage pipe from the former laundry sump to the manhole was sealed with concrete. See Appendix H for photographs of the interior of this manhole.

4.5 SURVEYING

ECC subcontracted the surveying of the soil boring locations at CC RVAAP-77 to Campbell and Associates, Inc., Cuyahoga Falls, Ohio, a licensed surveyor in the state of Ohio. All survey data were reported in North American Datum 1983 Universal Transverse Mercator Zone 17 North in meters.

4.6 INVESTIGATION-DERIVED WASTE

IDW consisted of soil cuttings from subsurface soil sampling; personal protective equipment; used, empty acetate liners; used TerraCore® samplers; and general non-environmental trash. The soil cuttings were primarily collected in plastic garbage liners placed inside 5-gallon buckets.

Additional soil materials were collected on clear 6-millimeter thick plastic sheeting placed on the ground at the end of the cutting table and below the two 5-gallon buckets used for collecting soil cuttings. A large garbage bag contained used nitrile gloves, used TerraCore® samplers, and cut-up pieces of acetate liners. A long-handled steel lopper was used to cut the acetate liners into 12 to 18-inch long pieces for disposal. Finally, a large garbage bag was used to collect general non-environmental waste. The buckets for soil cuttings were brought to Building 1036 and placed in appropriately labeled 55-gallon open-headed drums.

4.6.1 Collection and Containerization

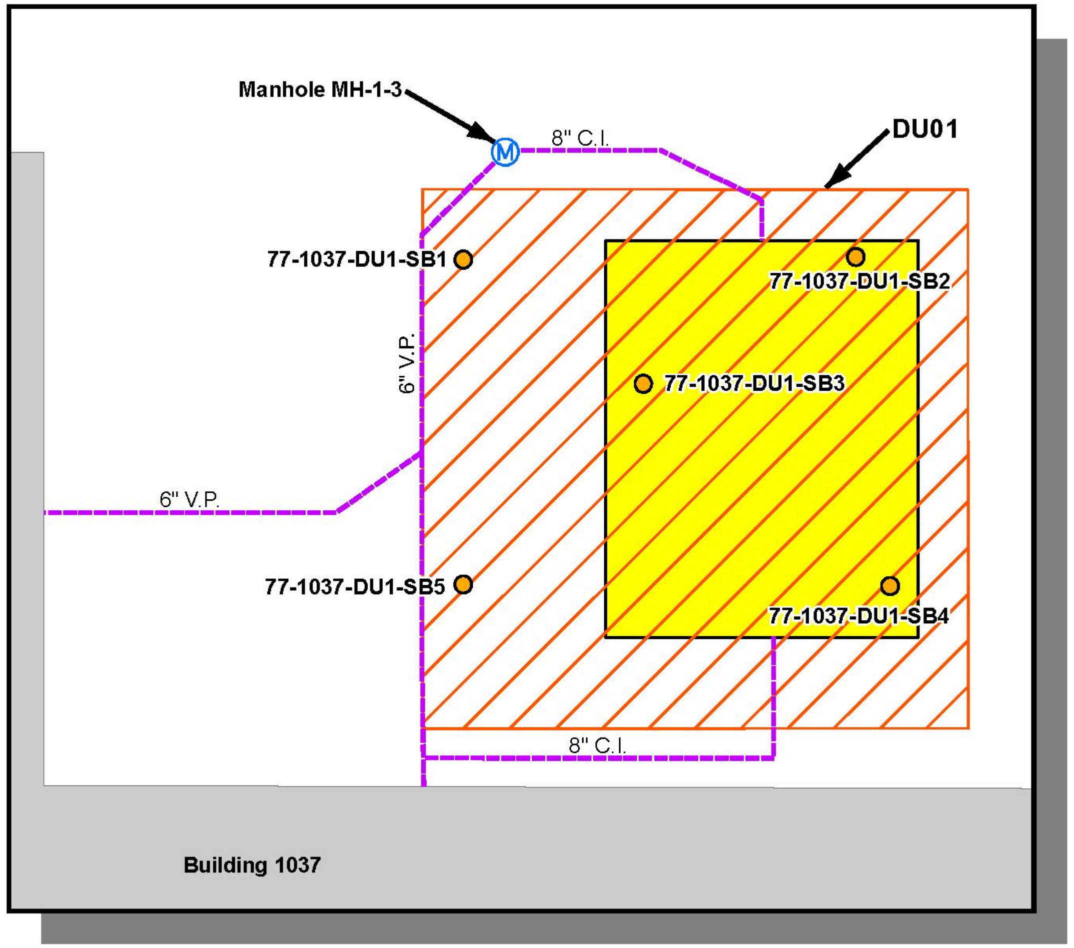
All IDW, including soil cuttings, personal protective equipment, disposable sampling equipment, and decontamination fluids, was properly handled, labeled, characterized, and managed in accordance with Section 8.0 of the FWSAP (SAIC 2011b), federal and state of Ohio large quantity generator requirements, and the former RVAAP's Installation Hazardous Waste Management Plan (Army Base Realignment and Closure Office 2009).

4.6.2 Characterization for Disposal

IDW disposal characterization samples were collected by ECC personnel on December 12, 2012. Samples were comprised of liquid IDW consisting of decontamination fluids, and solid IDW consisting of drill cuttings. IDW analysis included both liquid and solid full Toxicity Characteristic Leaching Procedure, and Reactivity, Corrosivity, and Ignitability analyses.

4.6.3 Transportation and Disposal

On March 15, 2013, the Ohio EPA approved the IDW letter report for the transport and disposal of the accumulated IDW as a result of executed SI tasks. The Ohio EPA approval letter for the IDW is provided in Appendix G. On April 5, 2013, the drummed IDW was transported under a non-hazardous waste manifest by Emerald Environmental Services, Inc. for disposal at Vexor Technology in Medina, Ohio. The manifest is provided in Appendix G.



Manhole MH-1-3 and Laundry Sump

Excavation of Laundry Sump

Laundry Sump Prior to Excavation

LEGEND

- Manhole (MH-1-3)
- Direct-Push Sampling Location
- Piping
- Building 1037
- Former Laundry Sump (208 sq ft)
- Decision Unit (478 sq ft)

NOTES & SOURCES

1. Map Coordinates: NAD 83, UTM Zone 17N
2. CC = Army Environmental Compliance-Related Cleanup Program
3. RVAAP = Ravenna Army Ammunition Plant
4. Surface soil incremental sampling methodology (ISM) sampling was performed at the decision unit (DU) from 0 to 1 feet below ground surface (ft bgs).
5. Horizontal subsurface soil ISM sampling was performed at all direct-push locations from 1 to 4 ft bgs and from 4 to 7 ft bgs.
6. Vertical subsurface soil ISM sampling was performed at all direct-push locations from 1 to 7 ft bgs.
7. A composite sample was also taken at location 77-1037-DU1-SB2 from 7 to 13 ft bgs.
8. Site photographs taken from Final Project Completion Report: Disposal of Discarded Munitions Debris & Components; Demolition of RVAAP- 35 Building 1037 – Laundry Waste Water Sump and Laundry Flame Proofing Building; and Evaluation and Recommendations for Closure of Clean-Hard Fill Sites (PIKA. 2010)
9. sq ft = square feet; C.I. = cast iron (8-inch pipe)
10. V.P. = vitrified pipe (6-inch pipe)

TITLE

Figure 4-1

Soil Boring Locations
CC RVAAP-77

CC RVAAP-77
Building 1037
Laundry Waste Water Sump

Former Ravenna Army Ammunition Plant
Portage and Trumbull Counties, Ohio

0 5 10 Feet

ECC
Marlborough, Massachusetts

GIS Server
F:\Projects\Ravenna\MapDocuments\SI_RPT\CC77\SI77_Fig4-1_Bldg1037_SampLocNEW.mxd
October 2014 DWN BY: CG CHKD BY: GC

NO. **4-1**

This page intentionally left blank.

5.0 DATA EVALUATION AND SUMMARY OF ANALYTICAL RESULTS

This section summarizes the analytical sampling results for CC RVAAP-77 Building 1037 Laundry Waste Water Sump. The laboratory analytical data for this SI are provided in Appendix E.

5.1 DATA EVALUATION

The data collected during this SI were verified and validated in accordance with the procedures outlined in the FWSAP (SAIC 2011b). The processes used to evaluate the analytical data are described in this section. The completed data verification report is included in Appendix D and the data validation report (to be provided by USACE–Louisville District) is included as Appendix F of this SI report. Non-detect data were reported as not detected in the summary of analytical results tables included in Section 5 and at the Limit of Detection (LOD) in Appendix D and Appendix E.

5.1.1 Soil Sampling Intervals

The soil sampling intervals defined for this SI are as follows:

- Surface Soil (0-1 ft bgs)*
- Subsurface Soil Horizontal Profile (1-4 and 4-7 ft bgs)
- Soil Boring Vertical Profile (1-7 ft bgs)
- DSB (7-13 ft bgs).

*= One surface soil sample (and a duplicate sample) were collected during this SI to verify the absence of surface soil contamination and as part of the QA/QC sampling for full suite analysis.

5.1.2 Data Verification, Validation, and Determination of Potential Contamination

5.1.2.1 Data Verification and Validation

Data verification was performed on the surface and subsurface soil samples. The analytical results were reported by the laboratory in accordance with the FWSAP (SAIC 2010).

Data qualifiers were assigned to each result based on the laboratory (i.e., TestAmerica of North Canton, Ohio) QA review and verification criteria. The SI analytical results were qualified as follows:

- "U" is not detected

- "UJ" is not detected and the reporting limit is an estimated value

- "J" denotes that the analyte was positively identified, but the associated numerical value is an approximate concentration of the analyte in the sample

- "R" indicates that the result is not usable.

In addition to assigning qualifiers, the verification process also selected the appropriate result to use when re-analyses or dilutions were performed. Where laboratory surrogate recovery data or laboratory QC samples were outside of analytical method specifications, the verification chemist determined whether or not laboratory re-analysis should be used in place of an original reported result. If the laboratory reported results for both diluted and undiluted samples, diluted sample results were used for those analytes that exceeded the calibration range of the undiluted sample. A complete discussion of verification process results is contained in the Data Verification Report (Appendix D).

A data validation report was completed for all six CR sites where ECC conducted site inspections. The *Final Data Validation Report for Compliance Restoration Sites: RVAAP-70 East Classification Yard, RVAAP-71 Barn No. 5 Petroleum Release, RVAAP-72 Facility-Wide USTs, RVAAP-75 George Road Sewer Treatment Plan Mercury Spill, RVAAP-77 Building 1037 Laundry Waste Water Sump and RVAAP-83 Former Buildings 1031 and 1039* was issued by North Wind Services and MEC^x in August 2014. The report is provided in Appendix F. In general, the data validation performed for the CC RVAAP-77 SI indicates that no false negatives or false positives were identified, and the results are usable for their intended purposes. Two SVOCs (n-Nitrosodiphenylamine and benzoic acid) were rejected in one sample (i.e., 77 077SS-0001M-0001-SO). These compounds are not site-related chemicals.

5.1.2.2 Determination of Potential Contamination

This section provides an outline of the process used to determine if potential contamination is present at this AOC. Per the *Facility-Wide Human Health Risk Assessment Manual* (USACE 2005), a chemical detected at a concentration greater than the established background value, which is not an essential nutrient, or screened out through a frequency of detection evaluation is identified as an SRC. An SRC may, or may not, be related to the former operations at the site. The maximum detected concentration of each SRC is then compared to the most stringent FWCUGs for the Resident Receptor between the adult and child using the Target Cancer Risk (TCR) level of 10^{-6} or the Target Hazard Quotient (THQ) of 0.1 for each SRC, as outlined in the *Final Facility-Wide Human Health Cleanup Goals for RVAAP* (SAIC 2010). Both risk levels (carcinogenic and non-carcinogenic) were assessed for the Resident Receptor (adult and child) to determine which one was the most stringent for comparison to each SRC. The specific criteria used to identify SRCs are described below:

- **Background screening**: The maximum detected concentrations of inorganic chemicals were compared to the RVAAP background concentrations, where established. If exceedances of background concentrations occurred, the respective inorganic chemicals were identified as SRCs. Several inorganic chemicals were screened against a background concentration of 0 milligrams per kilogram (mg/kg) (e.g., cadmium, silver). A value of 0 mg/kg was assigned as background when the chemical was not detected in any of the samples collected during the background study.

- **Screening of essential human nutrients:** Chemicals that are essential nutrients (e.g., calcium, chloride, iodine, iron, magnesium, potassium, phosphorous, and sodium) are an integral part of the human food supply and often added to foods as supplements. The USEPA recommends these chemicals not be evaluated unless they are grossly elevated relative to background concentrations or would exhibit toxicity at the observed concentrations (USEPA 1989).

- **Frequency of detection/Weight-of-evidence**: A frequency of detection evaluation was not completed as part of the WOE since less than 20 soil samples were collected during this investigation. Therefore, frequency of detection was not used to further screen the identified SRCs as part of this SI. The SRCs that exceeded the most stringent Resident Receptor FWCUGs using the TCR level of 10^{-6} or THQ = 0.1 for non-carcinogenic risks were then evaluated using a WOE approach. Chemicals not detected were eliminated as SRCs. For chemicals with at least 20 samples and a frequency of detection of less than 5 percent, a WOE approach is used to determine if the chemical is AOC-related. A WOE evaluation considers the SRCs that exceeded their FWCUGs, as described above, to determine if the chemical should be identified as potential contamination. If the results of the WOE evaluation indicated that potential contamination was present, then an additional investigation, such as an RI, is recommended. However, if no potential contamination was identified, then No Further Action (NFA) is recommended.

If no FWCUG has been developed for the particular chemical, then the USEPA's Regional Screening Levels (RSLs) (USEPA 2014) for the Residential Receptor were used for comparison using the same TCR of 10^{-6} and THQ of 0.1. The National Guard Trainee FWCUGs and the EPA Industrial RSLs (May 2014) are provided on the data summary tables in this section for comparison purposes only and were not used to determine whether or not chemicals were identified as potential contamination. If potential contamination is identified in this SI, it indicates that further investigation under CERCLA, in the form of an RI, is warranted at this AOC.

Tables 5-1 and 5-2 provide a summary of the SRCs identified in the surface and subsurface soil at CC RVAAP-77, respectively. The complete laboratory analytical data packages, including laboratory analytical results tables with final qualifiers, are included in Appendix E.

Table 5-1: Site-Related Chemical Determination for Surface Soil Results, November and December 2012, CC RVAAP-77

Analytes	CAS Number	Frequency of Detect	Minimum Detect	Maximum Detect	Background Criteria[a]	SRC (yes/no)	SRC Justification
Volatile Organic Compounds (µg/kg)							
1,1,1-Trichloroethane	71-55-6	0/2	None	None	None	No	Not detected
1,1,2,2-Tetrachloroethane	79-34-5	0/2	None	None	None	No	Not detected
1,1,2-Trichloroethane	79-00-5	0/2	None	None	None	No	Not detected
1,1-Dichloroethane	159-59-2	0/2	None	None	None	No	Not detected
1,1-Dichloroethene	75-35-4	0/2	None	None	None	No	Not detected
1,2-Dibromoethane (EDB)	106-93-4	0/2	None	None	None	No	Not detected
1,2-Dichloroethane	107-06-2	0/2	None	None	None	No	Not detected
1,2-Dichloroethene	156-60-5	0/2	None	None	None	No	Not detected
1,2-Dichloropropane	78-87-5	0/2	None	None	None	No	Not detected
2-Butanone (MEK)	71-55-6	0/2	None	None	None	No	Not detected
2-Hexanone	591-78-6	0/2	None	None	None	No	Not detected
4-Methyl-2-Pentanone	**108-10-1**	**1/2**	**0.9**	**0.9**	**None**	**Yes**	**Detected organic**
Acetone	67-64-1	0/2	None	None	None	No	Not detected
Benzene	71-43-2	0/2	None	None	None	No	Not detected
Bromochloromethane	74-97-5	0/2	None	None	None	No	Not detected
Bromodichloromethane	75-27-4	0/2	None	None	None	No	Not detected
Bromoform	75-25-2	0/2	None	None	None	No	Not detected
Bromomethane	74-83-9	0/2	None	None	None	No	Not detected
Carbon Disulfide	75-15-0	0/2	None	None	None	No	Not detected
Carbon Tetrachloride	56-23-5	0/2	None	None	None	No	Not detected
Chlorobenzene	108-90-7	0/2	None	None	None	No	Not detected
Chloroethane	75-00-3	0/2	None	None	None	No	Not detected
Chloroform	67-66-3	0/2	None	None	None	No	Not detected
Chloromethane	74-87-3	0/2	None	None	None	No	Not detected
cis-1,3-Dichloropropene	10061-01-5	0/2	None	None	None	No	Not detected
Dibromochloromethane	124-48-1	0/2	None	None	None	No	Not detected
Ethylbenzene	100-41-4	0/2	None	None	None	No	Not detected
Methylene Chloride	75-09-2	0/2	None	None	None	No	Not detected
Styrene	100-42-5	0/2	None	None	None	No	Not detected
tert-Butyl Methyl Ether	1634-04-4	0/2	None	None	None	No	Not detected
Tetrachloroethene (PCE)	127-18-4	0/2	None	None	None	No	Not detected
Toluene	108-88-3	0/2	None	None	None	No	Not detected

Table 5-1: Site-Related Chemical Determination for Surface Soil Results, November and December 2012, CC RVAAP-77 (continued)

Analytes	CAS Number	Frequency of Detect	Minimum Detect	Maximum Detect	Background Criteria[(a)]	SRC (yes/no)	SRC Justification
Volatile Organic Compounds (µg/kg)							
trans-1,3-Dichloropropene	10061-02-6	0/2	None	None	None	No	Not detected
Trichloroethene (TCE)	79-01-6	0/2	None	None	None	No	Not detected
Vinyl Chloride	75-01-4	0/2	None	None	None	No	Not detected
Xylenes, Total	1330-20-7	0/2	None	None	None	No	Not detected
Semi-volatile Organic Compounds (µg/kg)							
1,2,4-Trichlorobenzene	120-82-1	0/2	None	None	None	No	Not detected
1,2-Dichlorobenzene	95-50-1	0/2	None	None	None	No	Not detected
1,3-Dichlorobenzene	541-73-1	0/2	None	None	None	No	Not detected
1,4-Dichlorobenzene	106-46-7	0/2	None	None	None	No	Not detected
2,4,5-Trichlorophenol	95-95-4	0/2	None	None	None	No	Not detected
2,4,6-Trichlorophenol	88-06-2	0/2	None	None	None	No	Not detected
2,4-Dichlorophenol	120-83-2	0/2	None	None	None	No	Not detected
2,4-Dimethylphenol	105-67-9	0/2	None	None	None	No	Not detected
2,4-Dinitrophenol	51-28-5	0/2	None	None	None	No	Not detected
2,4-Dinitrotoluene	121-14-2	0/2	None	None	None	No	Not detected
2,6-Dinitrotoluene	606-20-2	0/2	None	None	None	No	Not detected
2-Chloronaphthalene	91-58-7	0/2	None	None	None	No	Not detected
2-Chlorophenol	95-57-8	0/2	None	None	None	No	Not detected
2-Methylnaphthalene	**95-48-7**	**2/2**	**54**	**60**	**None**	**Yes**	**Detected organic**
2-Methylphenol (o-Cresol)	202-437-8	0/2	None	None	None	No	Not detected
2-Nitroaniline	88-74-4	0/2	None	None	None	No	Not detected
2-Nitrophenol	88-75-5	0/2	None	None	None	No	Not detected
3,3'-Dichlorobenzidine	91-94-1	0/2	None	None	None	No	Not detected
3-Nitroaniline	99-09-2	0/2	None	None	None	No	Not detected
4,6-Dinitro-2-Methylphenol	534-52-1	0/2	None	None	None	No	Not detected
4-Bromophenyl phenyl ether	101-55-3	0/2	None	None	None	No	Not detected
4-Chloro-3-Methylphenol	59-50-7	0/2	None	None	None	No	Not detected
4-Chloroaniline	106-47-8	0/2	None	None	None	No	Not detected
4-Chlorophenyl Phenyl Ether	7005-72-3	0/2	None	None	None	No	Not detected
4-Nitroaniline	202-437-8	0/2	None	None	None	No	Not detected
4-Nitrophenol	88-74-4	0/2	None	None	None	No	Not detected
Acenaphthene	83-32-9	0/2	None	None	None	No	Not detected

Table 5-1: Site-Related Chemical Determination for Surface Soil Results, November and December 2012, CC RVAAP-77 (continued)

Analytes	CAS Number	Frequency of Detect	Minimum Detect	Maximum Detect	Background Criteria[(a)]	SRC (yes/no)	SRC Justification
Semi-volatile Organic Compounds (µg/kg)							
Acenaphthylene	208-96-8	0/2	None	None	None	No	Not detected
Anthracene	**120-12-7**	**1/2**	**11**	**11**	**None**	**Yes**	**Detected organic**
Benzo(a)anthracene	**56-55-3**	**2/2**	**48**	**57**	**None**	**Yes**	**Detected organic**
Benzo(a)pyrene	**50-32-8**	**2/2**	**65**	**88**	**None**	**Yes**	**Detected organic**
Benzo(b)fluoranthene	**205-99-2**	**2/2**	**81**	**91**	**None**	**Yes**	**Detected organic**
Benzo(g,h,i)perylene	**191-24-2**	**2/2**	**37**	**47**	**None**	**Yes**	**Detected organic**
Benzo(k)fluoranthene	**207-08-9**	**2/2**	**17**	**18**	**None**	**Yes**	**Detected organic**
Benzoic acid	65-85-0	0/2	None	None	None	No	Not detected
Benzyl alcohol	100-51-6	0/2	None	None	None	No	Not detected
Benzyl butyl phthalate	85-68-7	0/2	None	None	None	No	Not detected
bis(2-Chloroethoxy) Methane	111-91-1	0/2	None	None	None	No	Not detected
bis(2-Chloroethyl) Ether (2-Chloroethyl Ether)	111-44-4	0/2	None	None	None	No	Not detected
bis(2-Chloroisopropyl) Ether	108-60-1	0/2	None	None	None	No	Not detected
bis(2-Ethylhexyl) Phthalate	117-81-7	0/2	None	None	None	No	Not detected
Carbazole	86-74-8	0/2	None	None	None	No	Not detected
Chrysene	**218-01-9**	**2/2**	**57**	**66**	**None**	**Yes**	**Detected organic**
Cresols, m & p	8001-28-3	0/2	None	None	None	No	Not detected
Dibenz(a,h)anthracene	53-70-3	0/2	None	None	None	No	Not detected
Dibenzofuran	**132-64-9**	**2/2**	**14**	**14**	**None**	**Yes**	**Detected organic**
Diethyl Phthalate	84-66-2	0/2	None	None	None	No	Not detected
Dimethyl Phthalate	131-11-3	0/2	None	None	None	No	Not detected
Di-n-Butyl Phthalate	84-74-2	0/2	None	None	None	No	Not detected
Di-n-Octylphthalate	117-84-0	0/2	None	None	None	No	Not detected
Fluoranthene	**206-44-0**	**2/2**	**99**	**120**	**None**	**Yes**	**Detected organic**
Fluorene	**86-73-7**	**1/2**	**9.6**	**9.6**	**None**	**Yes**	**Detected organic**
Hexachlorobenzene	118-74-1	0/2	None	None	None	No	Not detected
Hexachlorobutadiene	87-68-3	0/2	None	None	None	No	Not detected
Hexachlorocyclopentadiene	77-47-4	0/2	None	None	None	No	Not detected
Hexachloroethane	67-72-1	0/2	None	None	None	No	Not detected
Indeno(1,2,3-c,d)Pyrene	**193-39-5**	**2/2**	**44**	**55**	**None**	**Yes**	**Detected organic**
Isophorone	78-59-1	0/2	None	None	None	No	Not detected

Table 5-1: Site-Related Chemical Determination for Surface Soil Results, November and December 2012, CC RVAAP-77 (continued)

Analytes	CAS Number	Frequency of Detect	Minimum Detect	Maximum Detect	Background Criteria[a]	SRC (yes/no)	SRC Justification
Semi-volatile Organic Compounds (µg/kg)							
Naphthalene	**91-20-3**	**2/2**	**44**	**54**	**None**	**Yes**	**Detected organic**
Nitrobenzene	98-95-3	0/2	None	None	None	No	Not detected
n-Nitrosodi-n-propylamine	621-64-7	0/2	None	None	None	No	Not detected
n-Nitrosodiphenylamine	86-30-6	0/2	None	None	None	No	Not detected
Pentachlorophenol	87-86-5	0/2	None	None	None	No	Not detected
Phenanthrene	**85-01-8**	**2/2**	**64**	**77**	**None**	**Yes**	**Detected organic**
Phenol	108-95-2	0/2	None	None	None	No	Not detected
Pyrene	**129-00-0**	**2/2**	**74**	**95**	**None**	**Yes**	**Detected organic**
Pesticides (µg/kg)							
Aldrin	309-00-2	0/2	None	None	None	No	Not detected
alpha-BHC (alpha-Hexachlorocyclohexane)	319-84-6	0/2	None	None	None	No	Not detected
alpha-Chlordane	959-98-8	0/2	None	None	None	No	Not detected
alpha-Endosulfan	5103-79-9	0/2	None	None	None	No	Not detected
beta-BHC (beta-Hexachlorocyclohexane)	319-85-7	0/2	None	None	None	No	Not detected
beta Endosulfan	33213-65-9	0/2	None	None	None	No	Not detected
delta-BHC (delta-Hexachlorocyclohexane)	319-86-8	0/2	None	None	None	No	Not detected
Dieldrin	60-57-1	0/2	None	None	None	No	Not detected
Endosulfan Sulfate	1031-07-8	0/2	None	None	None	No	Not detected
Endrin	72-20-8	0/2	None	None	None	No	Not detected
Endrin Aldehyde	7421-93-4	0/2	None	None	None	No	Not detected
Endrin Ketone	53494-70-5	0/2	None	None	None	No	Not detected
gamma-BHC (Lindane)	58-89-9	0/2	None	None	None	No	Not detected
gamma-Chlordane	5103-74-2	0/2	None	None	None	No	Not detected
Heptachlor	76-44-8	0/2	None	None	None	No	Not detected
Heptachlor Epoxide	1021-57-3	0/2	None	None	None	No	Not detected
Heptachlor Epoxide	1021-57-3	0/2	None	None	None	No	Not detected
Methoxychlor	72-43-5	0/2	None	None	None	No	Not detected
p,p'-DDD	72-54-8	0/2	None	None	None	No	Not detected
p,p'-DDE	**72-55-9**	**2/2**	**5.2**	**8.6**	**None**	**Yes**	**Detected organic**

Table 5-1: Site-Related Chemical Determination for Surface Soil Results, November and December 2012, CC RVAAP-77 (continued)

Analytes	CAS Number	Frequency of Detect	Minimum Detect	Maximum Detect	Background Criteria[a]	SRC (yes/no)	SRC Justification
Pesticides (µg/kg)							
p,p'-DDT	**50-29-3**	0/2	None	None	None	No	Not detected
Toxaphene	8001-35-2	0/2	None	None	None	No	Not detected
Polychlorinated Biphenyls (µg/kg)							
PCB-1016	12674-11-2	0/2	None	None	None	No	Not detected
PCB-1221	11104-28-2	0/2	None	None	None	No	Not detected
PCB-1232	11141-16-5	0/2	None	None	None	No	Not detected
PCB-1242	53469-21-9	0/2	None	None	None	No	Not detected
PCB-1248	12672-29-6	0/2	None	None	None	No	Not detected
PCB-1254	52663-62-4	0/2	None	None	None	No	Not detected
PCB-1260	11096-82-5	0/2	None	None	None	No	Not detected
Metals (mg/kg)							
Aluminum	7429-90-5	2/2	7,700	8,200	17,700	No	Less than background
Antimony	7440-36-0	2/2	0.17	0.2	0.96	No	Less than background
Arsenic	7440-38-2	2/2	12	14	15.4	No	Less than background
Barium	7440-39-3	2/2	48	49	88.4	No	Less than background
Beryllium	7440-41-7	2/2	0.42	0.46	0.88	No	Less than background
Cadmium	**7440-43-9**	**2/2**	**0.19**	**0.2**	**0**	**Yes**	**Exceeds background**
Calcium **	7440-70-2	2/2	4,500	5,200	15,800	No	Essential nutrient
Chromium	**7440-47-3**	**2/2**	**15**	**18**	**17.4**	**Yes**	**Exceeds background**
Cobalt	7440-48-4	2/2	7.4	7.7	10.4	No	Less than background
Copper	7440-50-8	2/2	16	17	17.7	No	Less than background
Iron	7439-89-6	2/2	20,000	22,000	23,100	No	Less than background
Lead	7439-92-1	2/2	21	22	26.1	No	Less than background
Magnesium **	7439-95-4	2/2	2,700	2,800	3,030	No	Essential nutrient
Manganese	7439-96-5	2/2	520	540	1,450	No	Less than background
Mercury	**7439-97-6**	**2/2**	**0.041**	**0.045**	**0.036**	**Yes**	**Exceeds background**
Nickel	**7440-02-0**	**2/2**	**24**	**28**	**21.1**	**Yes**	**Exceeds background**
Potassium **	7440-09-7	2/2	740	830	927	No	Essential nutrient
Selenium	7782-49-2	2/2	0.53	0.56	1.4	No	Less than background
Silver	**7440-22-4**	**2/2**	**0.027**	**0.03**	**0**	**Yes**	**Exceeds background**
Sodium **	7440-23-5	2/2	29	32	123	No	Essential nutrient
Thallium	**7440-28-0**	**2/2**	**0.13**	**0.14**	**0**	**Yes**	**Exceeds background**

Table 5-1: Site-Related Chemical Determination for Surface Soil Results, November and December 2012, CC RVAAP-77 (continued)

Analytes	CAS Number	Frequency of Detect	Minimum Detect	Maximum Detect	Background Criteria[(a)]	SRC (yes/no)	SRC Justification
Metals (mg/kg)							
Vanadium	7440-62-2	2/2	15	16	31.1	No	Less than background
Zinc	**7440-66-6**	**2/2**	**62**	**63**	**61.8**	**Yes**	**Exceeds background**
Explosives (mg/kg)							
1,3,5-Trinitrobenzene	99-35-4	0/2	None	None	None	No	Not detected
1,3-Dinitrobenzene	99-65-0	0/2	None	None	None	No	Not detected
2,4,6-Trinitrotoluene	118-96-7	0/2	None	None	None	No	Not detected
2,4-Dinitrotoluene	121-14-2	0/2	None	None	None	No	Not detected
2,6-Dinitrotoluene	606-20-2	0/2	None	None	None	No	Not detected
2-Amino-4,6-dinitrotoluene	35572-78-2	0/2	None	None	None	No	Not detected
2-Nitrotoluene	88-72-2	0/2	None	None	None	No	Not detected
3-Nitrotoluene	99-08-1	0/2	None	None	None	No	Not detected
4-Amino-2,6-Dinitrotoluene	19406-51-0	0/2	None	None	None	No	Not detected
4-Nitrotoluene	99-99-0	0/2	None	None	None	No	Not detected
Hexahydro-1,3,5-Trinitro-1,3,5-Triazine (RDX)	121-82-4	0/2	None	None	None	No	Not detected
Nitrobenzene	98-95-3	0/2	None	None	None	No	Not detected
Octahydro-1,3,5,7-Tetranitro-1,3,5,7-Tetrazocine (HMX)	2691-41-0	0/2	None	None	None	No	Not detected
Pentaerythritol Tetranitrate	78-11-5	0/2	None	None	None	No	Not detected
Tetryl	**55-63-0**	**1/2**	**0.028**	**0.028**	**None**	**Yes**	**Detected organic**
Propellants (mg/kg)							
Nitrocellulose	9004-70-0	0/2	0	0	None	No	Not detected
Nitroglycerin	**479-45-8**	**1/2**	**0.083**	**0.083**	**None**	**Yes**	**Detected organic**
Nitroguanidine	**556-887-0**	**1/2**	**0.055**	**0.055**	**None**	**Yes**	**Detected organic**

Notes:

(a) The background concentrations for metals shown in this table were obtained from two sources: (1) The *Final Facility-Wide Human Health Cleanup Goals for the Ravenna Army Ammunition Plant* (SAIC 2010); and (2) *Final Phase II Remedial Investigation Report for Winklepeck Burning Grounds at Ravenna Army Ammunition Plant, Ravenna, Ohio* (SAIC 2001).

Bold indicates analyte identified as an SRC.
** Asterisk denotes the chemical is an essential nutrient.
µg/kg = Microgram per kilogram
BHC = Hexachlorocyclohexane
CAS = Chemical abstract number
DDD = p,p'-Dichlorodiphenyldichloroethane
DDE = p,p'-Dichlorodiphenyldichloroethylene
DDT = 1,1,1-trichloro-2,2-di(4-chlorophenyl)ethane
TCE = Trichloroethene
mg/kg = Milligram per kilogram
PCB = Polychlorinated biphenyl
SRC = Site-related chemical
SVOC = Semi-volatile organic compound
VOC = Volatile organic compound

Table 5-2: Site-Related Chemical Determination for Subsurface Soil Results, November and December 2012, CC RVAAP-77

Analytes	CAS Number	Frequency of Detect	Minimum Detect	Maximum Detect	Background Criteria	SRC (yes/no)	SRC Justification
Explosives (mg/kg)							
1,3,5-Trinitrobenzene	99-35-4	0/8	None	None	None	No	Not detected
1,3-Dinitrobenzene	99-65-0	0/8	None	None	None	No	Not detected
2,4,6-Trinitrotoluene	118-96-7	0/8	None	None	None	No	Not detected
2,4-Dinitrotoluene	121-14-2	0/8	None	None	None	No	Not detected
2,6-Dinitrotoluene	606-20-2	0/8	None	None	None	No	Not detected
2-Amino-4,6-dinitrotoluene	35572-78-2	0/8	None	None	None	No	Not detected
2-Nitrotoluene	88-72-2	0/8	None	None	None	No	Not detected
3-Nitrotoluene	99-08-1	0/8	None	None	None	No	Not detected
4-Amino-2,6-Dinitrotoluene	19406-51-0	0/8	None	None	None	No	Not detected
4-Nitrotoluene	99-99-0	0/8	None	None	None	No	Not detected
Hexahydro-1,3,5-Trinitro-1,3,5-Triazine (RDX)	99-35-4	0/8	None	None	None	No	Not detected
Octahydro-1,3,5,7-Tetranitro-1,3,5,7-Tetrazocine (HMX)	2691-41-0	0/8	None	None	None	No	Not detected
Pentaerythritol Tetranitrate	78-11-5	0/8	None	None	None	No	Not detected
Tetryl	479-45-8	0/8	None	None	None	No	Not detected
Propellants (mg/kg)							
Nitrocellulose	9004-70-0	0/8	None	None	None	No	Not detected
Nitroglycerin	55-63-0	0/8	None	None	None	No	Not detected
Nitroguanidine	556-88-7	0/8	None	None	None	No	Not detected

Notes:

Bold indicates analyte identified as an SRC.

CAS = Chemical abstract number
mg/kg = Milligram per kilogram
SRC = Site-related chemical

This page intentionally left blank.

5.2 SUMMARY OF SURFACE SOIL ANALYTICAL RESULTS

CC RVAAP-77 surface soil sampling data were evaluated to identify the SRCs at the AOC. One surface soil sample and a duplicate sample were collected from decision unit DU01 in order to verify absence of surface soil contamination and as part of the QA/QC sampling for full suite analysis. As noted previously, the water level in the waste water sump was approximately 4 ft bgs (due to the elevation of the discharge pipe to the sanitary sewer); therefore, any contamination released from the waste water sump would have entered into surrounding subsurface soil below this depth.

The surface soil ISM samples were analyzed for the RVAAP full-suite analytes, including VOCs, SVOCs, PCBs, pesticides, explosives, propellants, and TAL metals. Table 5-1 presents the determination of SRCs in the surface soil at CC RVAAP-77. The identified SRCs in surface soil are shown in Figures 5-1 and 5-2, for organic and inorganic chemicals, respectively.

The following organic and inorganic SRCs have been identified in the surface soil at CC RVAAP-77:

- One VOC (4-methyl-2-pentanone [MIBK]); however, this compound may be a laboratory contaminant.
- Fifteen SVOCs, primarily PAH compounds, were identified as SRCs as these chemicals were detected at low or estimated concentrations in the surface soil ISM sample. No background criteria have been established for these SVOCs.
- One pesticide (p,p′-dichlorodiphenyldichloroethylene [p,p′-DDE]).
- Seven metals (cadmium, chromium, mercury, nickel, silver, thallium, and zinc).
- One explosive (tetryl) and two propellants (nitroglycerin and nitroguanidine) were identified as SRCs.

The analytical results from the surface soil ISM samples are summarized by chemical group in the sections below. Tables 5-3 and 5-4 provide summaries of the analytical results for organic and inorganic chemicals detected in surface soil at CC RVAAP-77, respectively. The organic and inorganic chemicals reported in the surface soil samples are shown in Figures 5-1 and 5-2, respectively.

5.2.1 Volatile Organic Compounds

No VOCs (other than MIBK) were reported in the ISM surface soil samples. The reported MIBK concentration does not exceed the EPA residential RSL. This chemical is not a potential contaminant as the MIBK is not associated with potential releases from this AOC. VOCs were not identified as potential contaminants at this AOC.

5.2.2 Semi-Volatile Organic Compounds

Benzo(a)pyrene was reported at a concentration (88 micrograms per kilogram [µg/kg]) exceeding the Resident Receptor FWCUG of 22 µg/kg in the one surface soil sample. The one reported exceedance of benzo(a)pyrene at sample location 077SS-0001M-0001-SO is not associated with the laundry building waste water sump, but is suspected to be associated with both non-point sources and point sources nearby this AOC. Non-point sources include overland drainage from nearby asphalt roadways, as benzo(a)pyrene is a chemical used in the production of asphalt and railroad ties, and is released to the environment through various mechanisms and pathways, such as leaching from roadways and through motor vehicle exhaust. Surface water runoff from roadways and railroad ties is a common source of PAH compounds detected in surface soil (Kohler et. al. 2000 and USEPA 2013). There are two asphalt paved parking areas associated with Building 1037 located 30 ft southeast and west of DU01 at CC RVAAP-77. Benzo(a)pyrene is also a byproduct of incomplete combustion or burning of organic material, such as wood, gasoline, and coal (USEPA 2007), and is released to the air pathway through emissions from coal, oil, and wood burning furnaces, incinerators.

Therefore, benzo(a)pyrene is not a potential contaminant at this AOC, as the chemical is not related to the historical activities conducted at the former laundry building and can be attributed to several other potential sources of PAH compounds located adjacent to the site.

5.2.3 Pesticides and Polychlorinated Biphenyls

One pesticide, p,p′ DDE, was reported at a low estimated concentration (5.2 J µg/kg) in the primary sample. However, no pesticides or PCBs were reported at concentrations exceeding the most stringent Resident Receptor FWCUGs. Therefore, pesticides and PCBs are not potential contaminants at this AOC.

5.2.4 Explosives and Propellants

One explosive and two propellants were detected in the surface soil ISM samples, but the reported concentrations did not exceed their respective most stringent Resident Receptor

FWCUG. Therefore, explosives and propellants are not potential contaminants in the surface soil at this AOC.

5.2.5 Target Analyte List Metals

Metals (cadmium, chromium, mercury, nickel, silver, thallium, and zinc) were reported in ISM surface soil samples at concentrations that slightly exceed their respective background values. However, none of these reported metal concentrations exceeded their respective, most stringent, Resident Receptor FWCUG. Therefore, metals are not potential contaminants at this AOC.

5.3 SUMMARY OF HORIZONTAL SUBSURFACE SOIL ANALYTICAL RESULTS

CC RVAAP-77 subsurface soil sampling data were evaluated to identify the SRCs at the AOC. The subsurface samples were analyzed for only explosive and propellant chemicals. No SRCs were identified in the two horizontal ISM subsurface soil samples collected at DU01. Table 5-2 presents the SRCs determination in subsurface soil at CC RVAAP-77.

Table 5-5 provides a summary of analytical results for the horizontal subsurface soil ISM samples collected at CC RVAAP-77.

- There were no detected concentrations of explosive or propellant chemicals reported in the horizontal subsurface samples.

- Therefore, no potential contaminants were identified in the horizontal subsurface soil samples at this AOC.

5.4 SUMMARY OF VERTICAL SUBSURFACE SOIL ANALYTICAL RESULTS

Five vertical ISM subsurface soil samples were collected at DU01 as part of this SI. These samples were analyzed for explosive and propellant chemicals. No SRCs were identified in the vertical subsurface soil at this AOC. Table 5-2 presents the SRC determination for the subsurface soil ISM samples collected at CC RVAAP-77.

Table 5-5 provides a summary of analytical results for organic compounds detected in subsurface soil collected at CC RVAAP-77.

- Explosive and propellant chemicals were not detected in the vertical subsurface soil ISM samples.

- Therefore, no potential contaminants were identified in the vertical subsurface soil samples at this AOC.

5.5 SUMMARY OF DEEP SOIL BORING SAMPLE ANALYTICAL RESULTS

One composite subsurface soil sample was collected between 7 and 13 ft bgs at soil boring SB02 and analyzed for explosive and propellant chemicals. No SRCs were identified in the DSB subsurface soil sample at this AOC. Table 5-2 provides the SRC determination for the subsurface soil samples collected at CC RVAAP-77. Table 5-5 provides a summary of analytical results from the DSB sample collected at this AOC.

- Explosive and propellant chemicals were not detected in the DSB subsurface soil sample.

- Therefore, no potential contaminants were identified in the DSB subsurface soil sample collected at this AOC.

5.6 INVESTIGATION-DERIVED WASTE ANALYTICAL RESULTS

A description of the IDW steams generated during this SI, along with the Toxicity Characteristic Leaching Procedure waste characterization analysis results and disposal recommendations, are provided in the IDW Disposal Letter Report (Appendix G).

Table 5-3: Summary of Analytical Results for Organic Chemicals Detected in Surface Soil Samples Collected November and December 2012, CC RVAAP-77

						Sample Type:	Primary	Duplicate
						Location ID:	77-1037-DU1-SS	77-1037-DU1-SS
						Field Sample ID:	077SS-0001M-0001-SO	077SS-0002M-0001-SO
						Lab Sample ID:	240-17525-5	240-17525-6
						Sample Date:	11/11/2012	11/11/2012
						Location Type:	Horizontal ISM	Horizontal ISM
						Depth (ft):	0-1	0-1
		FWCUGs			**USEPA RSL**			
		National Guard Trainee	**Resident Receptor**					
Method/Chemicals	**Background**		**Resident Child**	**Resident Adult**	**Industrial**	**Residential**		
Volatile Organic Compounds (µg/kg)								
4-methyl-2-pentanone	None	None	None	None	5,600,000*	530,000*	ND	**0.90 J**
Semi-Volatile Organic Compounds (µg/kg)								
2-Methylnaphthalene	None	2,384,000*	30,600*	238,000*	NA	NA	**54**	**60**
Anthracene	None	None	None	None	23,000,000*	1,700,000*	ND	**11 J**
Benzo(a)anthracene	None	4,770	650	221	NA	NA	**57**	**48**
Benzo(a)pyrene	None	477	65	22	NA	NA	**88**	**65**
Benzo(b)fluoranthene	None	4,770	650	221	NA	NA	**91**	**81**
Benzo(g,h,i)perylene	None	None	None	None	None	None	**47**	**37**
Benzo(k)fluoranthene	None	47,700	6,500	2,210	NA	NA	**18 J**	**17**
Chrysene	None	477,000	65,000	22,100	NA	NA	**66**	**57**
Dibenzofuran	None	1,192,000	15,300*	119,000*	NA	NA	**14 J**	**14 J**
Fluoranthene	None	5,087,00*	163,000*	276,000*	NA	NA	**120**	**99**
Fluorene	None	11,458,000*	243,000*	737,000*	NA	NA	ND	**9.6 J**
Indeno(1,2,3-c,d)Pyrene	None	4,770	650	221	NA	NA	**55**	**44**
Naphthalene	None	1,541,000*	122,000*	368,000*	NA	NA	**44**	**54**
Phenanthrene	None	None	None	None	None	None	**77**	**64**
Pyrene	None	3,815,000*	122,000*	207,000*	NA	NA	**95**	**74**
Pesticides and Polychlorinated Biphenyls (µg/kg)								
beta Endosulfan	None	None	None	None	490,000*	37,000*	ND	ND
Heptachlor Epoxide	None	1,480	98	152	NA	NA	ND	ND
p,p'-DDD	None	None	None	None	9,600	2,200	ND	ND
p,p'-DDE	None	49,100	2,630	4,080	NA	NA	**5.2 J**	**8.6 J**
Propellants (mg/kg)								
Nitroglycerin	None	982	52,500	81,600	NA	NA	ND	**0.083 J**
Nitroguanidine	None	None	None	None	8,200*	620*	ND	**0.055 J**
Explosives (mg/kg)								
Tetryl	None	None	None	None	160*	12*	ND	**0.028 J**

Notes:

Yellow shading of a result indicates concentration is greater than the most stringent Resident Receptor FWCUG.

The FWCUGs used for data comparison are the values for the most stringent Resident Receptor FWCUG between the adult and the child receptor using the Target Cancer Risk (TCR) level of 10^{-6}. The RSLs shown are also the values for the TCR 10^{-6}. Any exceptions are noted with an Asterisk (*).

Asterisk (*) indicates non-carcinogenic FWCUGs and RSLs using the Target Hazard Quotient (THQ) =0.1).

Bold indicates chemical detected.

µg/kg = Microgram per kilogram
DU = Decision Unit
ft = Feet
FWCUG = Facility-Wide Cleanup Goal (SAIC 2010)
HQ = Hazard Quotient
ID = Identification
ISM = Incremental sampling methodology

J = Estimated value less than reporting limits
NA = Not applicable
ND = Not detected at the Limit of Detection (LOD)
RSL = Regional Screening Level (USEPA, May 2014)
USEPA = United States Environmental Protection Agency

Note: The National Guard Trainee FWCUGs and the Industrial RSLs are shown on this table for comparison purposes only.

RSLs are presented only for chemicals without Resident Receptor FWCUGs.

This page intentionally left blank.

Table 5-4: Summary of Analytical Results for Inorganic Chemicals Detected in Surface Soil Samples Collected November and December 2012, CC RVAAP-77

						Sample Type:	Primary	Duplicate
						Location ID:	77-1037-DU1-SS	77-1037-DU1-SS
						Field Sample ID:	077SS-0001M-0001-SO	077SS-0002M-0001-SO
						Lab Sample ID:	240-17525-5	240-17525-6
						Sample Date:	11/11/2012	11/11/2012
						Location Type:	Horizontal ISM	Horizontal ISM
						Depth (ft):	0-1	0-1
		FWCUGs			**USEPA RSL**			
			Resident Receptor					
Method/Chemicals	**Background**	**National Guard Trainee**	**Resident Child**	**Resident Adult**	**Industrial**	**Residential**		
Metals (mg/kg)								
Aluminum	17,700	3,496*	7,380*	52,923*	NA	NA	**8,200**	**7,700**
Antimony	0.96	175*	2.82*	13.6*	NA	NA	**0.20 J**	**0.17 J**
Arsenic	15.4	2.78	0.524	0.425	NA	NA	**12**	**14**
Barium	88.4	351*	1,413*	8,966*	NA	NA	**49**	**48**
Beryllium	0.88	None	None	None	230*	16*	**0.46**	**0.42**
Cadmium	0	10.9	6.41*	22.3*	NA	NA	**0.19**	**0.20**
Calcium **	15,800	None	None	None	None	None	**4,500 J**	**5,200 J**
Chromium	17.4	329,763*	8,174*	19,694*	NA	NA	**18**	**15**
Cobalt	10.4	7.03	131*	803	NA	NA	**7.4**	**7.7**
Copper	17.7	25,368*	311*	2,714*	NA	NA	**16 J**	**17 J**
Iron	23,100	184,370*	2,313*	19,010*	NA	NA	**22,000**	**20,000**
Lead	26.1	None	None	None	800	400	**22**	**21**
Magnesium **	3,030	None	None	None	None	None	**2,800 J**	**2,700 J**
Manganese	1,450	35.1*	293*	1,482*	NA	NA	**540**	**520**
Mercury	0.036	172*	2.27*	16.5*	NA	NA	**0.045 J**	**0.041 J**
Nickel	21.1	12,639*	155*	1,346*	NA	NA	**24**	**28**
Potassium **	927	None	None	None	None	None	**830**	**740**
Selenium	1.4	None	None	None	580*	39.0*	**0.56**	**0.53**
Silver	0	3,105*	38.6*	324*	NA	NA	**0.027 J**	**0.030 J**
Sodium **	123	None	None	None	None	None	**29 J**	**32 J**
Thallium	0	47.7*	0.612*	4.76*	NA	NA	**0.13**	**0.14**
Vanadium	31.1	2,304*	44.9*	156*	NA	NA	**16**	**15**
Zinc	61.8	187,269*	2,321*	19,659*	NA	NA	**63**	**62**

Notes:

Yellow shading of a result indicates concentration is greater than the most stringent Resident Receptor FWCUG.

The FWCUGs used for data comparison are the values for the most stringent Resident Receptor FWCUG between the adult and the child receptor using the Target Cancer Risk (TCR) level of 10^{-6}. The RSLs shown are also the values for the TCR 10^{-6}. Any exceptions are noted with an Asterisk (*).

Asterisk (*) indicates non-carcinogenic FWCUGs and RSLs using the Target Hazard Quotient (THQ) =0.1).

** Asterisk denotes the chemical is an essential nutrient.

Bold indicates chemical detected.

DU = Decision Unit
ft = feet
FWCUG = Facility-Wide Cleanup Goal (SAIC 2010)
HQ = Hazard Quotient
ISM = Incremental sampling methodology
J = Estimated value less than reporting limits
mg/kg = Milligram per kilogram
NA = Not applicable
NR = Not reported/not analyzed
RSL = Regional Screening Level (USEPA 2014)
USEPA = United States Environmental Protection Agency

RSLs are presented only for chemicals without Resident Receptor FWCUGs.

Note: The National Guard Trainee FWCUGs and the Industrial RSLs are shown on this table for comparison purposes only.

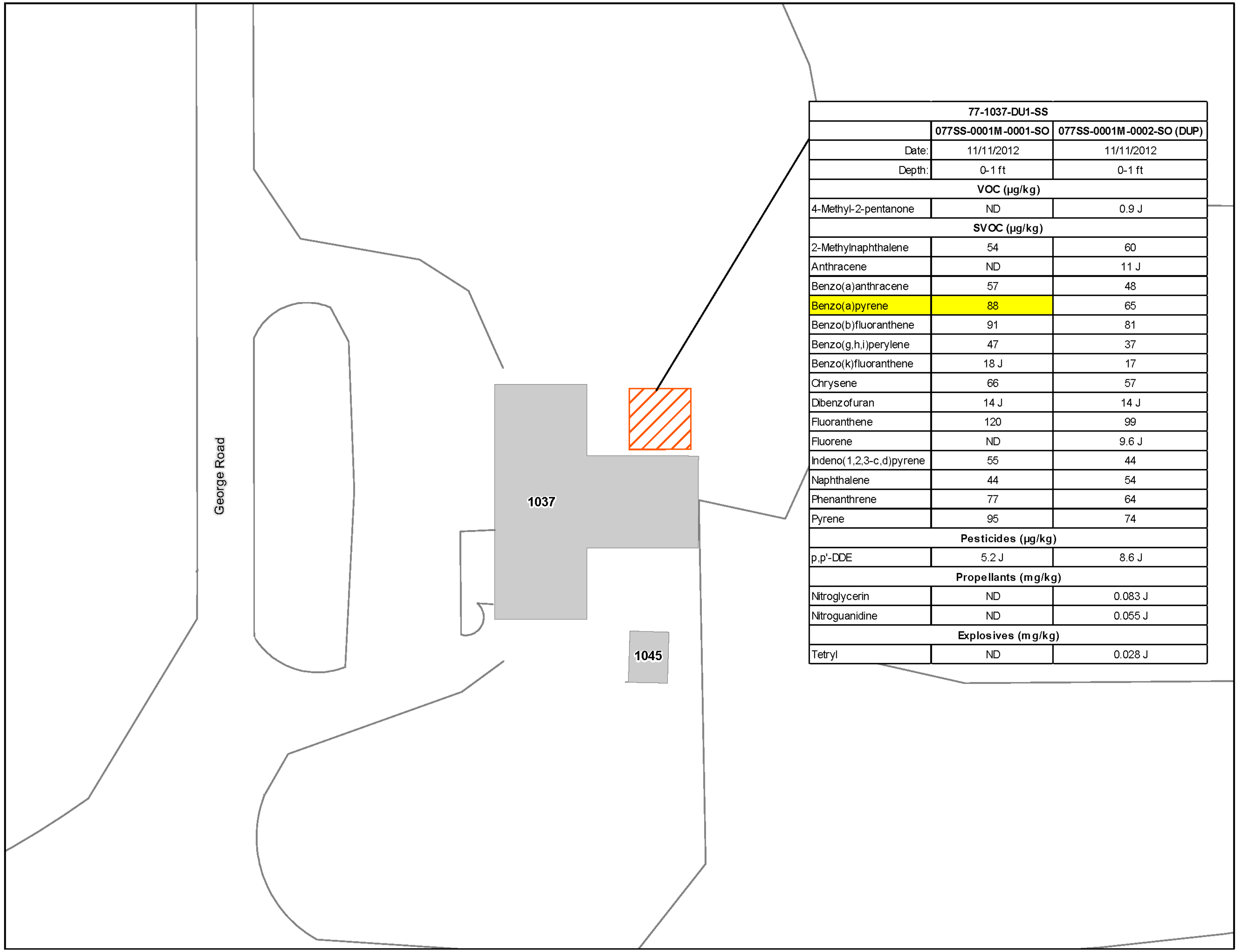
This page intentionally left blank.

Table 5-5: Summary of Analytical Results for Organic Chemicals Detected in Subsurface Soil Samples Collected November and December 2012, CC RVAAP-77

						Sample Type:	Primary	Primary	Primary	Primary	Primary	Primary	Primary	Primary
						Location ID:	77-1037-DU1-SB1-5	77-1037-DU1-SB1-5	77-1037-DU1-SB1	77-1037-DU1-SB2	77-1037-DU1-SB3	77-1037-DU1-SB4	77-1037-DU1-SB5	77-1037-DU1-SB2
						Field Sample ID:	077SB-0004M-0001-SO	077SB-0005M-0001-SO	077SB-0006M-0001-SO	077SB-0007M-0001-SO	077SB-0008M-0001-SO	077SB-0009M-0001-SO	077SB-0010M-0001-SO	077SB-0011-0001-SO
						Lab Sample ID:	240-18297-1	240-18297-2	240-18297-3	240-18297-4	240-18297-1	240-18297-2	240-18297-3	240-18297-4
						Sample Date:	12/3/2012	12/3/2012	12/3/2012	12/3/2012	12/3/2012	12/3/2012	12/3/2012	12/3/2012
						Location Type:	Horizontal ISM	Horizontal ISM	Vertical ISM	Vertical ISM	Vertical ISM	Vertical ISM	Vertical ISM	Deep Soil Boring
						Sample Depth (ft):	1-4	4-7	1-7	1-7	1-7	1-7	1-7	7-13
		FWCUGs			**USEPA RSL**									
			Resident Receptor											
Method/ Chemicals	**Background**	**National Guard Trainee**	**Resident Child**	**Resident Adult**	**Industrial**	**Residential**								
Explosives (mg/kg)														
Tetryl	None	None	None	None	160*	12*	ND	ND	ND	ND	ND	ND	ND	ND
Propellants (mg/kg)														
Nitroglycerin	None	982	52.5	81.6	NA	NA	ND	ND	ND	ND	ND	ND	ND	ND
Nitroguanidine	None	None	None	None	8,200*	620*	ND	ND	ND	ND	ND	ND	ND	ND

Notes:
Yellow shading of a result indicates concentration is greater than the FWCUG for the most stringent Resident Receptor.
The FWCUGs used for data comparison are the values for the most stringent Resident Receptor FWCUG between the adult and the child receptor using the Target Cancer Risk (TCR) level of 10^{-6}. The RSLs shown are also the values for the TCR 10^{-6}. Any exceptions are noted with an Asterisk (*).
Asterisk (*) indicates non-carcinogenic FWCUGs and RSLs using the Target Hazard Quotient (THQ) =0.1).
Bold indicates chemical detected.
DU = Decision Unit
ft = Feet
FWCUG = Facility-Wide Cleanup Goal (SAIC 2010)
HQ = Hazard Quotient
ID = Identification
ISM = Incremental sampling methodology
J = Estimated value less than reporting limits
mg/kg = Milligram per kilogram
NA = Not applicable
ND = Not detected at the Limit of Detection (LOD)
RSL = Regional Screening Level (USEPA 2014)
USEPA = United States Environmental Protection Agency
RSLs are presented only for chemicals without Resident Receptor FWCUGs.
Note: The National Guard Trainee FWCUGs and the Industrial RSLs are shown on this table for comparison purposes only.

This page intentionally left blank.



77-1037-DU1-SS		
	077SS-0001M-0001-SO	077SS-0001M-0002-SO (DUP)
Date:	11/11/2012	11/11/2012
Depth:	0-1 ft	0-1 ft
VOC (µg/kg)		
4-Methyl-2-pentanone	ND	0.9 J
SVOC (µg/kg)		
2-Methylnaphthalene	54	60
Anthracene	ND	11 J
Benzo(a)anthracene	57	48
Benzo(a)pyrene	88	65
Benzo(b)fluoranthene	91	81
Benzo(g,h,i)perylene	47	37
Benzo(k)fluoranthene	18 J	17
Chrysene	66	57
Dibenzofuran	14 J	14 J
Fluoranthene	120	99
Fluorene	ND	9.6 J
Indeno(1,2,3-c,d)pyrene	55	44
Naphthalene	44	54
Phenanthrene	77	64
Pyrene	95	74
Pesticides (µg/kg)		
p,p'-DDE	5.2 J	8.6 J
Propellants (mg/kg)		
Nitroglycerin	ND	0.083 J
Nitroguanidine	ND	0.055 J
Explosives (mg/kg)		
Tetryl	ND	0.028 J

LEGEND

- Decision Unit
- Road
- Building
- Concentration Exceeds FWCUG for Resident Receptor (HQ=0.1/Target Risk of 10^{-6})

NOTES & SOURCES

1. Map Coordinates: NAD 83, UTM Zone 17N
2. CC = Army Environmental Compliance-Related Cleanup Program
3. RVAAP = Ravenna Army Ammunition Plant
4. Concentrations shown are for site-related chemicals (SRC) at each sample location. Concentrations which exceed the Facility-Wide Cleanup Goal (FWCUG) for Resident Receptor are highlighted.
5. Surface soil incremental sampling methodology (ISM) samples were collected from 0 to 1 foot below ground surface.
6. µg/kg = micrograms per kilogram
7. mg/kg = milligrams per kilogram
8. DUP = duplicate sample
9. ft = foot
10. HQ = hazard quotient
11. ND = Non-detected concentration reported at the limit of detection (LOD)
12. J = estimated
13. VOC = volatile organic compound
14. SVOC = semi-volatile organic compound
15. DDE = dichlorodiphenyldichloroethylene

TITLE

Figure 5-1

Organic Site-Related Chemicals Identified in Surface Soil Samples CC RVAAP-77

CC RVAAP-77
Building 1037
Laundry Waste Water Sump

Former Ravenna Army Ammunition Plant
Portage and Trumbull Counties, Ohio

0 20 40 Feet

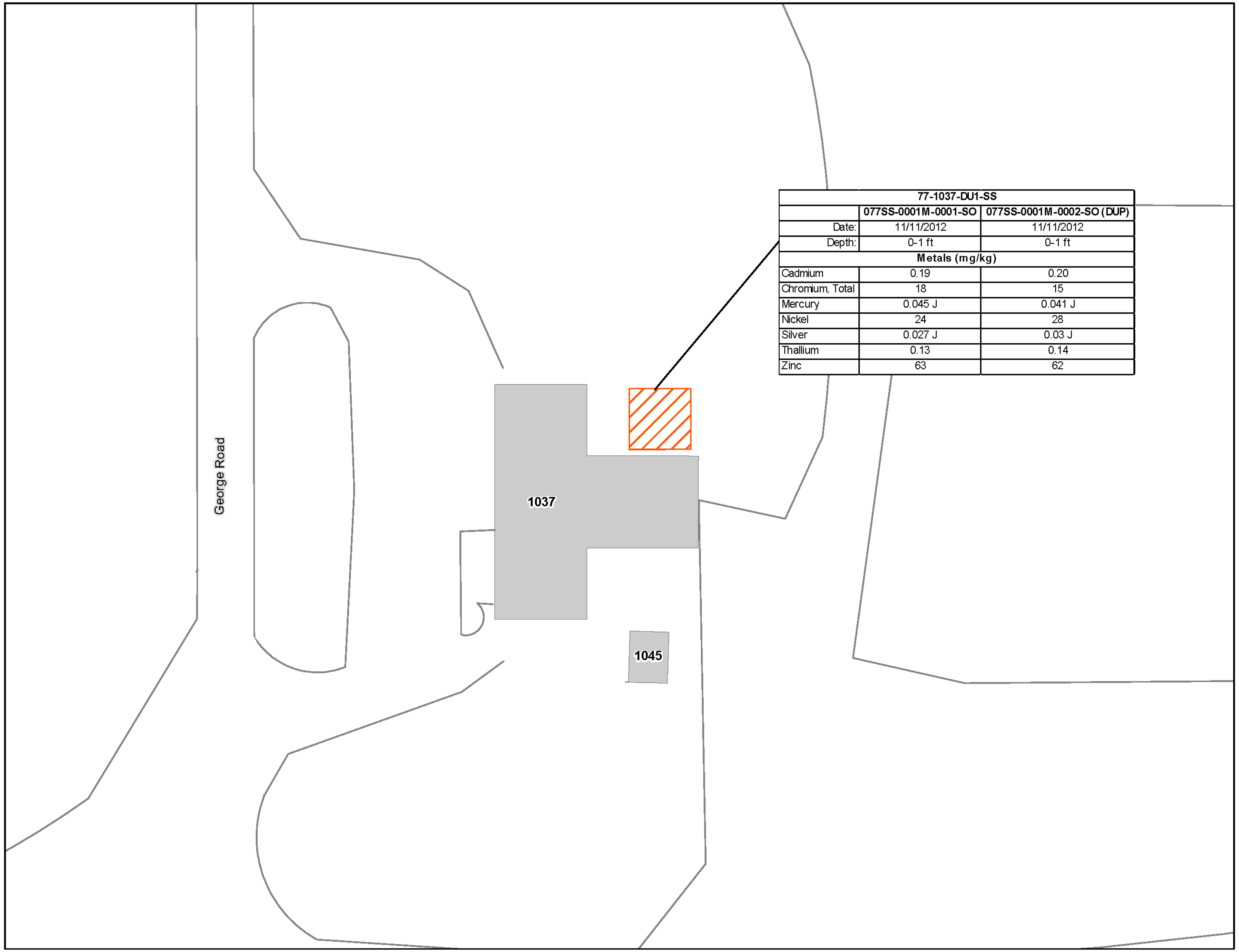
N

ECC
Marlborough, Massachusetts

GIS Server
F:\Projects\Ravenna 030113\MapDocuments\SI_RPT\CC77\SI77_Fig5-01_Bldg1037_Surface.mxd
January 2013 DWN BY: CG CHKD BY: GC

NO. 5-1

This page intentionally left blank



77-1037-DU1-SS		
	077SS-0001M-0001-SO	077SS-0001M-0002-SO (DUP)
Date:	11/11/2012	11/11/2012
Depth:	0-1 ft	0-1 ft
Metals (mg/kg)		
Cadmium	0.19	0.20
Chromium, Total	18	15
Mercury	0.045 J	0.041 J
Nickel	24	28
Silver	0.027 J	0.03 J
Thallium	0.13	0.14
Zinc	63	62

LEGEND

- Decision Unit
- Road
- Building

NOTES & SOURCES

1. Map Coordinates: NAD 83, UTM Zone 17N
2. CC = Army Environmental Compliance-Related Cleanup Program
3. RVAAP = Ravenna Army Ammunition Plant
4. Concentrations shown are for site-related chemicals (SRC) at each sample location.
5. Surface soil incremental sampling methodology (ISM) samples were collected from 0 to 1 foot below ground surface.
6. mg/kg = milligrams per kilogram
7. J = estimated
8. DUP = duplicate sample
9. ft = foot

TITLE

Figure 5-2

Inorganic Site-Related Chemicals Identified in Surface Soil Samples CC RVAAP-77

CC RVAAP-77
Building 1037
Laundry Waste Water Sump

Former Ravenna Army Ammunition Plant
Portage and Trumbull Counties, Ohio

0 20 40 Feet

N

ECC
Marlborough, Massachusetts

GIS Server
F:\Projects\Ravenna\MapDocuments\SI_RPT\CC77\
SI77_Fig5-02_Bldg1037_Surface.mxd
January 2013 DWN BY: CG CHKD BY: GC

NO. **5-2**

This page intentionally left blank

6.0 EXPOSURE PATHWAYS

6.1 SOIL EXPOSURE AND AIR PATHWAYS

6.1.1 Physical Conditions

The site is located within Hiram Till glacial deposits. The soil type found at this AOC is the Mahoning silt loam, 0-2 percent slopes (MgA) (Figure 1-7, Table 1-1). Mahoning silt loam is a gently sloping, poorly drained soil formed in silty clay loam or clay loam glacial till. The Mahoning silt loam has low permeability, with rapid runoff and seasonal wetness (USDA 2012). The bedrock formation at the AOC based on groundwater well installation logs is the Pennsylvanian-age Pottsville Formation, Sharon Sandstone member, informally referred to as the Sharon Conglomerate (Winslow and White 1966). The elevation of the Sharon Sandstone is approximately 980 ft amsl based on the Ohio Department of Natural Resources bedrock topography map (Figure 1-8).

6.1.2 Soil and Air Targets

Current and future human and ecological (animal and plant) receptors may come into contact with contamination in the surface or subsurface soil, if contaminants are present within the DU at this AOC. Considering the design and location of the waste water sump, any releases to soil would most likely have been to subsurface soil, which reduces the potential for exposure to ecological receptors via soil and air targets.

Airborne contamination (e.g., windblown dust) and soil gas vapor are not considered a viable migration or exposure pathway at this AOC. The likely contaminants associated with the Building 1037 Laundry Waste Water Sump CC RVAAP-77 (explosives, propellants) have low volatility, and potential releases of contaminants would likely have been to subsurface soil adjacent to the waste water sump, at or below water level in the sump of 4 ft bgs. The operational areas are currently paved, gravel covered, or currently well vegetated. The facility is located in a humid climate, and soil moisture content is typically high, which reduces the potential for dust generation. Further, as no organic chemicals were detected in the soil samples, there are no risks associated with soil gas vapor emissions.

6.1.3 Soil and Air Pathway Conclusions

The SI analytical results provided in this SI indicate that explosive and propellant chemicals were not detected in the surface soil (0-1 ft bgs), subsurface soil between 1 and 7 ft bgs, or in the subsurface soil collected between 7 and 13 ft bgs at CC RVAAP-77. Therefore, the exposure pathways for soil and air are incomplete.

6.2 SURFACE WATER PATHWAY

6.2.1 Hydrological Setting

No surface water or sediment samples were collected as part of this SI as surface water and sediment are not present at the AOC. Additionally, as reported in Section 4.4, sediment was not observed in the manhole. There are no perennial surface water features at the AOC. The closest perennial feature to receive drainage from the former Administration Area is a tributary to the west branch of the Mahoning River located southeast of the AOC.

6.2.2 Surface Water Targets

Surface water targets include human receptors that use surface water for potable water supply or recreation, as well as environmental (e.g., streams, wetlands, and sensitive aquatic environments) and physical targets (e.g., public or private water distribution system intakes) that may be affected by potential groundwater contamination on or adjacent to the AOC. No perennial streams are located at the AOC. There are no observed springs or groundwater discharge points to a surface water body in the immediate vicinity of the AOC. Therefore, there is no direct exposure pathway for human receptors or ecological targets to surface water at this AOC.

6.2.3 Surface Water Pathway Conclusions

There are no perennial surface water streams or wetlands in the immediate vicinity of CC RVAAP-77. Surface water flow and sediment transport are not migration pathways for potential contamination related to CC RVAAP-77 Building 1037 Laundry Waste Water Sump as they are not present at the AOC.

6.3 GROUNDWATER PATHWAY

6.3.1 Hydrogeological Setting

Section 1.4.4 presents the general hydrogeological setting for the former RVAAP. In April 2011, OHARNG installed two bedrock aquifer wells at the facility within the Sharon Conglomerate for use as a groundwater supply. These potable wells are located near Buildings 1067 and 1068 within the former Administration Area, which are approximately 430 and 1,500 ft from CC RVAAP-77. There is also one inactive non-potable groundwater supply well just south of Winklepeck Burning Grounds along the east side of George Road, which was formerly used to supply water for environmental restoration activities. These groundwater supply wells are used solely for on-site activities and are not used for public distribution or commercial groundwater potable supply.

There are also three monitoring wells located in the vicinity of CC RVAAP-77, south and southwest of Building 1037 and within the former Administration Area (referenced as monitoring wells FWGmw-004, FWGmw-015, and FWGmw-016). Monitoring wells FWGmw-004 and FWGmw015 are screened within the unconsolidated material. These two wells are relatively shallow with well screen bottoms set at 19.5 and 23.5 ft bgs, and are located 2,500 ft southwest and 1,500 ft south of Building 1037, respectively. Monitoring well FWGmw-016 is screened within the Sharon Conglomerate with the well screen bottom set at a depth of 64.5 ft bgs and located approximately 1,500 ft south of Building 1037 (EQM 2013).

Groundwater was not encountered in any of the soil borings completed in December 2012. Therefore, the depth to groundwater is expected to be greater than 13 ft bgs at CC RVAAP-77. Review of July 2012 gauging data from the RVAAP-66 Facility-Wide Groundwater Annual Report for 2012 (EQM 2013) indicates the depth to groundwater in the two monitoring wells (FWGmw-015 and FWGmw-004) screened within the unconsolidated aquifer ranges from approximately 6.33 to 13.76 ft bgs. However, as noted above, these wells are over 1,000 ft from Building 1037.

6.3.2 Groundwater Targets

Groundwater targets include human receptors that use groundwater for potable water supply, as well as environmental receptors (e.g., livestock, fish farms) and physical targets (e.g., springs) that may be affected by potential groundwater contamination on or adjacent to the site. There are no public, livestock, or commercial groundwater supply wells within the facility. Groundwater in the vicinity of Building 1037 at CC RVAAP-77 is currently used for on-site activities by the OHARNG.

6.3.3 Groundwater Pathway Conclusion

The results of this SI indicate that the subsurface soil is not contaminated; therefore, soil is not a source of groundwater contamination at this AOC. The groundwater associated with CC RVAAP-77 is being evaluated under the RVAAP-66 Facility-Wide Groundwater.

This page intentionally left blank.

7.0 SUMMARY AND CONCLUSIONS

This section provides a summary of the findings and conclusions of this SI conducted by ECC at the CC RVAAP-77 Building 1037 Laundry Waste Water Sump AOC. Only surface and subsurface soil were sampled as part of this SI, since there are no surface water bodies, wetlands, streams, or sediment onsite, and the groundwater associated with CC RVAAP-77 is currently being addressed separately under RVAAP-66 Facility-Wide Groundwater.

7.1 SUMMARY OF RESULTS

The SI results for CC RVAAP-77 are summarized below:

Surface Soil Results

- SRCs were identified in the one surface soil sample. A total of 529 constituents were analyzed and the following SRCs were identified in surface soil: one VOC (MIBK); fifteen SVOCs (PAH compounds); one pesticide (p,p′-DDE); seven metals (cadmium, chromium, mercury, nickel, silver, thallium, and zinc); one explosive (tetryl); and two propellants (nitroglycerin and nitroguanidine).

- No metals, explosives, propellants, VOCs, PCBs, or pesticides were detected at concentrations exceeding their respective Resident Receptor FWCUGs in the ISM surface soil sample collected.

- One SVOC (benzo[a]pyrene) was reported at a concentration of 88 µg/kg exceeding the most stringent Resident Receptor FWCUG of 22.0 µg/kg in the surface soil sample. However, the presence of this PAH chemical in the surface soil is not related to the historical operations conducted at the laundry building, which was used to wash workers' overalls potentially contaminated with explosives and/or propellants, as stated in the HRR (SAIC 2011a). Benzo(a)pyrene is not a potential contaminant at this AOC and is expected to be associated with overland runoff from the adjacent asphalt roadways and other potential sources nearby the AOC.

- Therefore, no potential contaminants related to site operations were identified in the surface soil at this AOC.

Subsurface Soil Results

- No SRCs were identified in subsurface soil which was sampled to a maximum depth of 13 ft bgs. All subsurface soil samples were non-detect for explosive and propellant chemicals.

- No explosive derivative or propellant chemicals were detected in the vertical or horizontal subsurface soil ISM samples collected at this AOC. No other organic chemicals were detected in the subsurface soil ISM samples exceeding their respective most stringent Resident Receptor FWCUGs.

- No potential contaminants related to site operations were identified in subsurface soil at this AOC.

7.2 CONCLUSIONS

The conclusions of this SI are as follows:

- No potential contaminants were identified in the surface or subsurface soil sampled at this AOC.

- The results of this SI indicate that the subsurface soil is not contaminated; therefore, soil is not a source of groundwater contamination at this AOC.

The results of this SI indicate that NFA is warranted for soil at the CC RVAAP-77 Building 1037 Laundry Waste Water Sump.

8.0 REFERENCES

Army Base Realignment and Closure Office. 2009. *Installation Hazardous Waste Management Plan for Ravenna Army Ammunition Plant*. August.

Environmental Chemical Corporation (ECC). 2012. *Final Site Inspection and Remedial Investigation Work Plan at Compliance Restoration Sites (Revision 0), Ravenna Army Ammunition Plant Ravenna, Ohio*. Prepared for the U.S. Army Corps of Engineers–Louisville District. October.

Environmental Quality Management, Inc. (EQM). 2013. *Final Facility-Wide Groundwater Monitoring Program RVAAP-66 Facility-Wide Groundwater, Annual Report for 2012, Revision 1*. Ravenna Army Ammunition Plant, Ravenna, Ohio. October.

Kammer, H.W. 1982. *A Hydrologic Study of the Ravenna Arsenal, Eastern Portage and Western 18 Trumbull Counties, Ohio*. Master Thesis, Kent State University.

Kohler, M., T. Kunniger, P. Schmid, E. Gujer, R. Crockett, and M. Wolfensberger. 2000. Inventory and emission factors of creosote, polycyclic aromatic hydrocarbons, and phenols from railroad ties treated with creosote. *Env. Science and Technology*. Vol. 34, pp. 4766 -4772. October.

Ohio Army National Guard (OHARNG). 2008. *Final Integrated Natural Resources Management Plan and Environmental Assessment for the Ravenna Training and Logistics Site and the Ravenna Army Ammunition Plant, Portage and Trumbull Counties, Ohio, Plan, Period FY 2002–2007*. March.

Ohio Environmental Protection Agency (Ohio EPA). 2004. Ohio Environmental Protection Agency Director's Final Findings and Orders for Ravenna Army Ammunition Plant, Ravenna, Ohio. 10 June.

PIKA International. Inc. (PIKA). 2010. *Final Project Completion Report – Disposal of Discarded Munitions Debris and Components; Demolition of RVAAP-35 Building 1037 – Laundry Waste Water Sump and Laundry Flame Proofing Building; and Evaluation and Recommendations for Closure of Clean-Hard Fill Sites*. February 5.

Science Applications International Corporation (SAIC). 2001. *Final Phase II Remedial Investigation Report for Winklepeck Burning Grounds at Ravenna Army Ammunition Plant, Ravenna, Ohio*. Prepared for the U.S. Army Corps of Engineers–Louisville District. April.

SAIC. 2010. *Final Facility-Wide Human Health Cleanup Goals for the Ravenna Army Ammunition Plant, Ravenna, Ohio*. Prepared for the U.S. Army Corps of Engineers–Louisville District. 23 March.

SAIC. 2011a. *Final Historical Records Review Report for the 2010 Phase I Remedial Investigation Services at Compliance Restoration Sites (9 Areas of Concern), Revision 0 at the Ravenna Army Ammunition Plant, Ravenna, Ohio.* W912QR-08-D-0008, Delivery Order 0016. December.

SAIC. 2011b. *Facility-Wide Sampling and Analysis Plan for Environmental Investigations at the Ravenna Army Ammunition Plant, Ravenna, Ohio*. Prepared for the U.S. Army Corps of Engineers–Louisville District. 24 February.

United States Army Corps of Engineers (USACE). 1998. *Phase I Remedial Investigation Report of High Priority Areas of Concern at the Ravenna Army Ammunition Plant, Ravenna, Ohio*. February.

USACE. 2001. *Facility-wide Sampling and Analysis Plan for Environmental Investigations at the Ravenna Army Ammunition Plant, Ravenna, Ohio*. March.

USACE. 2005. *Ravenna Army Ammunition Plant's Facility-Wide Human Health Risk Assessment Manual*. Amendment 1. December.

USACE. 2010. *Disposal of Discarded Munitions Debris and Components, Demolition of the Laundry Flame Proofing Building, and Evaluation and Recommendations for Closure of Clean-Hard Fill Sites at the Ravenna Army Ammunition Plant in Ravenna, Ohio*. February.

United States Army Industrial Operations Command. 2008. *Pamphlet 385-1 Classification and Remediation of Explosive Contamination*.

United States Army Toxic and Hazardous Materials Agency. 1978. *Installation Assessment of Ravenna Army Ammunition Plant.* Records Evaluation Report No. 132. November.

United States Department of Agriculture (USDA). 1978. Soil Survey of Portage County, Ohio.

USDA. 2012. Soil Map of Portage County. Version 4. Natural Resources Conservation Service Website: *www.websoilsurvey.nrcs.usda.gov*. Accessed 23 December.

United States Environmental Protection Agency (USEPA). 1989. *Risk Assessment Guidance for Superfund, Volume 1: Human Health Evaluation Manual (Part A)*. December.

USEPA. 1992. *Guidance for Performing Site Inspections under CERCLA, Interim Final*. EPA Publication PB92-963375, EPA/540-R-92-021. September.

USEPA. 1999. *Improving Site Assessment: Abbreviated Preliminary Assessments*. Office of Emergency and Remedial Response Site Assessment Team. October.

USEPA. 2007. *TEACH Chemical Summary Benzo(a)pyrene (BaP)*. 1 August.

USEPA. 2013. *Technical Factsheet on Polycyclic Aromatic Hydrocarbons*. Website: *http://www.epa.gov/ogwdw/pdfs/factsheets/soc/tech/pahs.pdf.*

USEPA. 2014. *Regional Screening Levels*. Screening Levels for Chemical Contaminants. May.

United States Geological Survey. 1968. *Mineral Resources of the Appalachian Region.* U.S. Geological Survey Professional Paper 580.

Winslow, J.D. and G.W. White. 1966. *Geology and Ground-water Resources of Portage County, Ohio*. U.S. Geological Survey Professional Paper.

This page intentionally left blank.