Draft
Site Inspection Report
CC RVAAP-75 George Road Sewage Treatment Plant
Mercury Spill
Revision 0

Former Ravenna Army Ammunition Plant
Portage and Trumbull Counties, Ohio

March 12, 2015

Contract No. W912QR-04-D-0039
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Prepared for:

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14. ABSTRACT
This Site Inspection (SI) report documents the SI activities conducted at CC RVAAP-75 George Road Sewage Treatment Plant Mercury Spill at the former Ravenna Army Ammunition Plant in Portage and Trumbull counties, Ohio. The purpose of the SI was to determine the presence or absence of contamination and whether the George Road Sewage Treatment Plant Mercury Spill Area of Concern (AOC) warrented further investigation pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980. The sampling completed for this SI indicates that there is no contamination present at the George Road Sewage Treatment Plant Mercury Spill AOC that would warrant further investigation. This SI report recommends No Further Action.

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CONTRACTOR'S STATEMENT OF INDEPENDENT TECHNICAL REVIEW

Environmental Chemical Corporation has completed the *Draft Site Inspection Report, CC RVAAP-75 George Road Sewage Treatment Plant Mercury Spill, Revision 0, at the 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 United States Army Corps of Engineers policy.

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LIST OF ACRONYMS AND ABBREVIATIONS

ºF	Degrees Fahrenheit
µg/mg	Microgram per kilogram
amsl	Above mean sea level
AOC	Area of concern
ARNG	Army National Guard
bgs	Below ground surface
BKG	Background
CAS	Chemical Abstract Number
CC	Army Environmental Database Compliance-Related Cleanup Program
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
cm	Centimeter
CR	Compliance Restoration
DDE	Dichlorodiphenyldichloroethylene
DDT	Dichlorodiphenyltrichloroethane
DU	Decision Unit
ECC	Environmental Chemical Corporation
ER	Equipment rinsate
FS	Feasibility study
ft	Feet
FWCUG	Facility-Wide Cleanup Goal
FWSAP	Facility-Wide Sampling and Analysis Plan
HRR	Historical Records Review
ID	Identification
IDW	Investigation-derived waste
km	Kilometer
m	Meter
mg/m^3	Milligram per cubic meter
mg/kg	Milligram per kilogram

LIST OF ACRONYMS AND ABBREVIATIONS (CONTINUED)

NA	Not applicable
ND	Not detected
NFA	No Further Action
No.	Number
NPDES	National Pollutant Discharge Elimination System
OHARNG	Ohio Army National Guard
Ohio EPA	Ohio Environmental Protection Agency
PAH	Polycyclic aromatic hydrocarbon
PCB	Polychlorinated biphenyl
QA	Quality assurance
QC	Quality control
RI	Remedial investigation
RL	Reporting Limit
RSL	Regional Screening Level
RVAAP	Ravenna Army Ammunition Plant
SAIC	Science Applications International Corporation
SB	Soil boring
SD	Wet sediment
SI	Site inspection
SO	Soil
SRC	Site-related chemical
SVOC	Semi-volatile organic compound
TAL	Target Analyte List
TB	Trip blank
TCR	Target Cancer Risk
THQ	Target Hazard Quotient
TR	Trench
USACE	United States Army Corps of Engineers
USDA	United States Department of Agriculture
USEPA	United States Environmental Protection Agency
Vista	Vista Sciences Corporation
VOC	Volatile organic compound
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 Database Compliance-Related Cleanup Program) RVAAP-75 George Road Sewage Treatment Plant Mercury Spill at the former Ravenna Army Ammunition Plant (RVAAP), in Portage and Trumbull counties, Ohio. This SI was completed under Contract Number (No.) W912QR-04-D-0039, Delivery Order No. 0004, Modification No. 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 SIs under the CERCLA* (USEPA 1992).

This SI was conducted to investigate a historic spill of a 1 pint jar of elemental mercury within the comminutor building that went into the floor drain of the building. Based on the findings of the *Historical Records Review Report for the 2010 Phase I RI Services at CR Sites (9 Areas of Concern)* (Science Applications International Corporation [SAIC] 2011a), an SI was recommended because this past mercury spill may have resulted in a release of contaminants into subsurface soil or sediment at this area of concern (AOC).

For this SI, subsurface soil and wet sediment samples were collected and evaluated. Surface soil samples were not collected since the release of mercury occurred within the comminutor building and entered the building's drainage system, which is located below ground surface. No surface water samples were collected as part of this SI, as no surface water is present at the AOC. Groundwater was not sampled as part of this SI since it is being evaluated under a facility-wide basis (RVAAP-66 Facility-Wide Groundwater).

The objectives of this SI were as follows:

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

- Collect subsurface soil and wet sediment samples for laboratory analysis at CC RVAAP-75.

- Identify whether Site-Related Chemicals (SRCs) are present in the soil or sediment 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-75 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 (between the adult and child) 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 subsurface soil sampling was conducted at CC RVAAP-75 in order to collect representative samples along the migration pathway of the mercury spill. Since the mercury spill was reported to have occurred within the comminutor building and entered the building's floor drain, the SI sampling plan was developed to collect soil samples along this flow path, from the comminutor building floor drain to the outside of the building via a 4-inch diameter cast iron pipe. The 4-inch cast iron pipe is connected to a 15-inch vitrified clay pipe that discharged into the sanitary sewer line at manhole MH-P1 (SAIC 2012).

For this SI, soil samples were collected at locations where the spilled mercury may have leaked from this underground piping system. The subsurface soil sampling was conducted within three separate areas: (1) beneath the floor drain within the comminutor building, (2) beneath and adjacent to the floor drain's 4-inch diameter cast iron pipe, and (3) beneath the 15-inch diameter drain line (vitrified clay pipe).

A wet sediment sample was collected from the outfall of the sanitary sewer system, identified as the outfall area. In addition, one sample was collected from the drainage pipe deposit located within the 15-inch drain line.

For this SI, two decision units (DUs) were assigned, as follows:

- One DU (DU01) consists of the floor drain inside the comminutor building, where 1 pint of elemental mercury had reportedly been spilled (SAIC 2011a). The floor drain within the building connects directly above a P-trap and discharges to a 4-inch cast iron pipe. The 4-inch cast iron pipe connects to a 15-inch vitrified clay pipe. The 15-inch pipe is approximately 22 feet (ft) in length and is plugged with brick and mortar at its discharging end.

  Formerly, the 15-inch vitrified clay pipe discharged flow eastwardly into the 10-inch vitrified clay stormwater sewer line. The 10-inch pipe discharges to the outfall area south of the treatment plant.

- The second DU (DU02) is located downstream of the outfall headwall. During sewage treatment plant operations, this outfall served as the terminus of the former sanitary discharge. Currently, this outfall area is the discharge location for stormwater runoff from the Administration Area. The Administration Area includes buildings, parking lots, rail road beds, and paved roads.

The following media samples were collected during this SI:

- Five subsurface soil samples were collected from beneath the 15-inch vitrified clay pipe (drain line) that received discharge from the comminutor building floor drain. These subsurface soil samples were collected between 5 and 6 ft below ground surface (bgs).

- Three subsurface soil samples were collected from beneath the floor drain's P-trap and the 4-inch cast iron pipe associated with the floor drain inside the comminutor building into which the mercury reportedly spilled (SAIC 2011a).

- Two subsurface soil samples were collected from two soil borings located on either side of the 4-inch cast iron pipe, which runs from the floor drain P-trap inside the comminutor building to the 15-inch vitrified clay pipe (drain line). These samples were collected between 5 and 6 ft bgs.

- One subsurface soil sample was collected at depth of 7 to 13 ft bgs to characterize the soil to 13 ft bgs.

- One wet sediment sample was collected from the discharge location of the drainage outfall area in order to inspect the terminus area of the drainage system. The wet sediments within the discharge outfall area were analyzed for mercury.

- One discrete sample was collected of the drainage pipe deposit located within the 15-inch vitrified clay pipe (drain line). The deposit was sampled from the northeastern corner of the comminutor building.

Additionally, in order to determine the flow path of the mercury spill and the condition of the drainage system leading from the comminutor building, a video camera inspection was conducted as part of this SI.

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 drainage pipe deposit within the 15-inch drain line (vitrified clay) was also compared to the Resident Receptor FWCUG (using a TCR of 10^{-6} or a THQ = 0.1) for mercury in subsurface soil.

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.

The SI results are summarized for CC RVAAP-75 George Road Sewage Treatment Plant Mercury Spill as follows.

Subsurface Soil

- One SRC (mercury) was identified in the subsurface soil samples collected beneath the 15-inch vitrified clay pipe (drain line), under the floor drain P-trap, and beneath and adjacent to the 4-inch cast iron pipe.

- Mercury was not detected in concentrations exceeding the Resident Receptor FWCUG in any of the subsurface soil samples collected at this AOC. Mercury was not identified as a potential contaminant in the subsurface soil.

- The reported concentration of mercury (0.05 mg/kg) in the deepest subsurface soil sample collected between 7 and 13 ft bgs is below the maximum contaminant level for protection of groundwater (0.1 mg/kg). Therefore, mercury is not considered a potential source for groundwater contamination at this AOC.

Wet Sediment

- SRCs were identified in the DU02 outfall area wet sediment samples as follows: 3 volatile organic compounds (VOCs) (2-hexanone, carbon disulfide, and methylene chloride); 22 semivolatile organic compounds (SVOCs) primarily polycyclic aromatic hydrocarbon (PAH) compounds; 2 pesticides (p,p-dichlorodiphenyldichloroethylene and p,p-dichlorodiphenyl-trichloroethane), 1 explosive (tetryl), and 13 metals including mercury.

- Three metals (aluminum, cobalt, and manganese) were reported in the wet sediment samples collected at DU02 outfall area. Aluminum and manganese were reported at concentrations exceeding the background concentrations and respective Resident Receptor FWCUG. Cobalt was reported greater than the background concentration; however, no FWCUG has been established for this chemical. These inorganic chemicals were not related to the elemental mercury spill at CC RVAAP-75 AOC and were not identified as potential contaminants in the wet sediments collected from the outfall area.

- Three SVOCs (benzo[a]anthracene, benzo[a]pyrene, and benzo[b]fluoranthene) were reported in one of the two wet sediment samples and one SVOC, benzo(a)pyrene, was reported in only the second wet sediment sample collected at the drainage outfall area (DU02) at concentrations exceeding the Resident Receptor FWCUG.

- The PAH compounds and metals reported in the two wet sediment samples collected from the discharge area of the outfall area are expected to be present at the active outfall area since the outfall area is the current terminus for the storm sewer network, receiving runoff from surrounding areas including rail beds, parking lots, and roads that contain PAH compounds. The active outfall area also potentially receives inorganic chemicals from mineral scaling deposits and metal pipe debris that may have accumulated in the sanitary and storm sewer pipes over time (SAIC 2012). These chemicals are not related to the spill of mercury at the George Road Sewage Treatment Plant. These organic and inorganic chemicals were not identified as potential contaminants in the wet sediments collected from the drainage outfall area.

Drainage Pipe Deposit

- One mercury sample was reported at 7.2 milligrams per kilogram [mg/kg] at DU01 in the drainage pipe deposit sample collected from inside the 15-inch vitrified clay pipe (drain line). Mercury was identified as an SRC, because it exceeded the background value of 0.044 mg/kg. Mercury also exceeded the Resident Receptor FWCUG (2.27 mg/kg) for soil. The mercury level was compared to the Resident Receptor FWCUG for soil, as there are no criteria for a drainage pipe deposit.

The conclusions of this SI are as follows:

- No organic or inorganic potential contaminants were identified in the subsurface soil or wet sediment sampled at this AOC.

- Mercury was reported at a concentration 7.2 mg/kg on the drainage pipe deposit sample located within the 15-inch vitrified clay pipe (drain line) that exceeds the Resident Receptor FWCUG (2.27 mg/kg). However, the mercury within the drainage deposit sample collected from within the enclosed 15-inch vitrified clay pipe (drain line) is not subsurface soil and is not a potential source of contamination to the environment since there is no complete exposure pathway. This is supported by the following lines of evidence:

    1. The end of the drain line is plugged with concrete (at the junction with manhole MH-P1) preventing any migration of the drainage pipe deposit, and this line is no longer used for drainage.

    2. The SI sampling results of the subsurface soil surrounding and beneath the 15-inch vitrified clay pipe (drain line) do not contain any potential contamination from the estimated 0.5 grams of mercury contained in the drainage pipe deposit.

- 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. Groundwater associated with CC RVAAP-75 is currently being addressed separately under the RVAAP-66 Facility-Wide Groundwater.

The results of this SI indicate that NFA is warranted at CC RVAAP-75 George Road Sewage Treatment Plant Mercury Spill.

1. 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) Area of Concern (AOC) CC (Army Environmental Compliance-Related Cleanup Program) RVAAP-75 George Road Sewage Treatment Plant Mercury Spill at the former Ravenna Army Ammunition Plant (RVAAP) in Portage and Trumbull counties, Ohio (Figure 1-1). This document was prepared by ECC under the USACE–Louisville District, Multiple Award Remediation Contract Number (No.) W912QR-04-D-0039, Delivery Order No. 0004, Modification No. 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 AOC CC RVAAP-75. The location of CC RVAAP-75 is shown on Figure 1-2 and Figure 1-3.

This SI for CC RVAAP-75 was conducted in accordance with the U.S. Environmental Protection Agency's (USEPA) *Interim Final Guidance for Performing SI 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 description and operational history
- 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, Multiple Award Remediation Contract No. W912QR-04-D-0039, Delivery Order No. 0004 under a firm-fixed price performance-based acquisition to provide environmental investigation and remediation services at 14 CR sites at the former RVAAP, in Portage and Trumbull counties, Ohio (Figures 1-1 and 1-2). The Delivery Order was issued by the USACE–Louisville District on 15 August 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.

According to the 1993 Installation Action Plan (Olin 1993), the CC RVAAP-75 George Road Sewage Treatment Plant Mercury Spill (identified as RVAAP-22 in the 1993 Installation Action Plan) was first identified as an AOC with low potential for releases to soil and groundwater.

Historical information for CC RVAAP-75 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 22 December 2011 (Science Applications International Corporation [SAIC] 2011a). The Historical Records Review (HRR) followed the guidance and requirements of a CERCLA Abbreviated Preliminary Assessment; *USEPA Improving Site Assessment: Abbreviated Preliminary Assessments*, dated October 1999. The HRR (SAIC 2011a) indicated that 1 pint of elemental mercury had reportedly spilled within the communitor building and entered the floor drain.

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 had been transferred to the U.S. Property and Fiscal Officer 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 RVAAP relate to previous activities at the facility as associated with 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 Ohio Army National Guard (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 the CC RVAAP-75 is included in Chapter 6.

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 western portion of the facility to approximately 930 ft amsl in the eastern portion of the facility. The average surface elevation for CC RVAAP-75 is 995 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 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 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 coverings of glacial material 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 materials 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 the soil types are discussed and mapped in the *Soil Survey of Portage County, Ohio*. The Soil Survey 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 at the facility 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 Figures 1-5 and 1-6. The primary soil type present at CC RVAAP-75 is shown in Figure 1-7 and summarized in Table 1-1.

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. 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) (Environmental Quality Management, Inc. 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 onsite supply wells completed within the Sharon Conglomerate range from 30 to 400 gallons per minute (U.S. Army Toxic and Hazardous Materials Agency 1978). Yields of 5-200 gallons per minute have also been reported for onsite bedrock wells completed in the Sharon Conglomerate (Kammer 1982).

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 gallons per minute, and the Connoquennissing Sandstone. Wells completed in the Connoquennissing Sandstone in Portage County yield from 5 to 100 gallons per minute, 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, which indicates 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 in a north to south direction, before flowing into the Michael J. Kirwan Reservoir, which is located south of State Route 5 (Figure 1-3). 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.

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 km), 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 square km), 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 square km), 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 most 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 could 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 1 January 1996 and 31 July 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 chapter 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 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—Field Activity Forms
- 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 Reports
- Appendix H—Site Photographs
- Appendix I—Video Inspection of Drainage System Piping
- Appendix J—Regulatory Correspondence and Comment Response Table

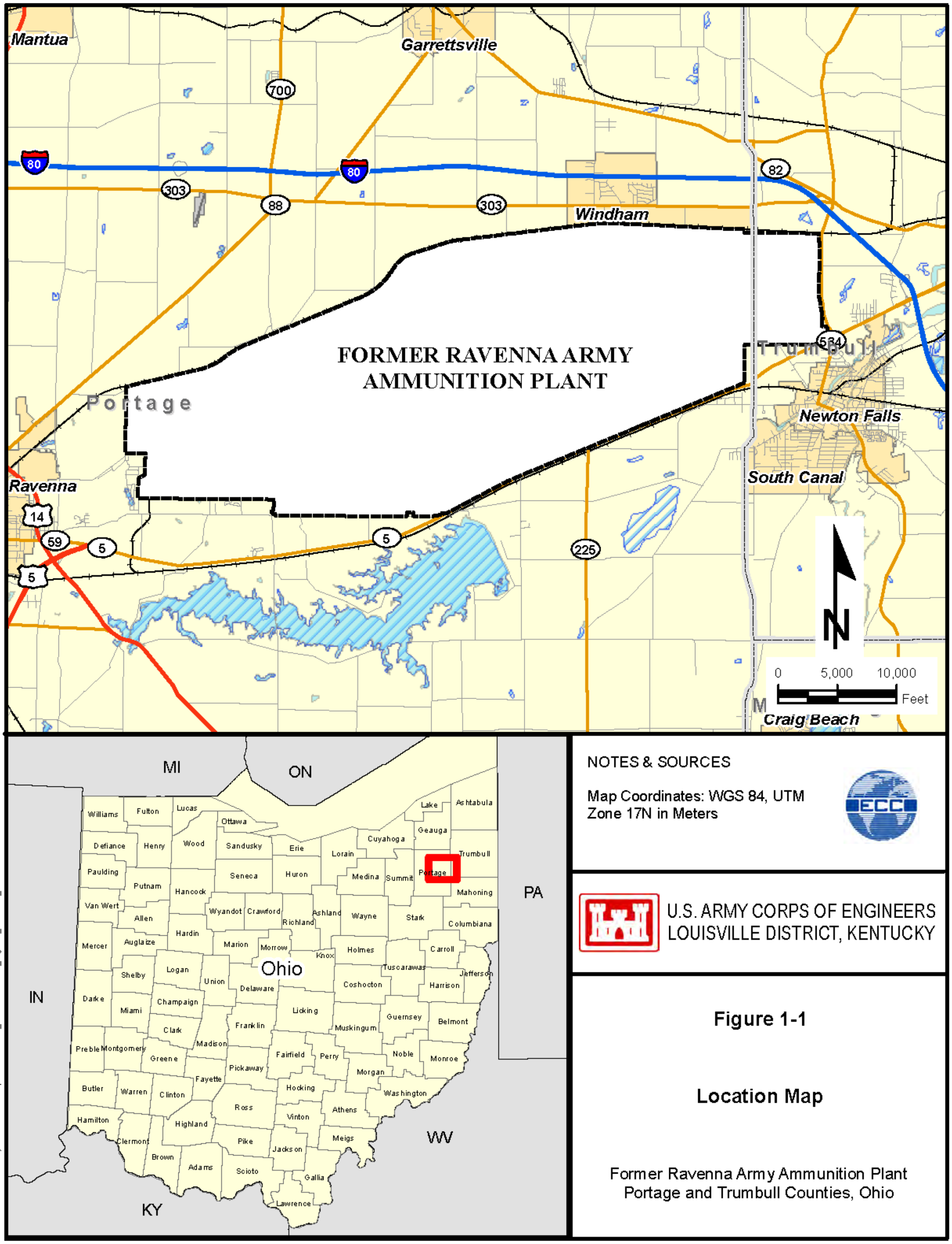

Figure 1-1

Location Map

Former Ravenna Army Ammunition Plant
Portage and Trumbull Counties, Ohio

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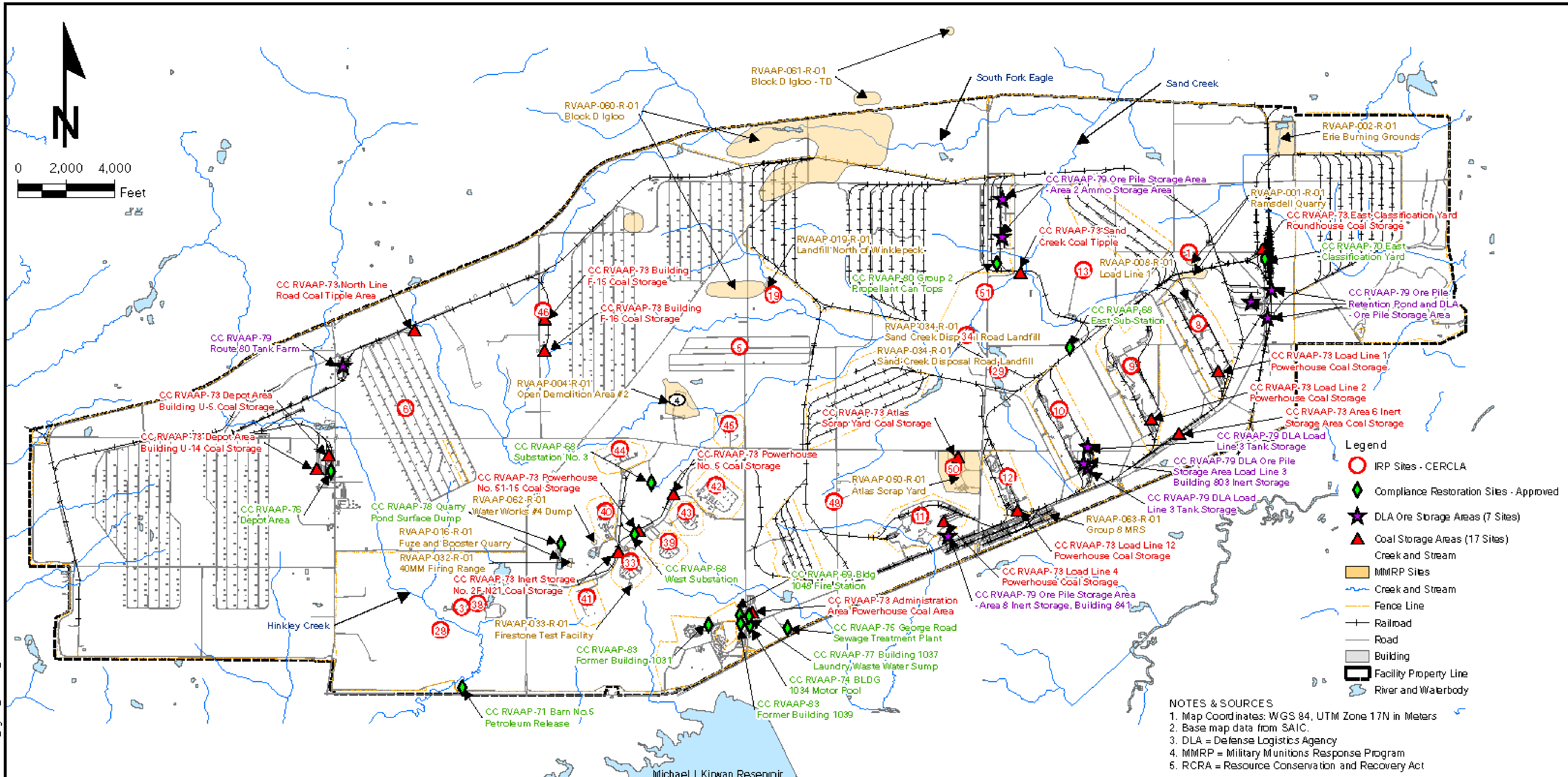

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IRP SITES - CERCLA		
1	RVAAP-01	Ramsdell Quarry Landfill
3	RVAAP-03	Open Demolition Area #1
5	RVAAP-05	Winklepeck Burning Grounds
6	RVAAP-06	C Block Quarry
8	RVAAP-08	Load Line 1
9	RVAAP-09	Load Line 2
10	RVAAP-10	Load Line 3
11	RVAAP-11	Load Line 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

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Figure 1-2

Location of
Compliance Restoration Sites

Former Ravenna Army Ammunition Plant
Portage and Trumbull Counties, Ohio

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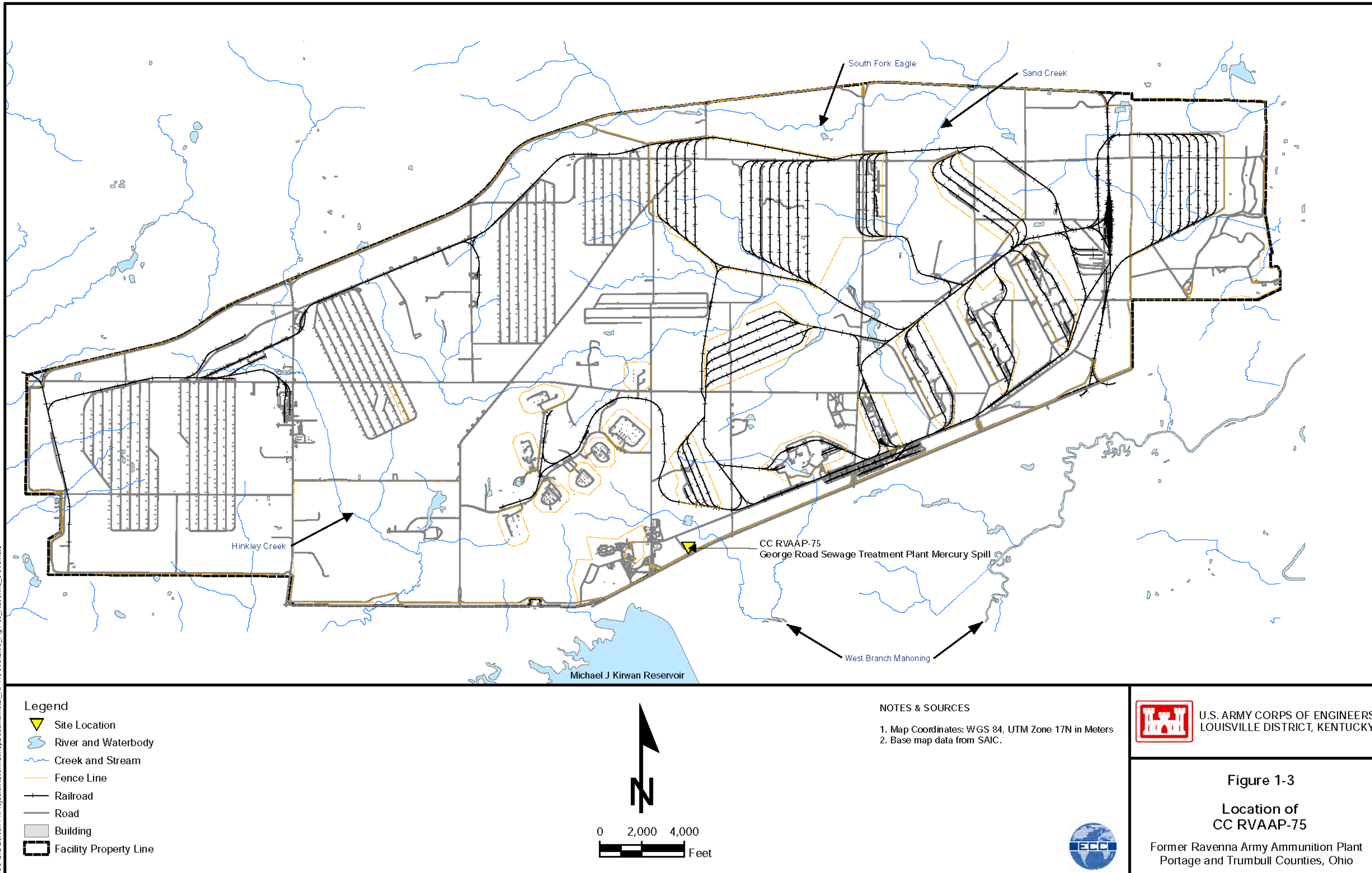

Figure 1-3

Location of
CC RVAAP-75

Former Ravenna Army Ammunition Plant
Portage and Trumbull Counties, Ohio

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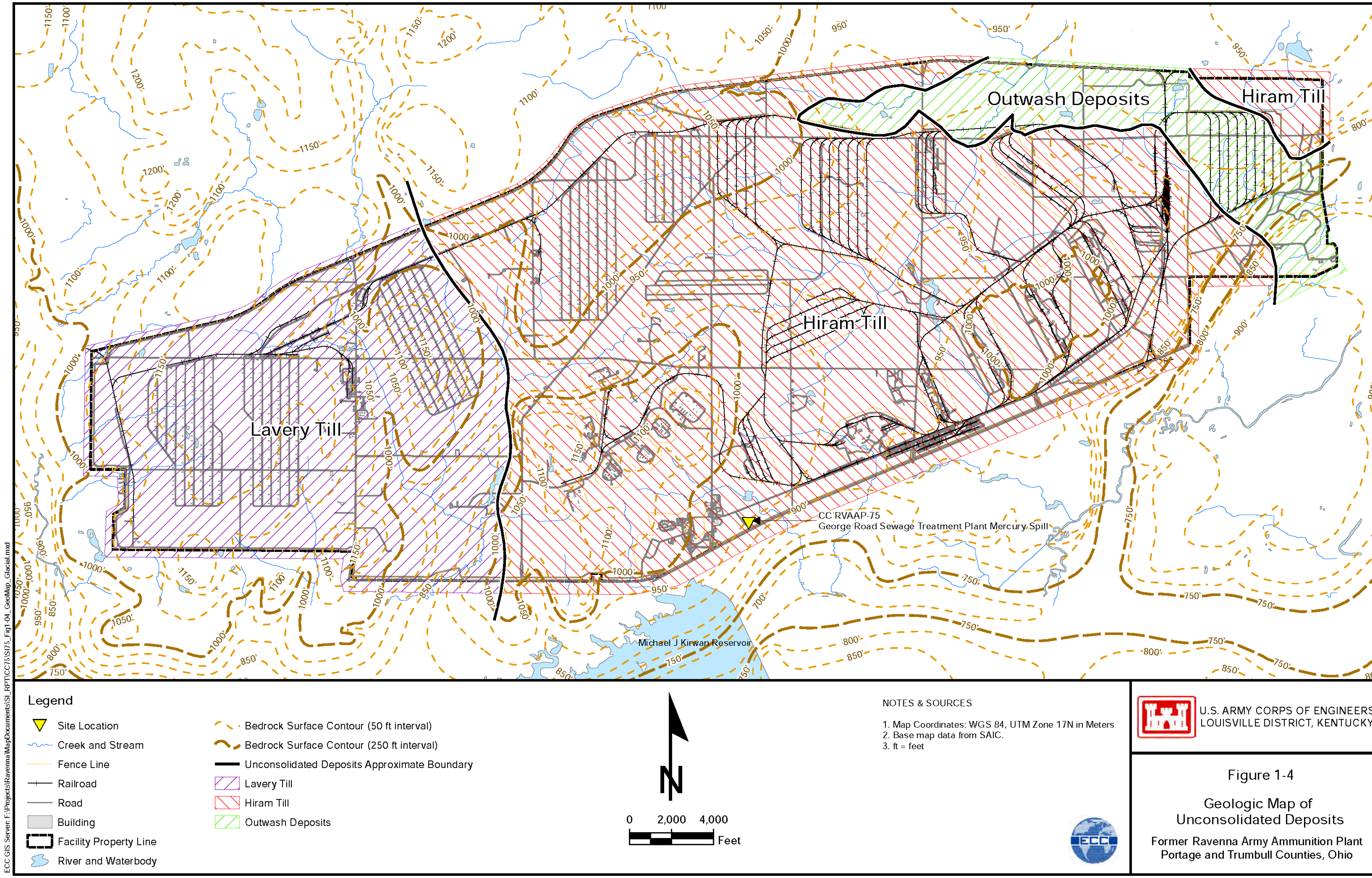

Figure 1-4

Geologic Map of Unconsolidated Deposits

Former Ravenna Army Ammunition Plant
Portage and Trumbull Counties, Ohio

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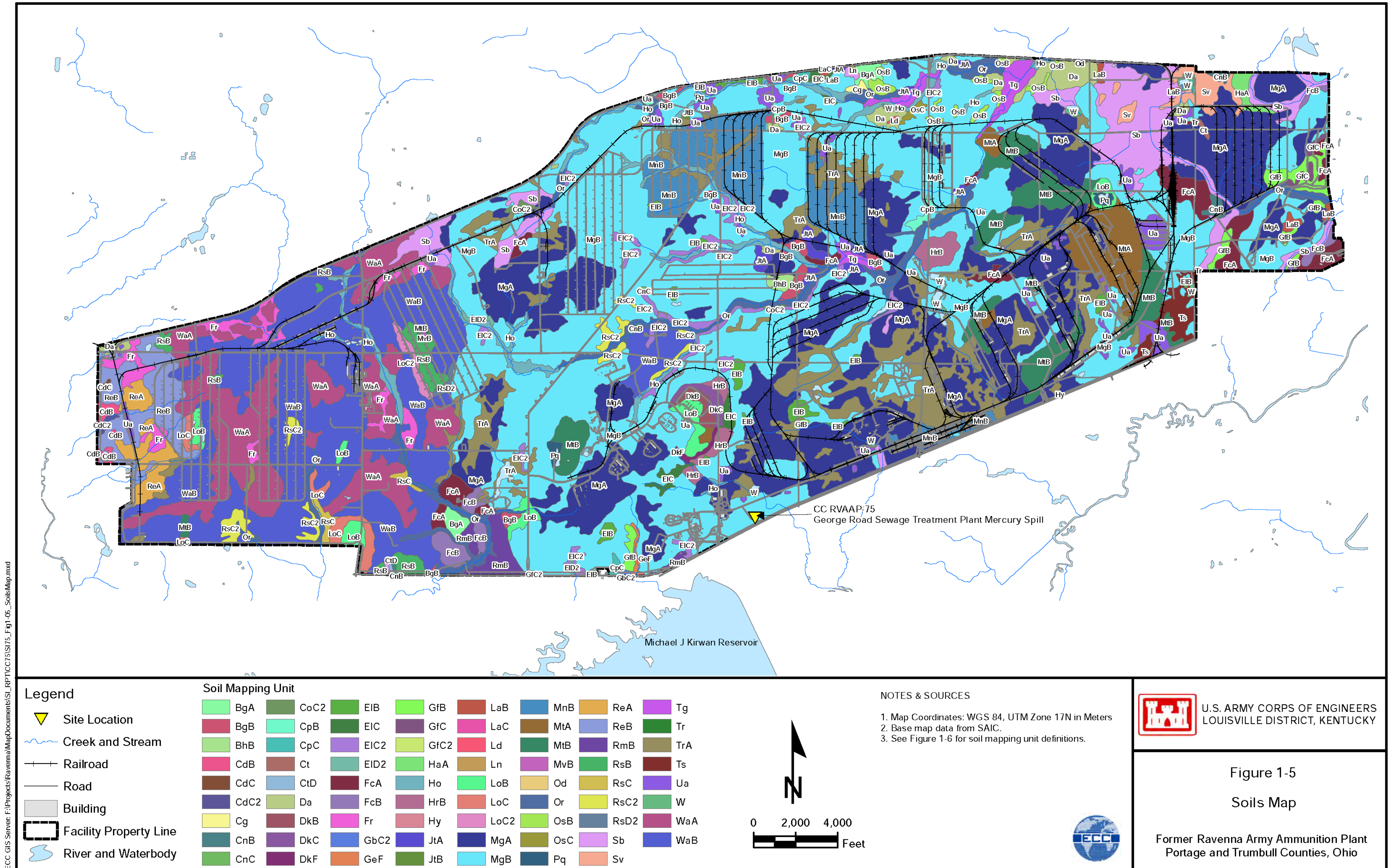

Figure 1-5
Soils Map

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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.

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Figure 1-6

Description of Soil Mapping Units

Former Ravenna Army Ammunition Plant
Portage and Trumbull Counties, Ohio

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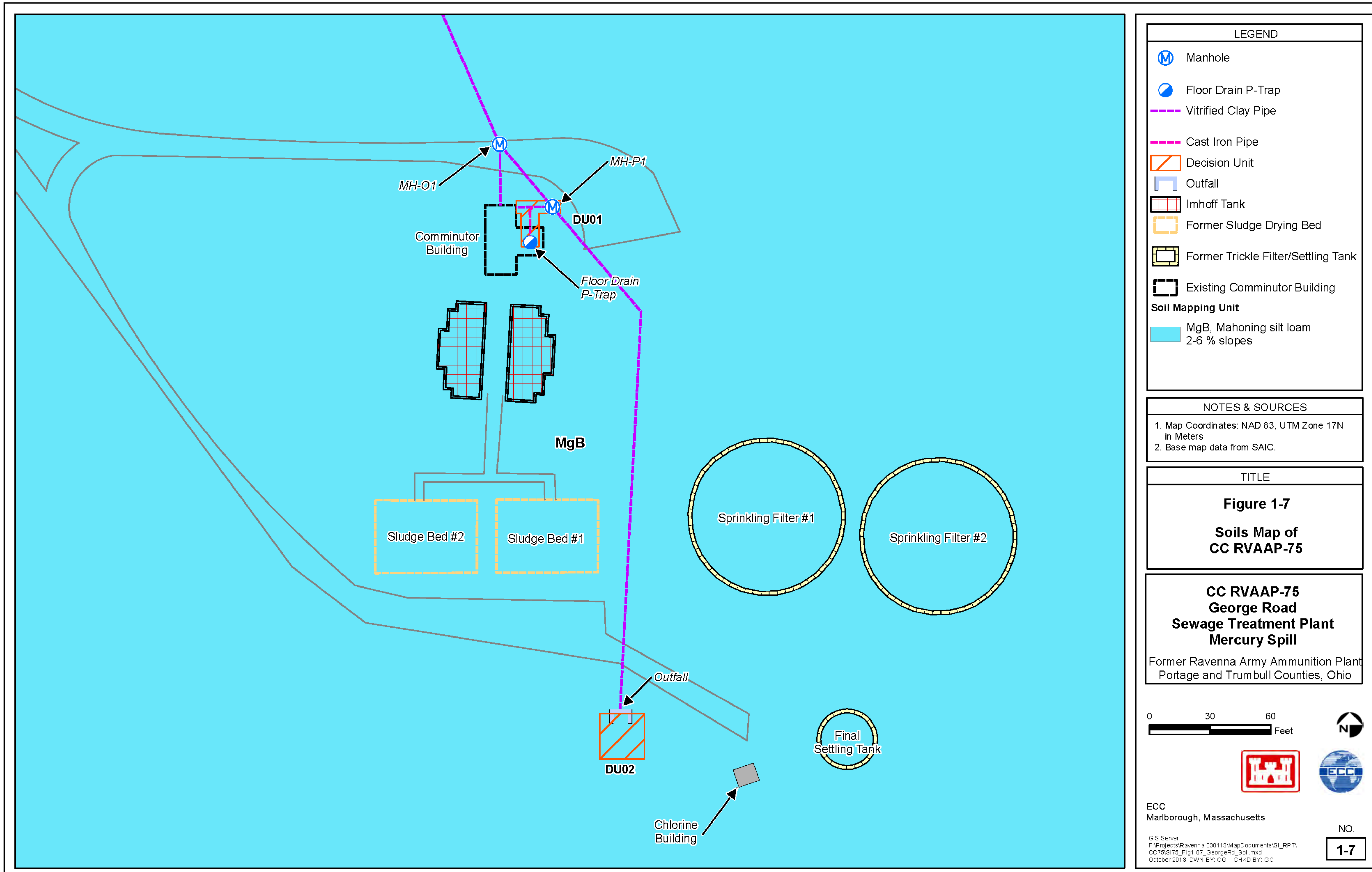
MH-O1
MH-P1
DU01
Comminutor Building
Floor Drain P-Trap
MgB
Sludge Bed #2
Sludge Bed #1
Sprinkling Filter #1
Sprinkling Filter #2
Outfall
DU02
Final Settling Tank
Chlorine Building
LEGEND
Manhole
Floor Drain P-Trap
Vitrified Clay Pipe
Cast Iron Pipe
Decision Unit
Outfall
Imhoff Tank
Former Sludge Drying Bed
Former Trickle Filter/Settling Tank
Existing Comminutor Building
Soil Mapping Unit
MgB, Mahoning silt loam 2-6 % slopes
NOTES & SOURCES
1. Map Coordinates: NAD 83, UTM Zone 17N in Meters
2. Base map data from SAIC.
TITLE
Figure 1-7
Soils Map of CC RVAAP-75
CC RVAAP-75
George Road
Sewage Treatment Plant
Mercury Spill
Former Ravenna Army Ammunition Plant
Portage and Trumbull Counties, Ohio
0 30 60 Feet
N
ECC
ECC
Marlborough, Massachusetts
NO.
1-7

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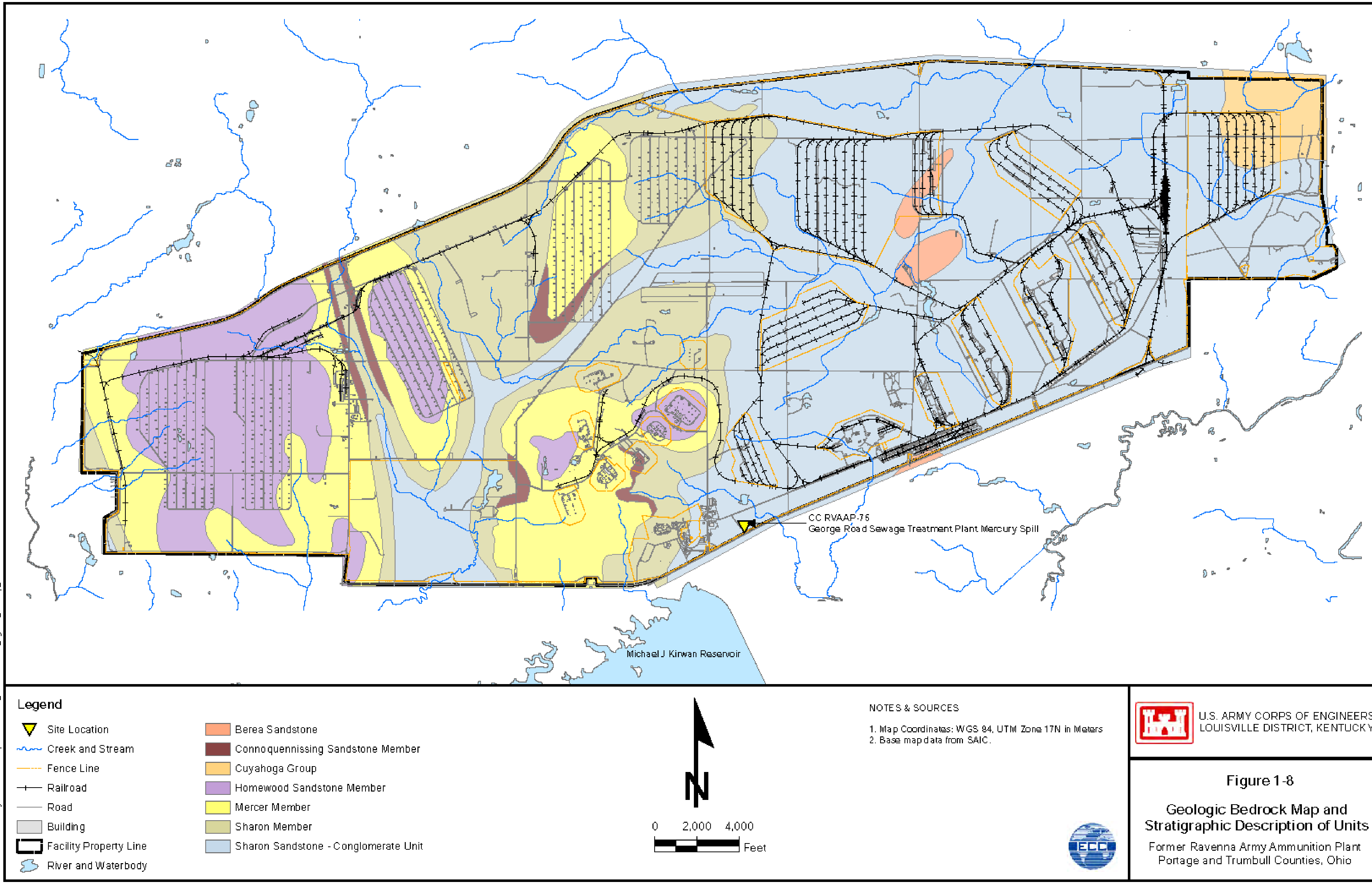

Figure 1-8

Geologic Bedrock Map and Stratigraphic Description of Units

Former Ravenna Army Ammunition Plant
Portage and Trumbull Counties, Ohio

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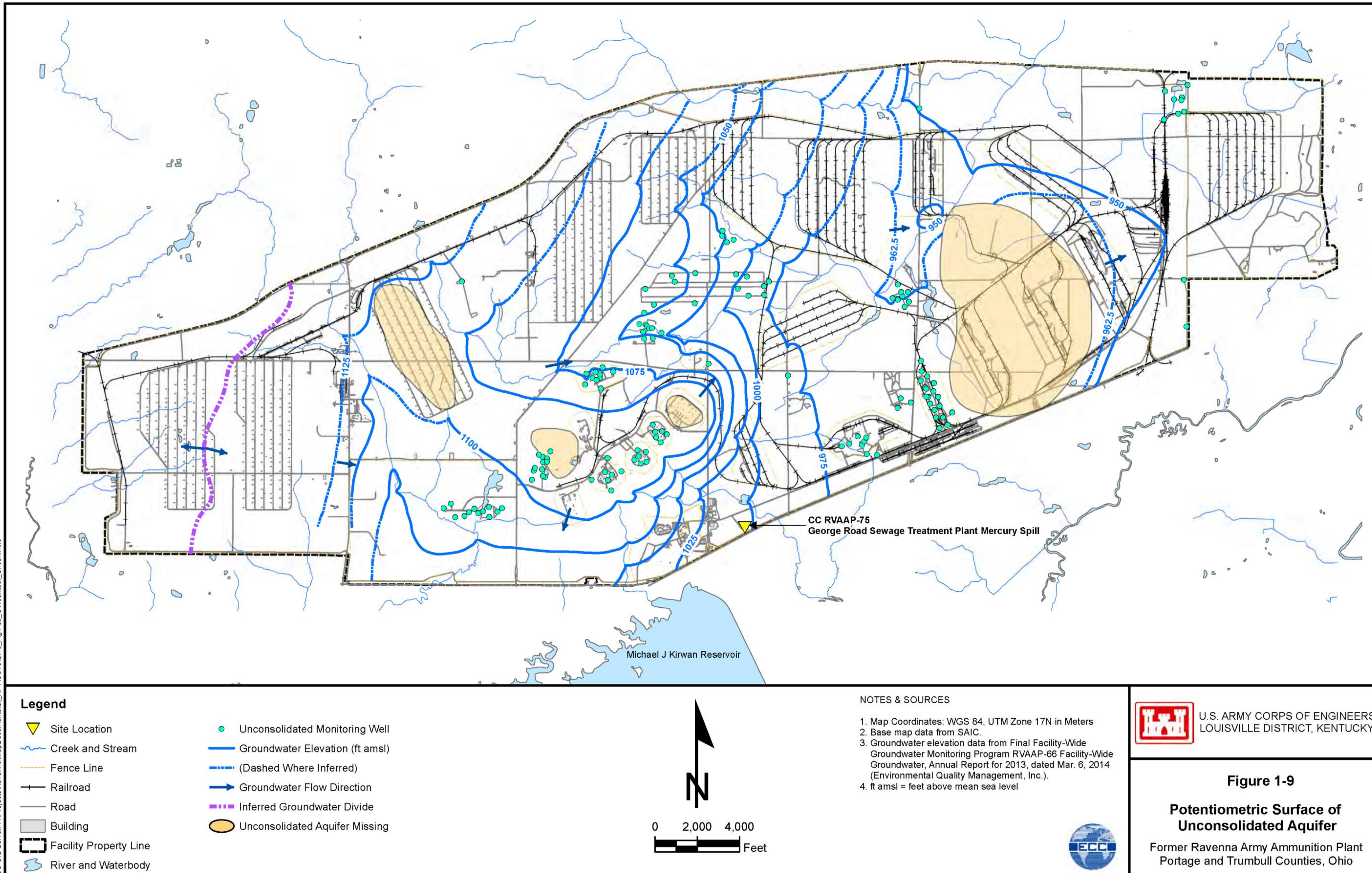

Figure 1-9

Potentiometric Surface of Unconsolidated Aquifer

Former Ravenna Army Ammunition Plant
Portage and Trumbull Counties, Ohio

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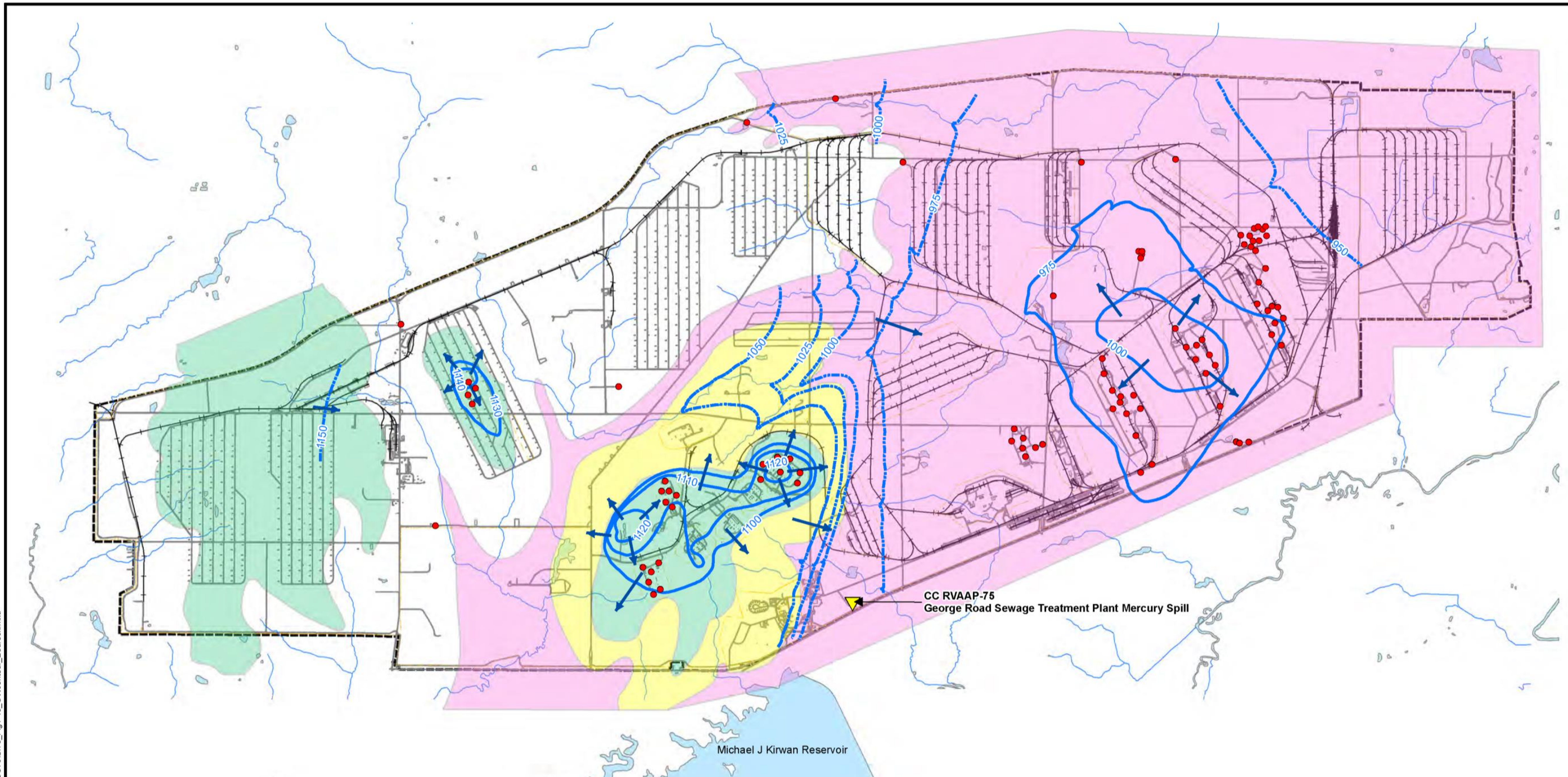

Legend

- 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 Elevation (ft amsl)
- (Dashed Where Inferred)
- Groundwater Flow Direction

N

0 2,000 4,000 Feet

NOTES & SOURCES

1. Map Coordinates: WGS 84, UTM Zone 17N in Meters
2. Base map data from SAIC.
3. Groundwater elevation data from Final Facility-Wide Groundwater Monitoring Program RVAAP-66 Facility-Wide Groundwater, Annual Report for 2013, dated Mar. 6, 2014 (Environmental Quality Management, Inc.).
4. 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

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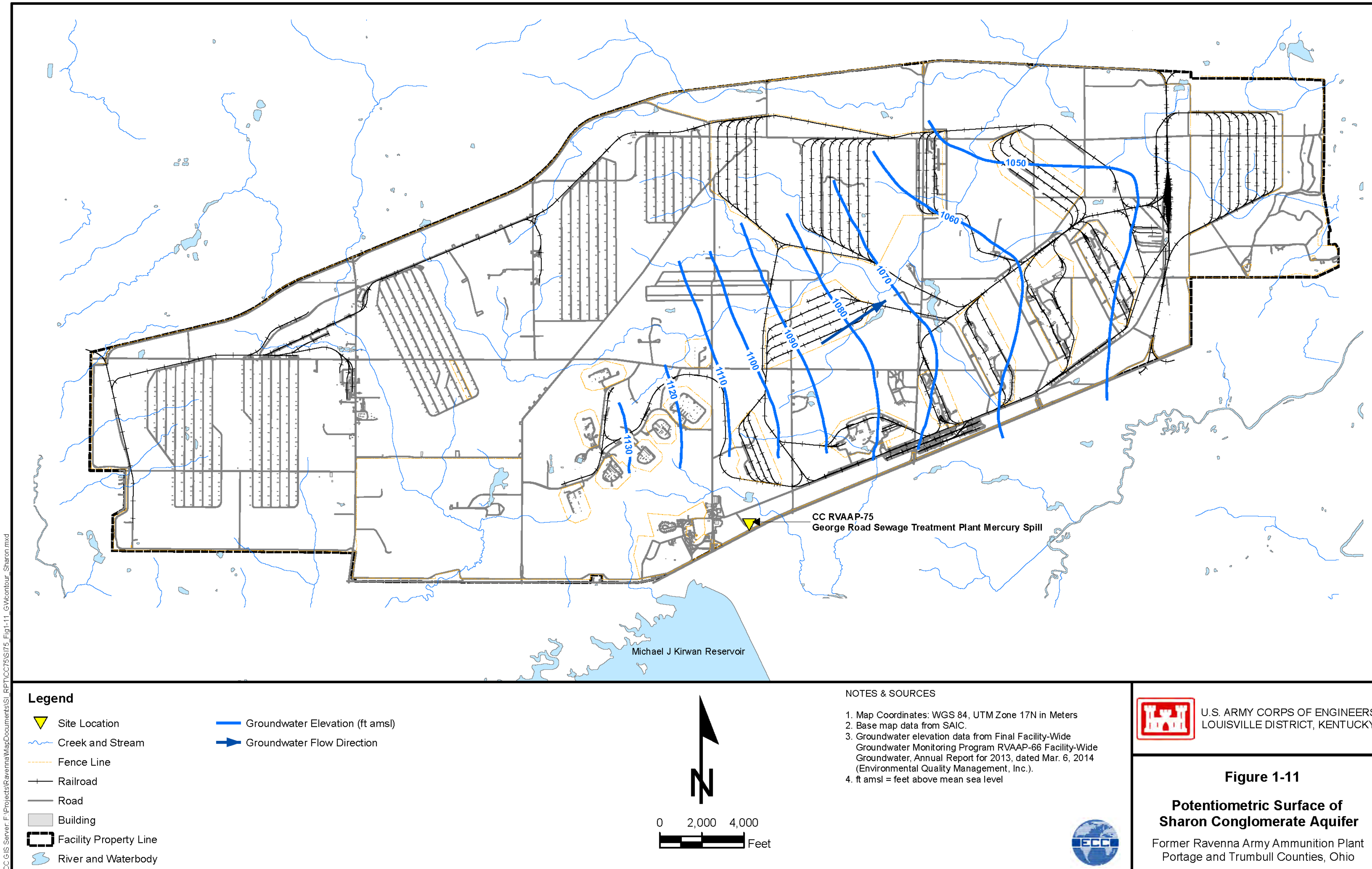

Figure 1-11

Potentiometric Surface of Sharon Conglomerate Aquifer

Former Ravenna Army Ammunition Plant
Portage and Trumbull Counties, Ohio

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Table 1-1: Soil Type at CC RVAAP-75

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

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2. SITE DESCRIPTION AND OPERATIONAL HISTORY

2.1 SITE DESCRIPTION

The CR site, CC RVAAP-75 George Road Sewage Treatment Plant Mercury Spill AOC (Figure 2-1) is located south of South Service Road and north of South Patrol Road about 0.5 miles east of the Administration Area. The George Road Sewage Treatment Plant is an inactive domestic sewage treatment plant that was used to process domestic sewage from Load Line 6 (RVAAP-15) and Load Line 7 (RVAAP-30). The George Road Sewage Treatment Plant received influent from the Administration Area, Hospital, Family Housing, Power House No. 6, and the vehicle maintenance garage. The plant also received sludge from the Depot Sewage Treatment Plant (RVAAP-21). The George Road Sewage Treatment Plant was taken out of service in 1993, and was properly closed under an Ohio National Pollutant Discharge Elimination System (NPDES) Permit No. 31000000BD. No records were discovered that document when plant operations began; however, a 1941 site schematic was found as part of the HRR, so it is assumed that operations began circa 1941 (SAIC 2011a).

The George Road Sewage Treatment Plant consisted of the comminutor building, (Figure 2-2) two Imhoff tanks, two trickling filters, sludge beds contained within greenhouses, and a chlorine building (Figure 2-1). The Imhoff tanks were abandoned in place and filled with soil, the trickling filters were removed, and sludge from the drying beds was also removed. The comminutor and chlorine buildings remain. Each is a small brick building.

Interviewees participating in the HRR indicated that a spill of elemental mercury from a pint-sized jar into the floor drain occurred inside the comminutor building (SAIC 2011a). The reported mercury spill discovered during the interview process of the HRR is the focus of this SI.

2.2 LAND USE AND OWNERSHIP HISTORY

The George Road Sewage Treatment Plant was used to process domestic sewage and discharge from Load Lines 6 and 7. The George Road Sewage Treatment Plant is located approximately 0.5 miles east of the Administration Area, which also includes Building 1034 Motor Pool (CC RVAAP-74) and Building 1037 Former Laundry Building (CC RVAAP-77), both now used as administration offices. Appendix A contains historical (1940-2009) aerial photographs of the CR site.

George Road Sewage Treatment Plant operated as part of the former activities associated with the facility. Administrative accountability for the AOC has been transferred to the Army National Guard (ARNG) who licenses the use of the AOC to the OHARNG for military training. Currently, this AOC is not actively used by the OHARNG for military training.

2.3 PREVIOUS INVESTIGATIONS

The George Road Sewage Treatment Plant was evaluated as an AOC (RVAAP-22) in the *Preliminary Assessment for the Characterization of Areas of Contamination RVAAP, Ravenna,* *Ohio* (SAIC 1996). The report concluded RVAAP-22 was maintained under an Ohio NPDES Permit No. 31000000BD and was not considered a high priority AOC.

An HRR report for CC RVAAP-75 was completed in December 2011. The report made the following observations and conclusions:

- Interviewees noted approximately a 1 pint jar of elemental liquid mercury was spilled within the comminutor building and went down a floor drain. The spilled elemental mercury was never recovered or located.

- The George Road Sewage Treatment Plant was removed from service in 1993, and closed under a NPDES permit.

- An interviewee noted that during decommissioning activities, the remaining sludge from the treatment plant was spread out along Greenleaf Road as part of a restoration research project.

- According to the findings of the HRR Report (SAIC 2010), the building schematics (Figure 2-3) show the comminutor building floor drain is connected to a 4-inch cast iron pipe which leads outside the building and ties into a 15-inch vitrified clay pipe (drain line), which “appears to be channeled back into the treatment system.” The 15-inch vitrified clay pipe (drain line) is tied back into the sanitary sewer at manhole MH-P1. Upon further review of the building schematics and onsite visual observations made by ECC during this SI at CC RVAAP-75, it was observed that the 15-inch vitrified clay pipe (drain line) is pitched to drain from the comminutor building to manhole MH-P1. Invert elevations for the manholes and 15-inch vitrified clay pipe (drain line) are shown in Figure 2-3.

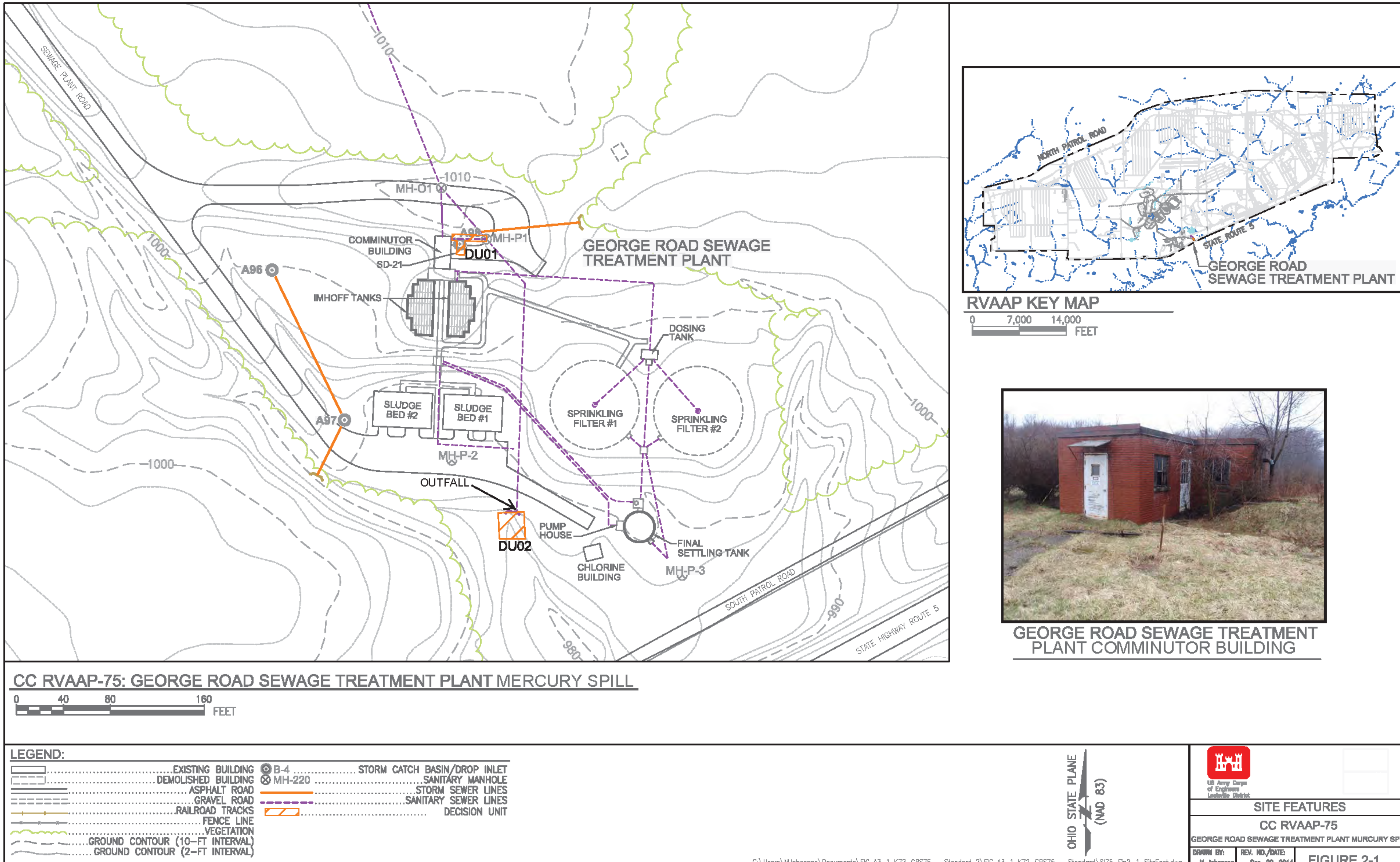
- An interviewee noted that the floor drains likely have a P-trap and, therefore, it may be possible that the mercury is still within the P-trap.

- No visual evidence of the mercury spill was noted.

- Further investigation at CC RVAAP-75 was recommended based on the findings of the HRR, which recommended that the floor drain pipe and pipe trap within the comminutor be further inspected and soil samples be collected immediately surrounding the floor drain pipeline.

This SI was completed based on the information and recommendations provided in the HRR report for the CC RVAAP-75 George Road Sewage Treatment Plant Mercury Spill AOC. Based on information presented in the Final HRR, SI activities were conducted at the following areas:

- Comminutor building floor drain/piping
- Sanitary sewer outfall area


GEORGE ROAD SEWAGE TREATMENT PLANT
SEWAGE PLANT ROAD
MH-01
1010
COMMINUTOR BUILDING
SD-21
A98
MH-P1
DU01
A96
IMHOFF TANKS
DOSING TANK
SLUDGE BED #2
SLUDGE BED #1
SPRINKLING FILTER #1
SPRINKLING FILTER #2
A97
MH-P-2
1000
OUTFALL
DU02
PUMP HOUSE
FINAL SETTLING TANK
CHLORINE BUILDING
MH-P-3
SOUTH PATROL ROAD
STATE HIGHWAY ROUTE 5
990
980
RVAAP KEY MAP
NORTH PATROL ROAD
STATE ROUTE 5
GEORGE ROAD SEWAGE TREATMENT PLANT
0 7,000 14,000 FEET
GEORGE ROAD SEWAGE TREATMENT PLANT COMMINUTOR BUILDING
CC RVAAP-75: GEORGE ROAD SEWAGE TREATMENT PLANT MERCURY SPILL
0 40 80 160 FEET
LEGEND:
EXISTING BUILDING
DEMOLISHED BUILDING
ASPHALT ROAD
GRAVEL ROAD
RAILROAD TRACKS
FENCE LINE
VEGETATION
GROUND CONTOUR (10-FT INTERVAL)
GROUND CONTOUR (2-FT INTERVAL)
B-4 STORM CATCH BASIN/DROP INLET
MH-220 SANITARY MANHOLE
STORM SEWER LINES
SANITARY SEWER LINES
DECISION UNIT
OHIO STATE PLANE (NAD 83)
C:\Users\MJohnson\Documents\FIG A3-1 K72-CRS75 – Standard 2\FIG A3-1 K72-CRS75 – Standard\SI75_Fig2-1_SiteFeat.dwg
US Army Corps of Engineers Louisville District
SITE FEATURES
CC RVAAP-75
GEORGE ROAD SEWAGE TREATMENT PLANT MURCURY SPILL
DRAWN BY: M Johnson
REV. NO./DATE: Dec. 22, 2014
FIGURE 2-1

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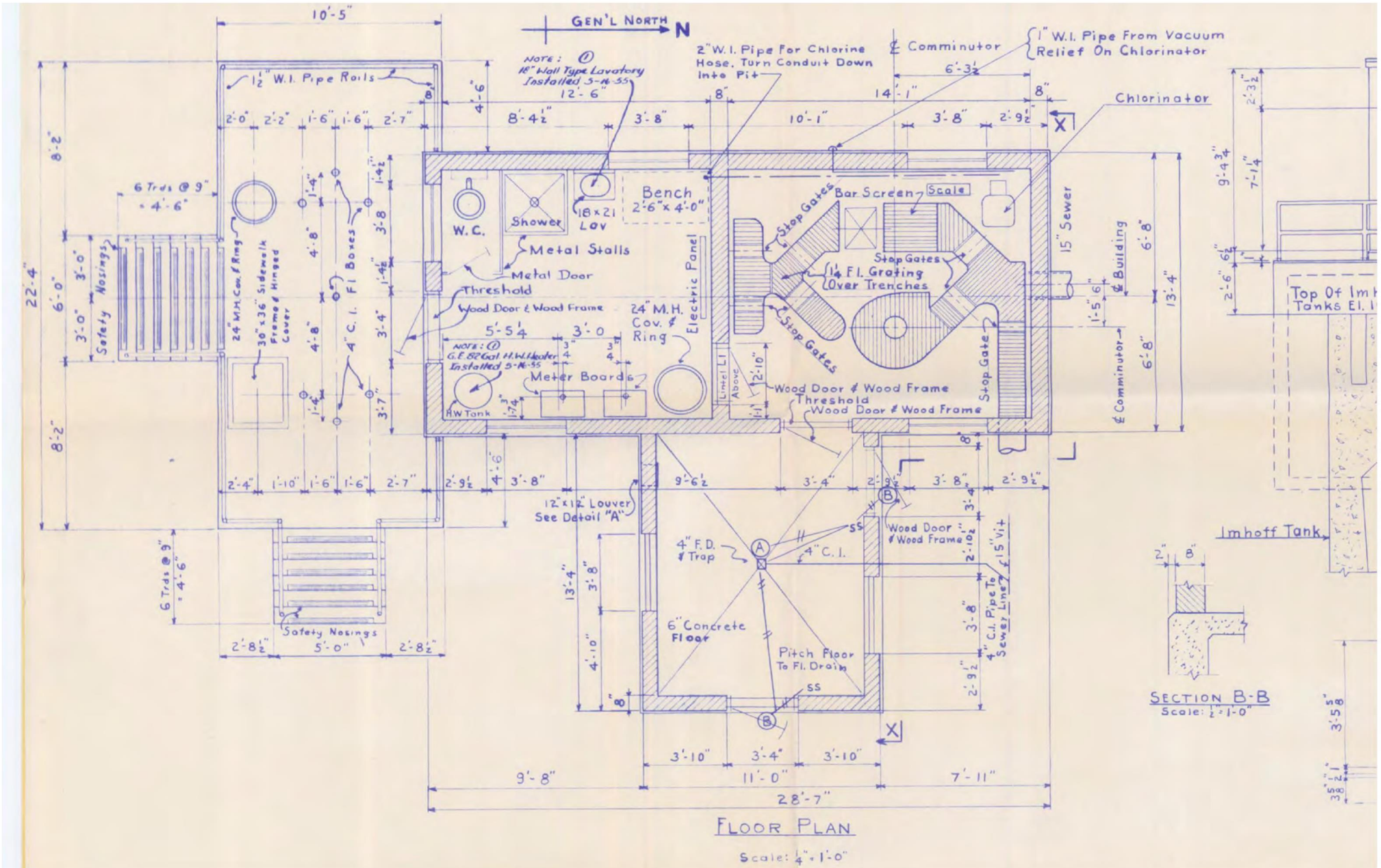

TITLE

Figure 2-2

Comminutor Building Plan

CC RVAAP-75 George Road Sewage Treatment Plant Mercury Spill

Former Ravenna Army Ammunition Plant
Portage and Trumbull Counties, Ohio

ECC
Marlborough, Massachusetts

SOURCE:
Drawing from the Final Historical Records Review Report for the 2010 Phase I Remedial Investigation Services at Compliance Restoration Sites (9 Areas of Concern), Revision 0, Appendix I Maps/Drawings References (SAIC 2011b).

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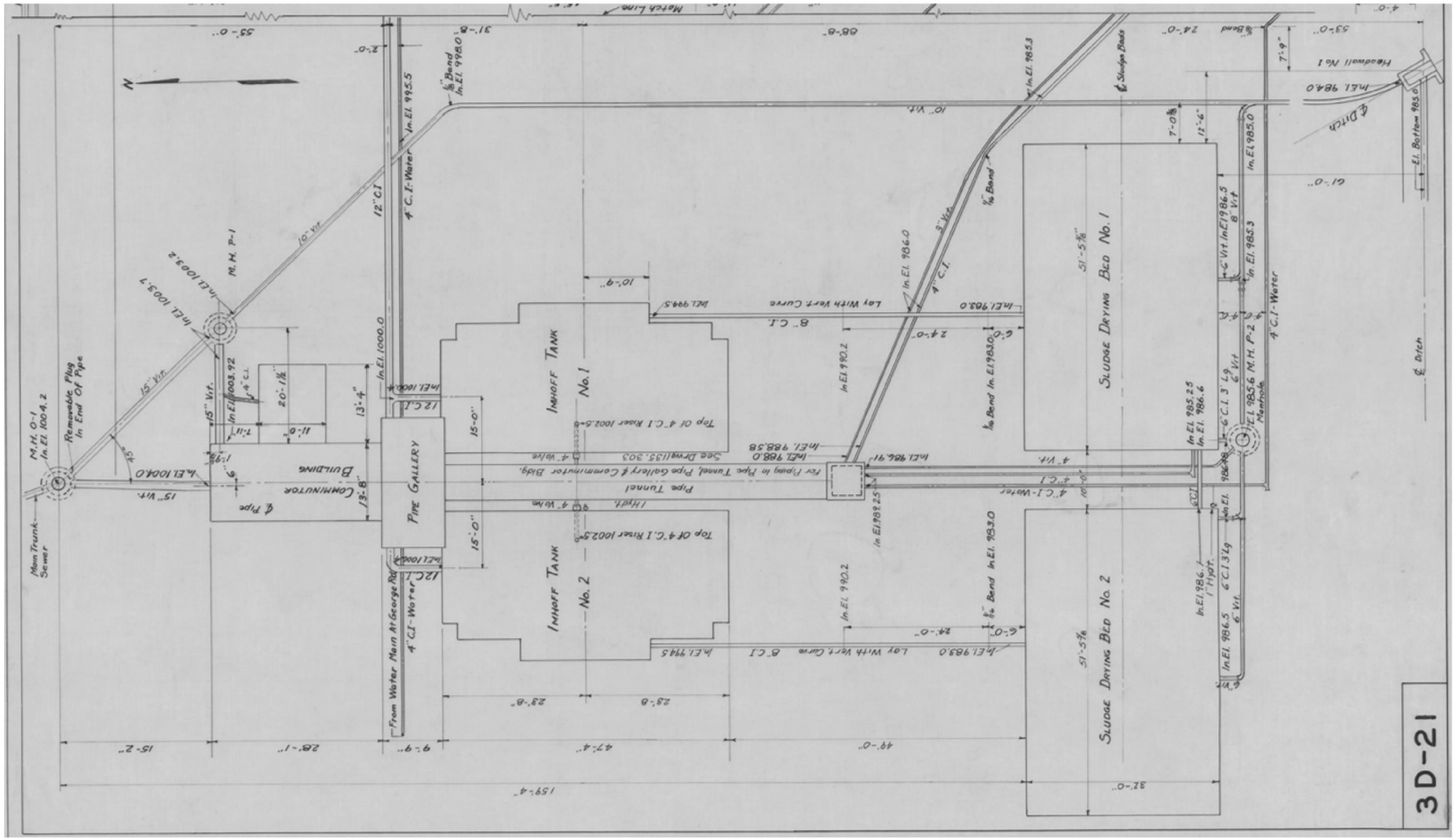

SOURCE:
Drawing from the Final Historical Records Review Report for the 2010 Phase I Remedial Investigation Services at Compliance Restoration Sites (9 Areas of Concern), Revision 0, Appendix I Maps/Drawings References (SAIC 2011b).

ECC
Marlborough, Massachusetts

TITLE

Figure 2-3

Treatment Plant Piping Plan

CC RVAAP-75
George Road
Sewage Treatment Plant
Mercury Spill

Former Ravenna Army Ammunition Plant
Portage and Trumbull Counties, Ohio

1404

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3. HISTORICAL OPERATIONS

According to the HRR (SAIC 2011a), the trickling filters had mercury seals that tended to leak. Under drains were associated with the trickling filters, which drained into a collection box. The mercury was periodically collected after heavy flows and placed in a pint-sized jar for storage. As noted in Section 2.1, interviewees indicated elemental mercury contained in a pint-sized jar reportedly spilled into a floor drain in the comminutor building (SAIC 2011a).

During the HRR, one interviewee noted sludge from the drying beds was removed and spread along Greenleaf Road during the building decommissioning. An interviewee noted that silver recovery operations from photographic and x-ray development solutions were conducted at the AOC. No other documentation was found regarding other chemicals formerly used at the sewage treatment plant.

The previous operations at George Road Sewage Treatment Plant Mercury Spill are summarized in Table 3-1, which includes descriptions of potential contaminants associated with these activities. The potential contaminant associated with this AOC is mercury since it was reported that 1 pint of elemental mercury was spilled within the comminutor building and entered the building’s floor drain (SAIC 2011a).

Table 3-1: Summary of Previous Operations, Investigations, and Removal Actions at CC RVAAP-75

Operations	Reported Documentation	Evidence/Description/Potential Contamination
Previous Operations - CC RVAAP-75		
Operations Involving Hazardous, Toxic, or Radioactive Waste	Yes	− Trickling filters had mercury seals and were reported to have leaked. − Silver was recovered from photographic solutions used in photography and radiography (x-ray) operations. − Use of chlorine in the building.
Previous Investigations/Removal Actions – CC RVAAP-75		
Year	**Type of Investigation/Action**	**Findings**
1993	Sewage Treatment Plant taken out of service and dismantled	Not applicable
2011	Historical Records Review	Mercury spill was noted during an interview with Mr. McGee, (interviewed in August 2010) who indicated approximately 1 pint of liquid mercury was spilled and entered into the floor drain. The date of the spill was not noted on the interview form.

Source: Historical Records Review (Science Applications International Corporation 2011a).

4. FIELD INVESTIGATION

Work completed 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 24 February 2011, unless specifically noted otherwise (Section 4.4). The samples collected for this SI are presented in Table 4-1.

4.1 SAMPLING RATIONALE

The SI sampling of subsurface soil and wet sediment was conducted at the CC RVAAP-75 to determine the presence of SRCs and identify potential contamination at the AOC. In addition, the deposit within the 15-inch vitrified clay pipe (drain line) was sampled. Surface water was not present at this AOC. Table 4-2 provides the sampling rationale for each sample collected and Figure 4-1 shows the locations of DU01 and DU02.

In order to determine the presence or absence of contamination for this SI, subsurface soil samples were collected from locations where mercury would potentially leak out of one of the drainage pipes along its flow path, and from the sediment at the exit the drainage system at the outfall area. To determine this drainage flow path, ECC reviewed the George Road Sewage Treatment Plant Utility Plans, which indicated that liquids released to the floor drain of the comminutor building would have traveled via a 4-inch cast iron pipe and drained into the 15-inch vitrified clay pipe (drain line) located along the northeast exterior of the building. This 15-inch vitrified clay pipe (drain line) discharged to manhole MH-P1. This flow path is shown in Figure 4-2. The floor drainage system was the focus of this SI sampling. In addition, the deposits within the 15-inch vitrified clay pipe (drain line) were collected and analyzed for mercury to determine the presence of any residual mercury.

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 22 October 2012 to conduct a site walk and pre-mark the DUs and direct-push boring locations at CC RVAAP-75. The pre-mobilization tasks included the following activities:

- Conduct a site walk
- Locate the DUs
- Locate the soil borings
- Decontaminate the sampling equipment

4.2.1 Site Walk

ECC conducted a site walk at CC RVAAP-75 on 22 October 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 and Wet Sediment Sampling Locations

CC RVAAP-75 contains two DU sampling areas, DU01 and DU02 (Figure 4-1), the latter of which is where the discrete wet sediment sample was collected downstream of the headwall of the outfall area. This outfall area is where the drainage pipe daylights at the headwall.

- DU01 consists of a 4-inch diameter, cast iron floor drain with a P-trap and associated discharge pipe (4-inch cast iron) inside the comminutor building that discharges to the 15-inch vitrified clay pipe (along the northeast exterior of the building) (Figure 4-2). The 4-inch cast iron pipe from the floor drain connects with the 15-inch vitrified clay pipe approximately 15 ft from the floor drain (Figure 2-2). The 15-inch vitrified clay pipe (drain line) extends eastward to manhole MH-P1 where it joins the main sewer line east of the comminutor building (Figure 2-3).

  The 15-inch vitrified clay pipe that enters the comminutor building from the north extends approximately 30-40 ft upgradient from the building to manhole MH-O1 (Figure 2-3). The invert elevation inside MH-O1 is 1004.2 ft amsl and the invert elevation of the 15-inch drainage pipe entering the north side of the comminutor building is 1004.0 ft amsl. The invert elevation of the 15-inch drainage line that exits at the northeast corner of the comminutor building is 1003.92 ft amsl. This 15-inch drainage line discharges to manhole MH-P1. The invert elevation of MH-P1 at the connection of the 15-inch drainage line is 1003.7 ft amsl.

  During this SI, it was discovered that the northern 15-inch vitrified clay pipe had been sealed at manhole MH-O1, preventing any water from flowing into the north end of the comminutor building. In addition, it was found the 15-inch vitrified drainage pipe that discharges into manhole MH-P1 is sealed preventing flow from the comminutor building into manhole MH-P1. From manhole MH-P1, water discharge is conveyed via a 10-inch diameter vitrified clay pipe approximately 200 ft south to the outfall area (Figure 4-1).

- DU02 consists of the area just downstream of the headwall at the outfall area. The outfall area is the current terminus of the sanitary sewer network at the Administration Area and receives diverted runoff from the vicinities of rail beds, buildings, asphalt parking lots and roads.

After each DU was demarcated, direct-push soil boring locations and wet sediment sampling locations within each DU were marked with wooden stakes and high visibility paint and flagging.

4.2.3 Munitions and Explosives of Concern and Utility Clearance Surveys

Based on the findings of the HRR (SAIC 2011a), munitions and explosives of concern clearance was not conducted at the George Road Treatment Plant Mercury Spill site prior to the field investigation. Munitions and explosives of concern clearance was deemed unnecessary as no documentation was discovered of military munitions being historically located or stored onsite.

ECC met with Vista Sciences Corporation (Vista) representatives on 23 October 2012 at Building 1037. During this meeting, ECC asked Mr. James D. McGee, Vista Project Manager for the former RVAAP, about utility clearance protocols. After his review of the sites, Mr. McGee reported that any utilities within these areas would either have been previously removed or, if still in place, inactive and not energized. No live/active utilities were encountered during any of the intrusive SI activities conducted at CC RVAAP-75.

4.2.3.1 Site Clearing Activities

Site clearing activities consisted of clearing low brush and debris from the proposed sediment sampling area and soil boring locations.

4.2.3.2 Site Security

No specific site security was needed at CC RVAAP-75 AOC. However, each work day prior to mobilizing to the AOC, RVAAP Range Control was notified that ECC and subcontractor personnel would be working at the AOC.

4.2.3.3 Equipment Decontamination

Prior to conducting subsurface soil sampling, all sampling equipment was decontaminated at a pre-designated area within Building 1036. For this purpose, a piece of plastic sheeting (5 × 5 ft) was placed on the concrete floor in the designated 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 water contained in spray bottles. Brushes were used to scrub sampling equipment with a mixture of Alconox cleaner and potable water. Subsequently, the sampling equipment was rinsed with potable water, sprayed with isopropyl alcohol, sprayed with 10 percent nitric acid solution, rinsed with deionized water, and then wrapped in aluminum foil. Sufficient sampling equipment was brought to the site each morning to allow for sampling of each DU without the need to decontaminate equipment between sample locations at each DU. All sampling equipment was decontaminated inside Building 1036 at the end of each work day in preparation for sampling the following day.

Prior to subsurface soil sampling in the deep soil boring, all downhole 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 to catch decontamination rinsate. The drilling equipment was then placed on a temporary steel rack within the decontamination pad, and 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 George Road Sewage Treatment Plant, direct-push steel samplers were decontaminated between borings using 5-gallon buckets, Alconox wash and brushes, potable water rinse, pesticide grade isopropyl alcohol, a 10 percent nitric acid solution, and laboratory supplied deionized water contained in spray bottles. The decontamination area was set up on plastic sheeting off the northeast corner of the comminutor building. 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 METHODS AND LABORATORY ANALYSIS

4.3.1 Field Sampling Locations

At CC RVAAP-75 George Road Sewage Treatment Plant Mercury Spill, wet sediment samples and subsurface soil samples for the first sampling event were collected on 9 November and 6 December 2012, respectively. One sample was also collected of the deposit located within the 15-inch vitrified clay pipe (drain line). This sample is referred to as the drainage pipe deposit sample. Two DUs (DU01 and DU02) were designated within the site as shown in Figures 4-1 through 4-5.

- The subsurface soil samples were collected at DU01 on 9 November and 6 December 2012. These included the five discrete subsurface soil samples collected at 5-6 ft below ground surface (bgs) from beneath the 15-inch vitrified clay pipe (drain line) between the comminutor building (northeast corner) and manhole MH-P1 and the one soil boring (deep soil boring) sample that was collected at a depth of 13 ft bgs (Figures 4-3 and 4-4).

- The drainage pipe deposit sample was collected from within the 15-inch vitrified clay pipe (drain line) on 9 November 2012 (Figures 4-3 and 4-4).

- The outfall sample area at DU02 was saturated with water at the time of sampling. Therefore, samples collected from DU02 were classified as “wet” sediment samples (Figure 4-5).

To further characterize subsurface soil within DU01, additional samples were collected on 14 August and 10 September 2013, as follows:

- Subsurface soil samples were collected from 5 to 6 ft bgs on 14 August 2013 from two soil borings (SB02 and SB03) located on either side of the 4-inch cast iron pipe that runs from the floor drain P-trap inside the comminutor building to the 15-inch vitrified clay pipe (drain line). These borings are shown in Figure 4-3.

- Three discrete subsurface soil samples (P-Trap-1, P-Trap-2, and P-Trap-3) were collected on 10 September 2013 from beneath the floor drain P-trap and the floor drain’s 4-inch cast iron pipe as shown in Figure 4-3.

Table 4-1 provides a summary of the soil samples collected between November 2012 and September 2013 at CC RVAAP-75. Table 4-2 summarizes the sampling rationale for each sample collected at the AOC. Photographs of the field activities are provided in Appendix H.

4.3.2 Sampling Analysis

The subsurface soil samples, wet sediment samples, and a drainage pipe deposit sample collected at CC RVAAP-75 were submitted to a fixed laboratory for mercury analysis using USEPA Method SW846 7471A. In addition, one wet sediment sample collected at DU02 was analyzed for the RVAAP full suite of analytes in accordance with the FWSAP (SAIC 2011b). The RVAAP full suite analysis of the one wet sediment sample includes the following analyses:

- Volatile organic compounds (VOCs) using USEPA Method SW-846, 8260B/5035 (collected as a discrete sample)
- Semivolatile organic compounds (SVOCs) using USEPA Method SW-846, 8270C/3540C
- Pesticides using USEPA Method SW-846, 8081/3540C
- Polychlorinated biphenyls (PCBs) using USEPA Method SW-846, 8082/3540C
- Explosive derivatives using USEPA Method SW-846, 8330B
- Propellants using USEPA Methods Nitrocellulose E353.2 Modified and Nitroguanidine 8330 Modified
- Target Analyte List (TAL) Metals using USEPA Method SW-846, 6020/7471A, including total chromium analysis

Table 4-3 summarizes the sample preparation and analytical sampling conducted at CC RVAAP-75 for this SI.

4.4 SAMPLING METHODOLOGY

At CC RVAAP-75 George Road Sewage Treatment Plant Mercury Spill, wet sediment samples and subsurface soil samples were collected on 9 November and 6 December 2012, respectively. One sample was also collected of the deposited material located within the drainage pipe to determine the presence of contamination. This sample is referred to as the drainage pipe deposit sample. Two DUs (DU01 and DU02) were designated within the site as shown in Figures 4-1 through 4-5.

4.4.1 Subsurface Soil Sampling along 15-Inch Vitrified Clay Pipe (Drain Line)

On 6 December 2012, five discrete subsurface soil samples were collected (5-6 ft bgs) at CC RVAAP-75 at DU01 from beneath the 15-inch vitrified clay pipe (drain line) between the comminutor building and manhole MH-P1 (Figures 4-2 and 4-3). The soil samples were collected using direct-push drilling and sampling methods following the excavation of a trench along the length of the 15-inch vitrified clay pipe (drain line). A set of concrete stairs 4 ft wide, located on the east exterior wall of the comminutor building, prevented access to the initial 5 linear ft of 15-inch vitrified clay pipe (drain line) immediately adjacent to the comminutor building. The subsurface soil sample collection locations were based on the results of the video survey (as summarized in Section 4.6) in areas where joints/flanges, cracks or breaks were identified in the 15-inch vitrified clay pipe (drain line). A trench was excavated alongside of the 15-inch vitrified clay pipe (drain line) to expose the pipe and collect required subsurface soil samples beneath the pipe.

Once the excavation exposed the 15-inch vitrified clay pipe (drain line) approximately 5 ft beyond the building's exterior wall, five pipe joints/flanges were visible between the side of the comminutor building and manhole MH-P1. No cracks or breaks were observed along the exterior of the exposed 15-inch vitrified clay pipe (drain line). One discrete soil sample was collected from beneath each pipe joint/flange, for a total of five subsurface samples. The samples were collected from a depth that ranged from 5 to 6 ft bgs and were laboratory analyzed for mercury.

4.4.2 Subsurface Soil Sampling of Floor Drain P-Trap in the Comminutor Building

On 10 September 2013, three discrete subsurface soil samples were collected at CC RVAAP-75 from beneath the comminutor building's floor drain P-trap and the associated 4-inch cast iron pipe directly associated with the reported spill of elemental mercury. The soil samples were collected by hand using decontaminated stainless steel spoons and a step-probe. In order to access to the soil beneath the P-trap, an approximate 4-ft × 3-ft section of the concrete floor (6 inches thick) was removed. The area adjacent to the floor drain was then hand dug to approximately 35 inches below the surface of the concrete floor. The floor drain pipe, P-trap, and approximately 15 inches of the discharge pipe were exposed and inspected.

All exposed cast iron piping appeared to be in good condition with no observable cracks or breaks. No visible staining or other indications of contamination were observed in the soil under or around the exposed piping. The bottom of the floor drain P-trap was 33 inches from the top of the concrete floor.

- One soil sample (075SB-0010-0001-SO) was collected from directly beneath the P-trap.

- A second soil sample (075SB-0011-0001-SO) was collected beneath the P-trap at a depth of 41 inches below the top of the concrete floor (8 inches below the first sample).

- A third soil sample (075SB-0012-0001-SO) was collected directly beneath the first connecting flange along the 4-inch cast iron P-trap discharge pipe that connects to the main 15-inch vitrified clay pipe (drain line) that discharges into manhole MH-P1. The depth of the third soil sample was approximately 27 inches from the top of the concrete floor.

Following completion of sampling activities, the excavated area around the floor drain was backfilled with the previously excavated material. The pieces of concrete floor were then replaced in their original locations.

4.4.3 Wet Sediment Sampling

Two discrete, wet sediment samples were collected at CC RVAAP-75 at the outfall area. On 9 November 2012, the wet sediment samples were collected from DU02 just downstream of the headwall at the outfall area. The wet sediment samples were analyzed for mercury.

4.4.4 Drainage Pipe Deposit Sampling

On 9 November 2012, a sample was collected from the deposit inside the 15-inch vitrified clay pipe (drain line) that extends from inside the comminutor building to manhole MH-P1. The sampling methods for collecting the drainage pipe deposit sample are summarized below:

- The drainage pipe deposit sample was collected on 9 November 2012 from approximately 10 ft inside the 15-inch vitrified clay pipe (drain line). The sample was collected by hand using a clean, plastic dredge attached to a 10 ft length of polyvinyl chloride pipe.

- The dredge was inserted into the 15-inch vitrified clay pipe (drain line) to collect a sample of the deposits within the drain line. The drainage pipe deposit sample location included the point where the 4-inch cast iron floor drain pipe intersects the 15-inch vitrified clay pipe (drain line). The 15-inch drain line is located approximately 5-6 ft bgs and flows downgradient from the comminutor building to manhole MH-P1. The entire length of the 15-inch vitrified clay pipe (drain line) from the comminutor building to manhole MH-P1 is approximately 22 ft. The drainage pipe deposit sample was laboratory analyzed for mercury.

4.4.5 Deep Soil Boring Sampling

On 4 December 2012, one soil boring was advanced to collect a composite subsurface soil sample between 7 and 13 ft bgs at DU01. The soil boring (SB-01) was advanced to a depth of 13 ft bgs along the south side of the comminutor building 15-inch vitrified clay pipe (drain line) (Figure 4-3). 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 sample. The sample was collected in accordance with composite sampling procedures as described in Section 5.5.2.5.1 in the FWSAP (SAIC 2011b).

4.4.6 Ambient Air Vapor Monitoring

During the P-trap sampling activities within the communitor building, the ambient air was continuously monitored for mercury vapors using a Jerome X431 mercury vapor analyzer in the work zone area. The ambient air within the floor drain and the 15-inch vitrified clay pipe (drain line) into which the floor drain discharges were also screened using the mercury vapor analyzer prior to beginning any intrusive activities.

The mercury vapor analyzer was used prior to and during the sampling and no readings were recorded above 0.0 milligrams per cubic meter (mg/m^3). Following exposure of the floor drain P-trap, the ambient air directly under the P-trap was screened for mercury vapors and all readings were also 0.0 mg/m^3.

4.5 VIDEO INSPECTION OF DRAINAGE PIPES

ECC conducted two video inspections of portions of the drainage system at CC-RVAAP 75 in order to obtain information on the integrity of the drainage system and its components. The first inspection was conducted on 6 November 2012 within DU01 and was focused on the portion of the drainage system that consists of the 15-inch drainage pipe made of vitrified clay that extends from the northeast interior corner of the comminutor building and formerly discharged to manhole MH-P1. The second inspection was conducted on 13 August 2013, and was focused on the portion of the drainage system extending from manhole MHP1 to the terminus of the 10-inch vitrified clay drain pipe discharging at the outfall area (DU02). The findings from both of these inspections are summarized below.

4.5.1 Video Inspection of 15-inch Vitrified Clay Pipe (Drain Line)

On 6 November 2012, ECC field personnel conducted a video inspection of the 15-inch vitrified clay pipe (drain line). The video camera was inserted into the pipe from inside the comminutor building and extended to its terminus at manhole MH-P1. The length of the pipe inspection was approximately 22 linear ft. The 15-inch vitrified clay pipe (drain line) had been previously sealed with brick and mortar at its terminus at manhole MH-P1.

The findings of the video inspection with the 15-inch drainage pipe are as follows:

- The entire length (approximately 22 ft) of the 15-inch vitrified clay drainage pipe was inspected beginning at the mouth of the pipe (located at the northeast interior corner of the comminutor building) to a brick and mortar seal located where the pipe entered manhole MH-P1. It is assumed this seal was put in place during the closing of the treatment plant in 1993. This seal prevents discharge of any residual water in the 15-inch vitrified clay pipe (drain line) from entering into manhole MH-P1.

- The 15-inch vitrified clay pipe (drain line) contained brown deposits approximately 2 inches in depth along with standing water approximately 2 or 3 inches in depth. Since a seal had been observed at manhole MH-01, it is assumed that any water in the 15-inch drainage pipe had seeped into the drainage pipe through the joints/flanges of the 15-inch vitrified clay pipe (drain line) over time. Numerous cracks within the first 5 ft of the 15-inch vitrified clay pipe (drain line) were observed within the pipe, with fewer cracks observed further toward the end of the 15-inch vitrified clay pipe at manhole MH-P1. The width of the cracks appeared to range from hairline cracks to 1/8- to 1/4-inch wide and 3-5 inches in length; however, these cracks were not observed on the outside of the 15-inch vitrified clay pipe (drain line).

- The video of the 15-inch vitrified clay pipe (drain line) also showed the connection of the 4-inch cast iron pipe from the floor drain entering the 15-inch vitrified clay pipe (drain line) from the right side (south side of pipe) of the 15-inch vitrified clay pipe (drain line). The floor drain is located 15 ft from the connection with the 15-inch vitrified clay pipe (drain line). The 4-inch cast iron pipe enters the 15-inch vitrified clay pipe (drain line) along the top portion of the 15-inch pipe, which indicates that the connection between the floor drain 4-inch cast iron pipe and the 15-inch drain line is at approximately 5 ft bgs.

4.5.2 Video Inspection of the 10-Inch Drainage Pipe

On 13 August 2013, ECC returned to CC RVAAP-75 to conduct a video inspection of the full length of 10-inch vitrified clay pipe extending from manhole MH-P1 to the outfall area. The video camera was first inserted into the 10-inch vitrified clay pipe at manhole MH- P1.

- The camera was advanced approximately 50 ft before encountering an obstruction in the pipe that prevented further inspection of the 10-inch vitrified clay pipe. The video shows the obstruction was one of the flanges used to connect the individual pipe sections, which may have broken off or became dislodged at the connection to the next section of pipe. Numerous attempts made to bypass the obstruction were unsuccessful. The video camera was then withdrawn from manhole MH-P1 and inserted into the 10-inch vitrified clay pipe from the terminus at the outfall area.

- The camera was advanced approximately 75-80 ft into the 10-inch vitrified clay pipe at the outfall area before encountering another obstruction within the pipe. This obstruction appeared to be another dislodged flange at a pipe joint (although at a different location than the one described above). The video survey showed the pipe to be in good condition with no discernable cracks observed from either end. Clear water was flowing freely along the length of the 10-inch vitrified clay pipe.

- Slower moving water was observed along approximately 10-15 ft of the pipe near the end of the outfall area. No discernable amount of pipe deposit was observed within the 10-inch pipe during the video inspection.

- The video inspection entering the drainage pipe from the outfall area showed the pipe connection to the 10-inch vitrified clay from the left (west side) and was approximately 50 ft from the entrance to the pipe at the outfall area (Figure 4-5). The pipe appears to be approximately 8-inch diameter and is likely the drainage line from the sludge beds at the treatment plant.

- Review of available site building drawings indicates that the pipe originates at manhole MH-P2, which is located just off the southwest corner of Sludge Drying Bed No. 1. According to the drawings, one, 6-inch vitrified clay pipe enters the manhole from Sludge Drying Bed No 2, a 4-inch vitrified clay pipe enters the manhole from the north, and a second 6-inch vitrified clay pipe enters the manhole from the 10-inch drainage pipe.

- A 6-inch vitrified clay pipe then extends from the manhole directly east where it connects with a third 6-inch vitrified clay pipe coming from Sludge Drying Bed No. 1. At this connection the pipe converts an 8-inch vitrified clay pipe and continues eastward where it connects with the 10-inch vitrified clay drainage pipe that originated at manhole MH-P1 (Figure 4-5).

The video inspections of the drainage pipes are provided as Appendix I.

4.6 DEVIATIONS FROM WORK PLAN

Deviations from the Final SI/RI Work Plan (ECC 2012) for fieldwork conducted at CC RVAAP-75 consisted of the following:

- On 13 August 2013, a second video inspection of the drainage system from manhole MH-P1 to the outfall area was conducted to document the condition of the 10-inch vitrified clay pipe that extends from manhole MH-P1 to the terminus of the drainage system at the outfall area.

- On 14 August 2013, two additional soil borings were advanced on either side of the comminutor floor drain discharge pipe (4-inch cast iron pipe) outside the comminutor building. Discrete subsurface soil samples were collected at a depth of 5-6 ft bgs at each boring to further characterize subsurface soil along the floor drain P-trap 4-inch cast iron discharge pipe.

- On 10 September 2013, three discrete subsurface soil samples were collected from beneath the floor drain P-trap and associated 4-inch cast iron discharge pipe to further characterize subsurface soil beneath the P-trap and discharge pipe.

4.7 SURVEYING

ECC subcontracted the surveying of the soil boring locations within CC RVAAP-75 George Road Sewage Treatment Plant Mercury Spill 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.

4.8 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 the 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 was used to contain the used nitrile gloves, the 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 ease of 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.

4.8.1 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 RVAAP's Installation Hazardous Waste Management Plan (Army Base Realignment and Closure Office 2009).

4.8.2 Characterization for Disposal

On 12 December 2012 and 15 August 2013, IDW disposal characterization samples were collected by ECC personnel. 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 analysis.

4.8.3 Transportation and Disposal

On 15 March 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 15 April 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.

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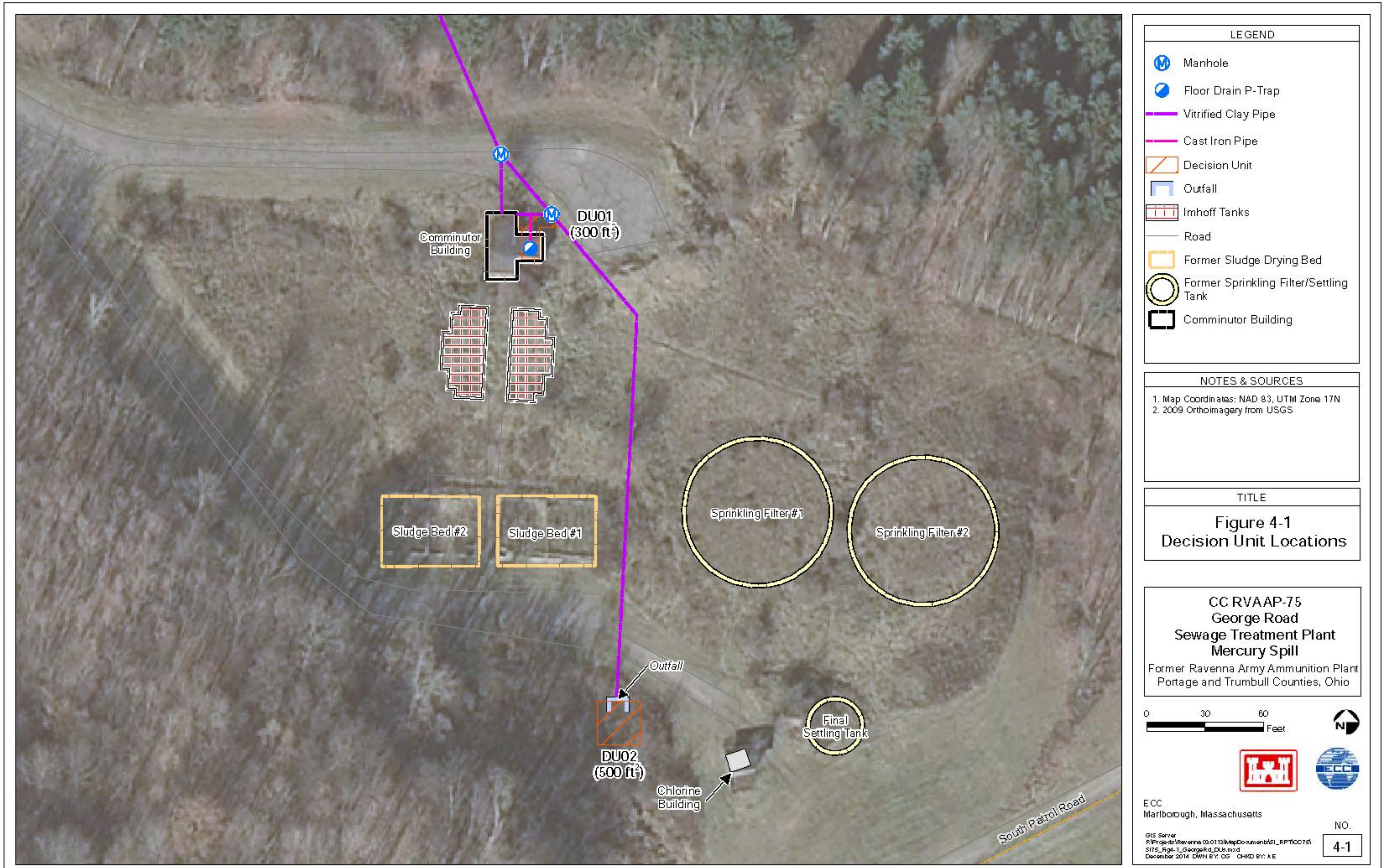
LEGEND
Manhole
Floor Drain P-Trap
Vitrified Clay Pipe
Cast Iron Pipe
Decision Unit
Outfall
Imhoff Tanks
Road
Former Sludge Drying Bed
Former Sprinkling Filter/Settling Tank
Comminutor Building
NOTES & SOURCES
1. Map Coordinates: NAD 83, UTM Zone 17N
2. 2009 Orthoimagery from USGS
TITLE
Figure 4-1
Decision Unit Locations
CC RVAAP-75
George Road
Sewage Treatment Plant
Mercury Spill
Former Ravenna Army Ammunition Plant
Portage and Trumbull Counties, Ohio
0 30 60
Feet
ECC
Marlborough, Massachusetts
NO.
4-1
Comminutor Building
DU01
(300 ft²)
Sludge Bed #2
Sludge Bed #1
Sprinkling Filter #1
Sprinkling Filter #2
Outfall
DU02
(500 ft²)
Final Settling Tank
Chlorine Building
South Patrol Road

1952

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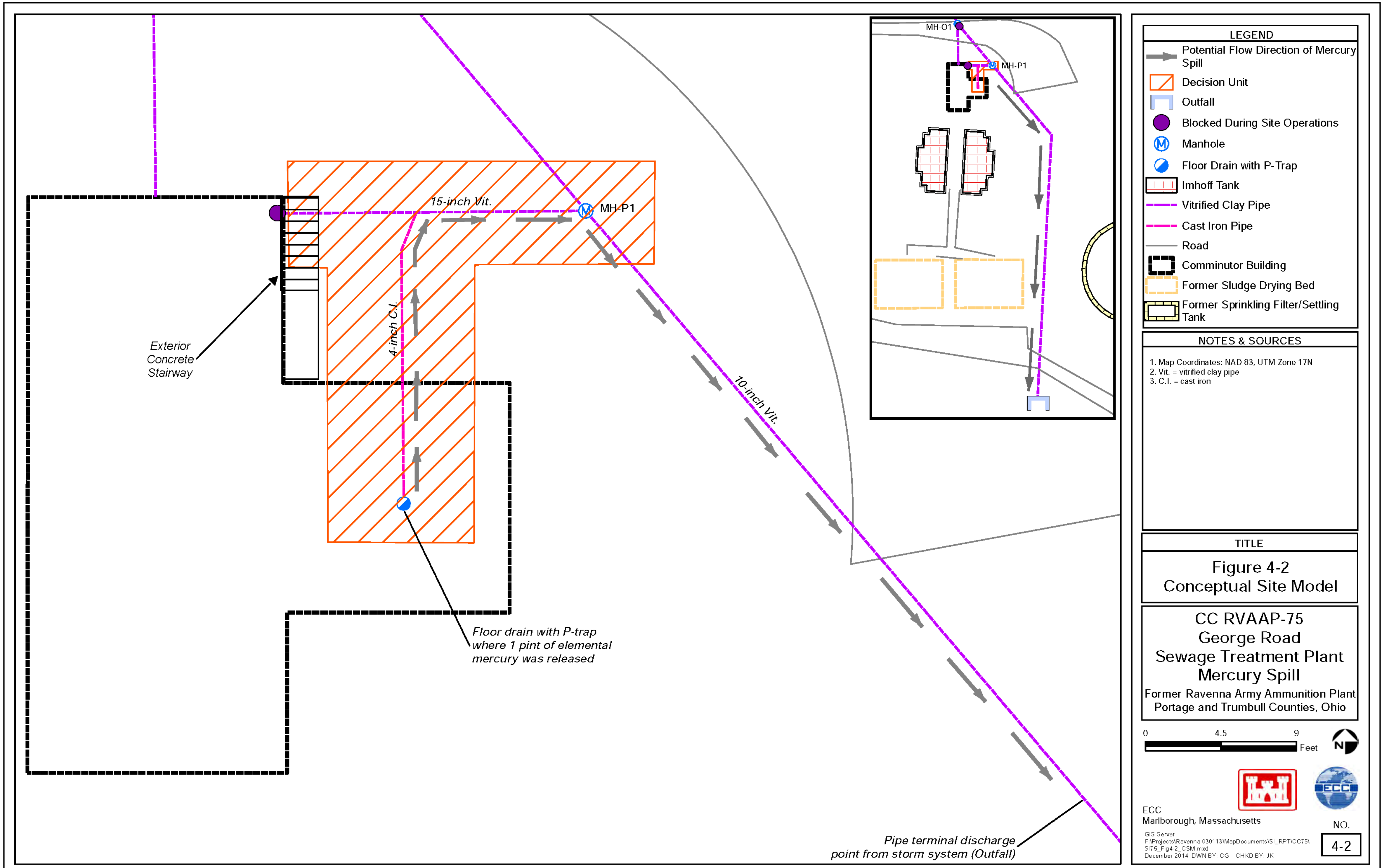
15-inch Vit.
MH-P1
4-inch C.I.
Exterior
Concrete
Stairway
Floor drain with P-trap
where 1 pint of elemental
mercury was released
10-inch Vit.
Pipe terminal discharge
point from storm system (Outfall)
MH-O1
MH-P1
LEGEND
Potential Flow Direction of Mercury Spill
Decision Unit
Outfall
Blocked During Site Operations
Manhole
Floor Drain with P-Trap
Imhoff Tank
Vitrified Clay Pipe
Cast Iron Pipe
Road
Comminutor Building
Former Sludge Drying Bed
Former Sprinkling Filter/Settling Tank
NOTES & SOURCES
1. Map Coordinates: NAD 83, UTM Zone 17N
2. Vit. = vitrified clay pipe
3. C.I. = cast iron
TITLE
Figure 4-2
Conceptual Site Model
CC RVAAP-75
George Road
Sewage Treatment Plant
Mercury Spill
Former Ravenna Army Ammunition Plant
Portage and Trumbull Counties, Ohio
0
4.5
9
Feet
N
ECC
Marlborough, Massachusetts
GIS Server
F:\Projects\Ravenna 030113\MapDocuments\SI_RPT\CC75\
SI75_Fig4-2_CSM.mxd
December 2014 DWN BY: CG CHKD BY: JK
NO.
4-2

1964

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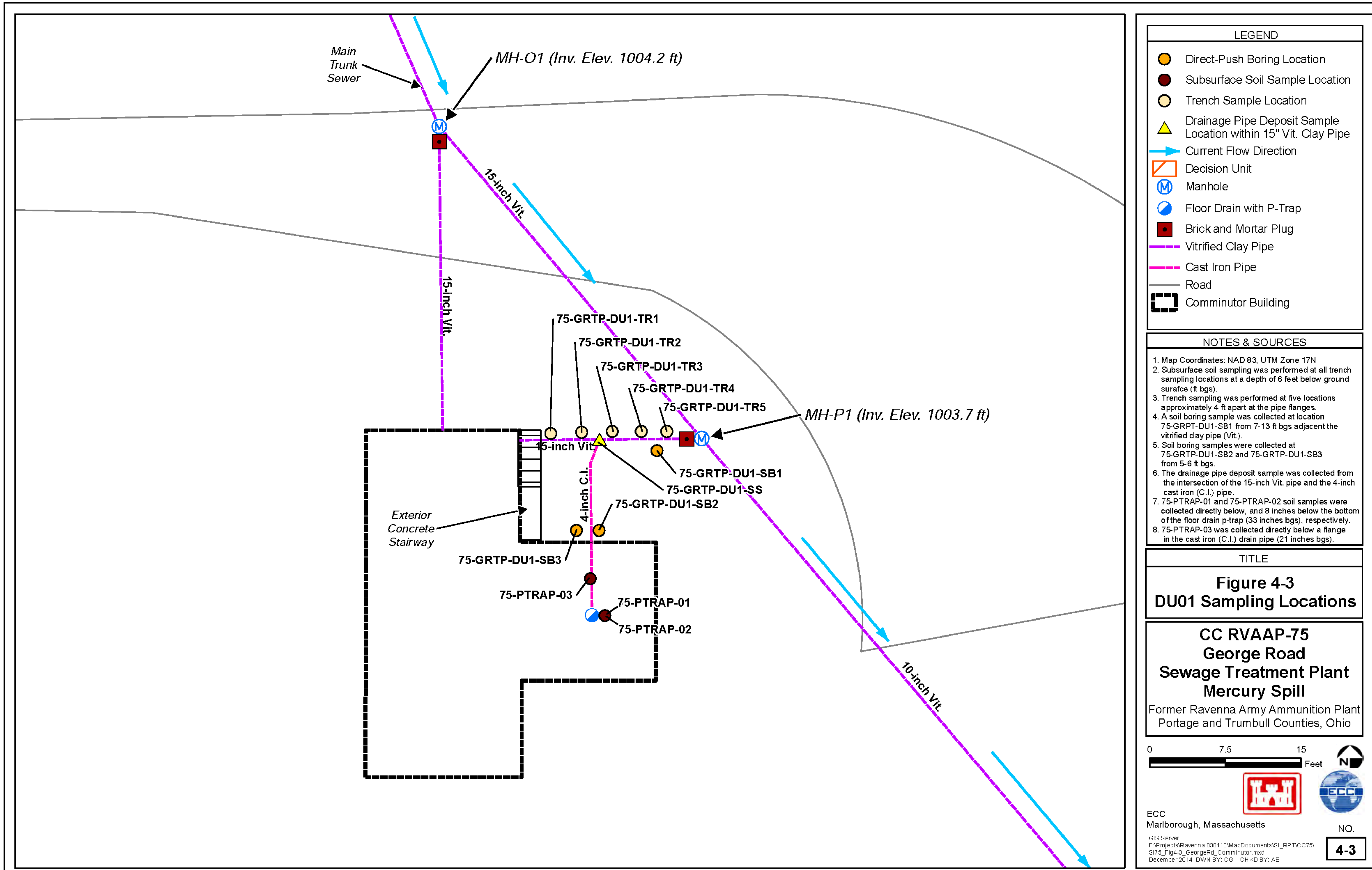
Main
Trunk
Sewer
MH-O1 (Inv. Elev. 1004.2 ft)
15-inch Vit.
15-inch Vit.
75-GRTP-DU1-TR1
75-GRTP-DU1-TR2
75-GRTP-DU1-TR3
75-GRTP-DU1-TR4
75-GRTP-DU1-TR5
MH-P1 (Inv. Elev. 1003.7 ft)
15-inch Vit.
75-GRTP-DU1-SB1
75-GRTP-DU1-SS
4-inch C.I.
75-GRTP-DU1-SB2
Exterior
Concrete
Stairway
75-GRTP-DU1-SB3
75-PTRAP-03
75-PTRAP-01
75-PTRAP-02
10-inch Vit.
LEGEND
Direct-Push Boring Location
Subsurface Soil Sample Location
Trench Sample Location
Drainage Pipe Deposit Sample Location within 15" Vit. Clay Pipe
Current Flow Direction
Decision Unit
Manhole
Floor Drain with P-Trap
Brick and Mortar Plug
Vitrified Clay Pipe
Cast Iron Pipe
Road
Comminutor Building
NOTES & SOURCES
1. Map Coordinates: NAD 83, UTM Zone 17N
2. Subsurface soil sampling was performed at all trench sampling locations at a depth of 6 feet below ground surafce (ft bgs).
3. Trench sampling was performed at five locations approximately 4 ft apart at the pipe flanges.
4. A soil boring sample was collected at location 75-GRPT-DU1-SB1 from 7-13 ft bgs adjacent the vitrified clay pipe (Vit.).
5. Soil boring samples were collected at 75-GRTP-DU1-SB2 and 75-GRTP-DU1-SB3 from 5-6 ft bgs.
6. The drainage pipe deposit sample was collected from the intersection of the 15-inch Vit. pipe and the 4-inch cast iron (C.I.) pipe.
7. 75-PTRAP-01 and 75-PTRAP-02 soil samples were collected directly below, and 8 inches below the bottom of the floor drain p-trap (33 inches bgs), respectively.
8. 75-PTRAP-03 was collected directly below a flange in the cast iron (C.I.) drain pipe (21 inches bgs).
TITLE
Figure 4-3
DU01 Sampling Locations
CC RVAAP-75
George Road
Sewage Treatment Plant
Mercury Spill
Former Ravenna Army Ammunition Plant
Portage and Trumbull Counties, Ohio
0
7.5
15
Feet
N
ECC
Marlborough, Massachusetts
GIS Server
F:\Projects\Ravenna 030113\MapDocuments\SI_RPT\CC75\
SI75_Fig4-3_GeorgeRd_Comminutor.mxd
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4-3

1976

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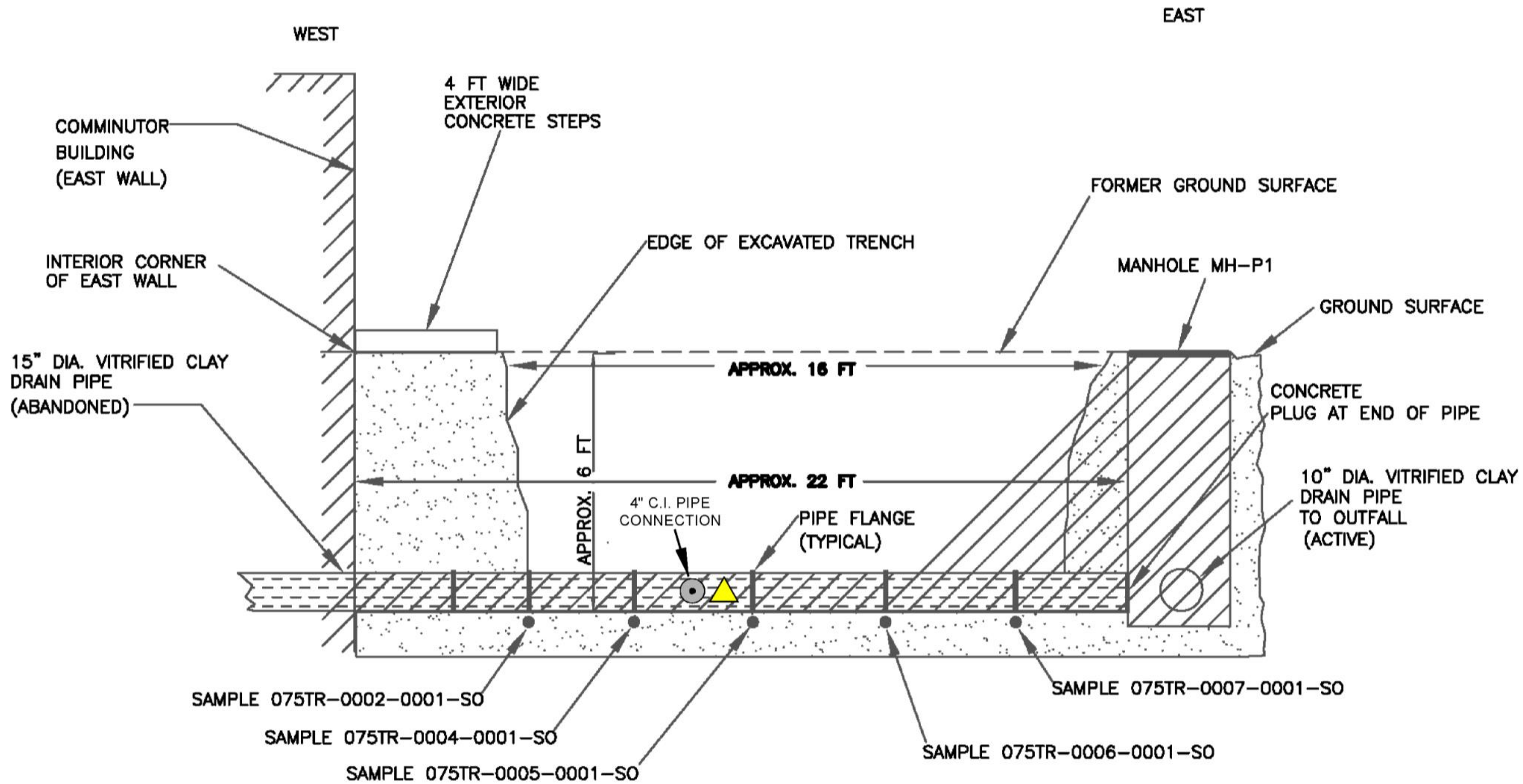

LEGEND

- Subsurface Soil Sample Location
- Building
- Pipe
- Soil
- 4-inch C.I. Pipe Connection
- Drainage Pipe Deposit Sample Location

NOTES & SOURCES

1. Cross-section not drawn to scale.
2. FT = feet
3. DIA. = diameter
4. " = inch
5. Approx. = Approximate
6. C.I. = cast iron
7. Vit. = vitrified clay pipe

TITLE

Figure 4-4
Cross Section of DU01
Along 15-inch Vit. Pipe

CC RVAAP-75
George Road
Sewage Treatment Plant
Mercury Spill

Former Ravenna Army Ammunition Plant
Portage and Trumbull Counties, Ohio

ECC
Marlborough, Massachusetts

GIS Server
F:\Projects\Ravenna 030113\MapDocuments\
SI_RPT\CC75\SI75_Fig4-4_GeorgeTP_XS_DU1.mxd
December 2014 DWN BY: CG CHKD BY: AE

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4-4

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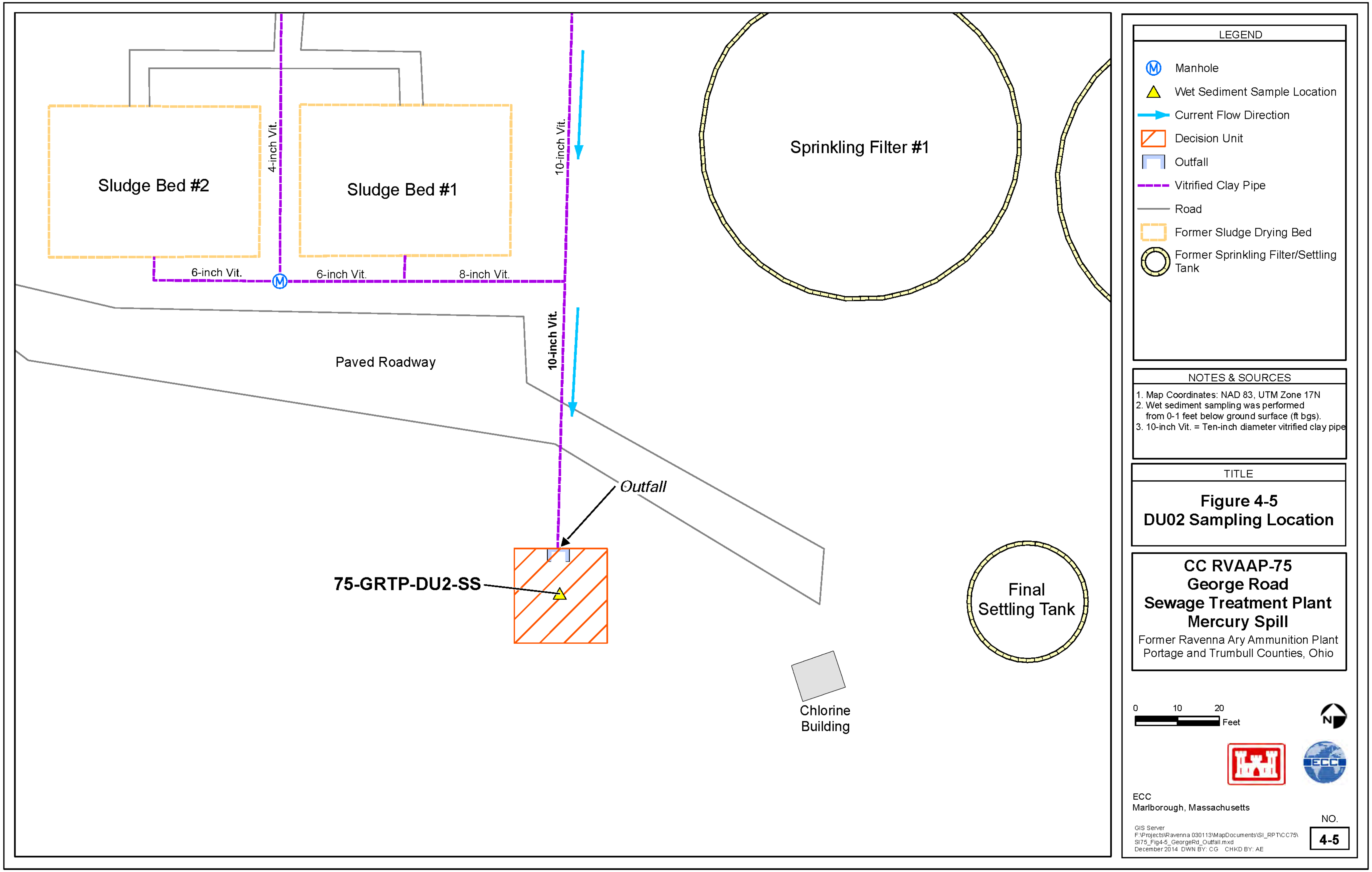
Sludge Bed #2
Sludge Bed #1
4-inch Vit.
10-inch Vit.
6-inch Vit.
6-inch Vit.
8-inch Vit.
10-inch Vit.
Sprinkling Filter #1
Paved Roadway
Outfall
75-GRTP-DU2-SS
Final Settling Tank
Chlorine Building
LEGEND
Manhole
Wet Sediment Sample Location
Current Flow Direction
Decision Unit
Outfall
Vitrified Clay Pipe
Road
Former Sludge Drying Bed
Former Sprinkling Filter/Settling Tank
NOTES & SOURCES
1. Map Coordinates: NAD 83, UTM Zone 17N
2. Wet sediment sampling was performed from 0-1 feet below ground surface (ft bgs).
3. 10-inch Vit. = Ten-inch diameter vitrified clay pipe
TITLE
Figure 4-5
DU02 Sampling Location
CC RVAAP-75
George Road
Sewage Treatment Plant
Mercury Spill
Former Ravenna Ary Ammunition Plant
Portage and Trumbull Counties, Ohio
0 10 20
Feet
N
ECC
Marlborough, Massachusetts
NO.
4-5
December 2014 DWN BY: CG CHKD BY: AE

2001

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Table 4-1: Summary of Samples Collected Between November 2012 and September 2013 at CC RVAAP-75

Location	Sample Location/Soil Boring	Sample ID	Matrix	Depth (ft)	Sampling Method	Date	VOC	SVOC	TAL Metals	PCB	Pesticides	Explosives	Herbicides	Propellants	Mercury
CC RVAAP-75 George Road Sewer Treatment Plant Mercury Spill															
Drainage Pipe Deposit Analytical Program															
15-inch Drain Pipe	DU01	075SD-0001-0001-SD	Drainage Pipe Deposit	0-1	Discrete	9-Nov-12									X
Wet Sediment Analytical Program															
Headwall at outfall area	DU02	075SD-0002-0001-SD	Wet SD	0-1	Discrete	9-Nov-12	X	X	X	X	X	X		X	X
Headwall at outfall area	DU02	075SD-0002-0002-SD	Wet SD	0-1	Discrete	9-Nov-12	X	X	X	X	X	X		X	X
Headwall at outfall area	DU02	075SD-0003-0001-SD	Wet SD	0-1	Discrete	9-Nov-12	X	X	X	X	X	X		X	X
Subsurface Soil Analytical Program															
Trench (TR) 1	DU01	075TR-0002-0001-SO	Soil	6	Discrete	6-Dec-12									X
TR2	DU01	075TR-0003-0001-SO	Soil	6	Discrete	6-Dec-12									X
TR2	DU01	075TR-0004-0001-SO	Soil	6	Discrete	6-Dec-12									X
TR3	DU01	075TR-0005-0001-SO	Soil	6	Discrete	6-Dec-12									X
TR4	DU01	075TR-0006-0001-SO	Soil	6	Discrete	6-Dec-12									X
TR5	DU01	075TR-0007-0001-SO	Soil	6	Discrete	6-Dec-12									X
SB1	DU01/SB1	075SB-0001-0001-SO	SB	7-13	Composite	4-Dec-12									X
SB2	DU01/SB2	075SB-0008-0001-SO	SB	5-6	Discrete	14-Aug-13									X

Table 4-1: Summary of Samples Collected Between November 2012 and September 2013 at CC RVAAP-75 (continued)

Location	Sample Location/Soil Boring	Sample ID	Matrix	Depth (ft)	Sampling Method	Date	VOC	SVOC	TAL Metals	PCB	Pesticides	Explosives	Herbicides	Propellants	Mercury
SB3	DU01	075SB-0009-0001-SO	SB	5-6	Discrete	14-Aug-13									X
Comminutor Building/ P-Trap-1	Under floor drain P-trap	075SB-0010-0001-SO	Soil	2.5	Discrete	10-Sep-13									X
Comminutor Building/ P-Trap-2	8 inches below bottom of floor drain P-trap	075SB-0011-0001-SO	Soil	3.2	Discrete	10-Sep-13									X
Comminutor Building/ P-Trap-3	Under flange of the 4-inch discharge pipe	075SB-0012-0001-SO	Soil	2	Discrete	10-Sep-13									X
Field Quality Control - Source Water															
NA	Source Water (Environmental Chemical Corporation bottled decontamination water)	070-0057-0001-Source Water	QC	Non-dedicated hand sampling tools	NA	12-Dec-12	X	X	X	X	X	X	X	X	X
NA	Source Water (Driller decontamination water)	070-0056-0001-Source Water	QC	Direct-push tools	NA	12-Dec-12	X	X	X	X	X	X	X	X	X
NA	Source Water (Driller decontamination water)	079-0007-0001-Source Water	QC	Direct Push Tools	NA	14-Mar-13	X	X	X	X	X	X	X	X	X
Field Quality Control – Equipment Rinsate															
NA	Equipment Rinsate Blank	076-0067-0001-ER	QC	Non-dedicated hand sampling tools during sampling event	NA	15-Nov-12	X	X	X	X	X	X	X	X	X

Table 4-1: Summary of Samples Collected Between November 2012 and September 2013 at CC RVAAP-75 (continued)

Location	Sample Location/Soil Boring	Sample ID	Matrix	Depth (ft)	Sampling Method	Date	VOC	SVOC	TAL Metals	PCB	Pesticides	Explosives	Herbicides	Propellants	Mercury
Field Quality Control – Equipment Rinsate															
NA	Equipment Rinsate Blank	076-0140-0001-ER	QC	Non-dedicated hand sampling tools during sampling event	NA	9-Dec-12	X	X	X	X	X	X		X	X
NA	Equipment Rinsate Blank	079RN-0317-0001-RN	QC	Non-dedicated hand sampling tools during sampling event	NA	3 Ap-13	X	X	X	X	X	X		X	X
NA	Equipment Rinsate Blank	083SB-0023-0001-ER	QC	Non-dedicated hand sampling tools during sampling event	NA	15-Aug-13	X	X	X	X	X	X		X	X
Field Quality Control – Trip Blanks															
NA	Trip Blank	070-0060-0001-TB	QC	NA	NA	12-Dec-12	X								
NA	Trip Blank	070-0060-0001-TB	QC	NA	NA	12-Dec-12	X								
NA	Trip Blank	079-0008-0001-TB	QC	NA	NA	14-Mar-13	X								
NA	Trip Blank	076-0068-0001-TB	QC	NA	NA	15-Nov-12	X								
NA	Trip Blank	076-0141-0001-TB	QC	NA	NA	9-Dec-12	X								
NA	Trip Blank	076-0142-0001-TB	QC	NA	NA	9-Dec-12	X								

Table 4-1: Summary of Samples Collected Between November 2012 and September 2013 at CC RVAAP-75 (continued)

Location	Sample Location/Soil Boring	Sample ID	Matrix	Depth (ft)	Sampling Method	Date	VOC	SVOC	TAL Metals	PCB	Pesticides	Explosives	Herbicides	Propellants	Mercury
Field Quality Control – Trip Blanks															
NA	Trip Blank	079-0318-0001-TB	QC	NA	NA	3-Apr-13	X								
NA	Trip Blank	083SB-0004-0001-TB	QC	NA	NA	15-Aug-13	X								
NA	Trip Blank	075SD-0004-0001-TB	QC	NA	NA	9-Nov-12	X								

Notes:

Field Duplicate	Matrix Spike/Matrix Spike Duplicate	Full Suite

Propellants include nitroguanidine, nitrocellulose, and nitroglycerin.
DU = Decision Unit.
ft = Feet.
ID = Identification.
NA = Not applicable.
PCB = Polychlorinated biphenyl.
QC = Quality control.
SB = Soil Boring.
SVOC = Semivolatile organic compound.
TAL = Target Analyte List.
TB = Trip Blank.
TR = Trench.
VOC = Volatile organic compound.

Table 4-2: Summary of Soil Sampling Rationale, November 2012 – September 2013 at CC RVAAP-75

Sample Type	Depth (ft bgs)	Location (DU/SB)	Sample ID	Date Sampled	Comments/Rationale
Composite	7-13	DU01/SB01	075SB-0001-0001-SO	4-Dec-12	Determine presence or absence of potential contamination in soil to a depth of 13 ft bgs.
Discrete	5-6	DU01/TR1	075TR-0002-0001-SO	6 –Dec-12	Determine presence or absence of potential contamination in subsurface soil.
Discrete	5-6	DU01/TR1	075TR-0003-0001-SO	6 –Dec-12	QC, Duplicate sample of 075TR-0002-0001-SO.
Discrete	5-6	DU01/TR2	075TR-0004-0001-SO	6 –Dec-12	Determine presence or absence of potential contamination in subsurface soil.
Discrete	5-6	DU01/TR3	075TR-0005-0001-SO	6 –Dec-12	Determine presence or absence of potential contamination in subsurface soil.
Discrete	5-6	DU01/TR4	075TR-0006-0001-SO	6 –Dec-12	Determine presence or absence of potential contamination in subsurface soil.
Discrete	5-6	DU01/TR5	075TR-0007-0001-SO	6 –Dec-12	Determine presence or absence of potential contamination in subsurface soil.
Discrete	0-1*	DU01	075SD-0001-0001-SD	9-Nov-12	Determine presence or absence of potential contamination in the drainage pipe deposit inside 15-inch drain pipe not previously sampled.
Discrete	0-1	DU02	075SD-0002-0001-SD	9-Nov-12	Determine presence or absence of potential contamination in the wet sediment at outfall area. Analyzed for Ravenna Army Ammunition Plant full suite analysis.
Discrete	0-1	DU02	075SD-0003-0001-SD	9-Nov-12	QC, Duplicate sample of 075SD-0002-0001-SD.
Discrete	NA	DU01	075SD-0004-0001-TB	9-Nov-12	QC, Trip Blank.
Discrete	5-6	DU01/SB02	075SB-0008-0001-SO	14-Aug-13	Determine presence or absence of potential contamination in soil not previously sampled.
Discrete	5-6	DU01/SB03	075SB-0009-0001-SO	14-Aug-13	Determine presence or absence of potential contamination in soil not previously sampled.
Discrete	2.75	P –Trap - 1	075SB-0010-0001-SO	10-Sep-13	Determine presence or absence of potential contamination in soil beneath floor drain P-trap not previously sampled.
Discrete	3.5	P –Trap - 2	075SB-0011-0001-SO	10-Sep-13	Determine presence or absence of potential contamination in soil beneath floor drain P-trap not previously sampled.
Discrete	2.25	P- Trap - 3	075SB-0012-0001-SO	10-Sep-13	Determine presence or absence of potential contamination in soil beneath floor drain P-trap discharge pipe not previously sampled.

Notes:
* Sample depth with respect to depth of deposit in the pipe.
bgs = Below ground surface.
DU = Decision Unit.
ft = Feet.
ID = Identification.
QC = Quality control.
RVAAP = Ravenna Army Ammunition Plant.
SB = Soil boring.
SD = Wet sediment.
SO = Soil.
TB = Trip blank.

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Table 4-3: Sample Preparation and Analytical Methods, November 2012 – September 2013 at CC RVAAP-75

Parameter	Soil		Aqueous	
	Preparation	**Analysis**	**Preparation**	**Analysis**
Metals	SW-846 3050B	SW-846 6020	NA	NA
Mercury	SW-846 7471A	SW-846 7471A	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
Explosives	SW-846 3550A	SW-846 8330B	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 = Semivolatile organic compound.
VOC = Volatile organic compound.

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5. DATA EVALUATION AND SUMMARY OF ANALYTICAL RESULTS

This chapter summarizes the analytical sampling results for the SI conducted at CC RVAAP-75 George Road Sewage Treatment Plant Mercury Spill. 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 is included as Appendix F. Non-detect data were reported as not detected in the summary of analytical results tables included in Chapter 5 and at the Limit of Detection in Appendices D and E.

5.1.1 Soil Sampling Intervals

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

- Wet Sediment (0-1 ft bgs)
- Subsurface Soil (2.75-6 ft bgs)
- Deep Soil Boring (7-13 ft bgs)
- Drainage Pipe Deposit

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 2011b).

Data qualifiers were assigned to each result based on the laboratory (i.e., TestAmerica of North Canton, Ohio) quality assurance 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 quality control 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).

Independent, third-party validation of 10 percent of this SI laboratory data was performed by a USACE–Louisville District subcontractor and is provided in Appendix F.

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 TCR level of 10^{-6} or the THQ = 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 FWCUGs (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 mg/kg (e.g., cadmium and 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 NFA is recommended.

If no FWCUG has been developed for the particular chemical, then the USEPA's Regional Screening Levels (RSLs) (November; USEPA 2014) for the Residential Receptor were used for comparison using the same TCR of 10^{-6} and THQ = 0.1. The National Guard Trainee FWCUGs and the USEPA 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, 5-2, and 5-3 provide a summary of the SRCs identified in the subsurface soil, wet sediment, and the drainage pipe deposit at CC RVAAP-75, respectively. The complete laboratory analytical data packages, including laboratory analytical results tables with final qualifiers, are included in Appendix E.

5.2 SUMMARY OF SUBSURFACE SOIL ANALYTICAL RESULTS

Subsurface soils were collected between 2.75 and 13 ft bgs. At CC RVAAP-75, subsurface samples were collected from four separate areas:

1. The trench, excavated in order to collect soil samples from beneath the flanges of the pipe leading from the comminutor building floor drain to manhole MH-P1 (December 2012).

2. The deep soil boring, collected between 7 and 13 ft bgs (December 2012).

3. The two soil borings, completed to 5-6 ft bgs immediately adjacent to the drainage pipe (August 2013).

4. Subsurface soil directly under the P-trap in the floor of the comminutor building (September 2013).

Table 5-1 presents the results of the SRC screening for subsurface soil samples collected at CC RVAAP-75. The analytical results of the subsurface soil sampling are summarized in the following sections.

5.2.1 Excavation Trench Sampling Results

Five subsurface soil samples were collected from the trench that was excavated to access the soil beneath the 15-inch drainage pipe in December 2012. The subsurface soil samples were collected at 6 ft bgs. The results of the subsurface soil sampling from the trench are summarized as follows:

- Mercury was identified as an SRC in the subsurface soil samples collected under the discharge pipe that leads from the comminutor building's floor drain to the manhole. The distribution of this inorganic SRC detected in subsurface soil is shown in Figure 5-1.

- The reported mercury concentrations did not exceed the Resident Receptor FWCUGs in any of the subsurface soil samples collected from the trench.

- Mercury was not identified as a potential contaminant in subsurface soil at this AOC.

5.2.2 Deep Soil Boring Analytical Results

One deep soil boring was advanced at DU01 in December 2012. A subsurface soil sample was collected between 7 and 13 ft bgs and analyzed for mercury (Figure 5-1). The estimated mercury concentration (0.050 J mg/kg) exceeded the background concentration (0.044 mg/kg), but did not exceed the Resident Receptor FWCUG.

5.2.2 Soil Samples Collected Beneath to 15-inch Vitrified Clay Pipe (Drain Line) and Floor Drain P-Trap

In August 2013, ECC collected additional soil samples from two borings (5-6 ft bgs) completed alongside of the 15-inch drainage pipe, specifically sampling the soil beneath the flanges of the pipe. The results of the additional soil sampling beneath the 15-inch drainage pipe are summarized as follows:

- Mercury was not reported in any of the additional subsurface soil samples at concentrations above the Resident Receptor FWCUG in the soil samples collected adjacent to the 15-inch pipe.

In September 2013, subsurface soil was sampled from directly under the P-trap in the floor of the comminutor building where the elemental mercury was reported to have entered the drainage system. The results of this sampling are as follows:

- Mercury was reported at concentrations above the background value in the three subsurface soil samples collected from under the floor drain P-trap and associated piping (Figure 5-1). However, mercury was not above the Resident Receptor FWCUG in any of the samples collected.

5.3 SUMMARY OF WET SEDIMENT ANALYTICAL RESULTS

CC RVAAP-75 wet sediment samples collected in November 2012 were screened to identify SRCs representing current conditions at the AOC. The SRC screening process for the wet sediment was comprised of two discrete samples collected during the SI activities at DU02. The wet sediment samples collected downstream of the outfall headwall were analyzed for mercury and RVAAP full suite analytes (TAL metals, explosives, propellants, SVOCs, VOCs, PCBs, and pesticides). A full-suite sample was collected as a requirement of the FWSAP. Table 5-2 presents the results of the SRC screening for wet sediment sample collected at CC RVAAP-75. Table 5-5 summarizes the inorganic analytical results for all detected analytes in the CC RVAAP-75 wet sediment samples. Table 5-6 summarizes the organic analytes detected in the wet sediment samples.

Complete laboratory analytical results and the laboratory analytical data packages are presented in Appendix E. Figure 5-2 illustrates the distribution of inorganic SRCs in the wet sediment and Figure 5-3 illustrates the distribution of organic SRCs in wet sediment.

5.3.1 Target Analyte List Metals

- The mercury concentration reported in wet sediment collected at the outfall area at DU02 was 0.47 J (estimated) mg/kg which exceeds the background concentration of 0.059 mg/kg. The mercury concentration in the duplicate sample (estimated at 1.1 J mg/kg) also exceeded the background value of 0.059 mg/kg for sediment.

- The mercury concentrations reported in the wet sediment collected at the outfall area did not exceed the Resident Receptor FWCUG (2.27 mg/kg) for mercury.

- Twelve metals (aluminum, antimony, barium, beryllium, cadmium, chromium, cobalt, lead, manganese, nickel, selenium, and silver) were identified as SRCs in wet sediment at CC RVAAP-75. The distribution of inorganic SRCs in wet sediment identified at this AOC is presented in Figure 5-2.

- Three of the 12 metals identified as SRCs (i.e., aluminum, cobalt, and manganese) were reported in the wet sediment samples exceeding their corresponding Residential Receptor FWCUG or RSL. Both aluminum and manganese were reported at concentrations exceeding the background concentrations and their respective Resident Receptor FWCUG. Cobalt was reported above the background concentration only as no FWCUG has been established for this chemical. Cobalt was reported greater than the USEPA Residential RSL of 2.30 mg/kg.

These inorganic chemicals were not related to the mercury spill associated with CC RVAAP-75 AOC and were not identified as potential contaminants in the wet sediments collected from the outfall area. The occurrence of aluminum, cobalt, and manganese in the surficial wet sediments at the storm and former sanitary sewer sediments reflects that the outfall receives discharge from multiple sources at the facility. Potential sources for the reported manganese in the sediment include deteriorating metal piping, mineral scale deposits, and manganese bacteria that often accumulate in sewer and stormwater metal pipelines, as well as from other metal debris that have washed into the systems over time (Gage et. al 2001; USEPA 2006; and SAIC 2012). These metals are not associated with the reported mercury spill at the AOC and were not identified as potential contaminants at CC RVAAP-75.

5.3.2 Volatile Organic Compounds

- Three VOCs (2-hexanone, carbon disulfide, and methylene chloride) were identified as SRCs in the outfall area wet sediment at the George Road Sewage Treatment Plant Mercury Spill AOC. Even though these VOCs are typically associated with laboratory-derived contamination, FWCUGs have not been established for these compounds in sediment and the RSLs were used for comparison. None of the reported concentrations exceeded their respective RSLs.

5.3.3 Semivolatile Organic Compounds

A total of 22 SVOCs were identified as SRCs in the outfall area wet sediment. The distribution of selected organic SRCs in wet sediment is shown in Figure 5-3.

- Of the 22 SVOCs reported, 3 SVOCs (benzo[a]anthracene, benzo[a]pyrene, and benzo[b]fluoranthene) were reported in the wet sediment sample and only 1 SVOC (benzo[a]pyrene) was reported in field duplicate sample collected at outfall area (DU02) at concentrations exceeding the Resident Receptor FWCUGs. However, the occurrence of these PAHs is expected to be present at the active outfall area as it receives drainage and runoff discharges from asphalt paved areas from the surrounding area (Table 5-6).

- These PAH compounds are not related to the reported elemental mercury spill that occurred at CC RVAAP-75 AOC. The occurrence of these PAHs (benzo[a]anthracene, benzo[a]pyrene, and benzo[b]fluoranthene) in the surficial wet sediments at the drainage outfall area are associated with stormwater runoff and discharges from nearby asphalt parking areas and roadways.

- Overland stormwater flow transports these chemicals into the storm system and they are likely to accumulate within the sediments in the outfall area. Additional information regarding PAH sources can be found in the Technical Factsheet on PAHs (USEPA 2013). Benzo(a)anthracene, benzo(a)pyrene, and benzo(b)fluoranthene are not considered potential contaminants at this AOC.

5.3.4 Propellants

No propellants were detected in the wet sediment sample and, therefore, are not identified as SRCs at the George Road Sewage Treatment Plant Mercury Spill AOC.

5.3.5 Pesticides

- Two pesticides (p,p-dichlorodiphenyldichloroethylene [DDE] and p,p-dichlorodiphenyltrichloroethane [DDT]) were identified as SRCs in the wet sediment samples collected at outfall area. However, the reported concentrations did not exceed the USEPA RSLs (1,400 and 1,700 micrograms per kilogram [µg/kg], respectively). There are no established FWCUGs for these pesticides.

5.3.6 Polychlorinated Biphenyls

- No PCBs were detected in the wet sediment samples at the George Road Sewage Treatment Plant Mercury Spill AOC.

5.3.7 Explosives

- One explosive compound (tetryl) was identified as an SRC in the surficial wet sediment; however, the reported concentration is estimated at 0.029 J mg/kg, which is below the USEPA RSL (12 mg/kg). There are no established FWCUGs for these chemicals.

No potential contaminants were identified in the wet sediment collected from the outfall area.

5.4 SUMMARY OF DRAINAGE PIPE DEPOSIT ANALYTICAL RESULTS

In November 2012, the deposit within the 15-inch drainage pipe located at the northeastern corner of the comminutor building was sampled for mercury. Table 5-7 presents the drainage pipe deposit mercury analytical results. The results were compared to the subsurface soil background mercury concentration (0.044 mg/kg) to determine if mercury concentrations within the pipe deposits could be attributable to the site release. The drainage pipe deposit result was as follows:

- Mercury was identified as an SRC in the drainage pipe deposit collected from the drainage pipe. The reported concentration of mercury in the drainage pipe deposit at DU01 was 7.2 mg/kg, which is above the subsurface soil background concentration (0.044 mg/kg).

- The mercury concentration reported in the drainage pipe deposit was compared to the FWCUG for the Resident Receptor for subsurface soil as drainage pipe deposits do not have their own FWCUGs established. The reported mercury concentration (7.2 mg/kg) from the drainage pipe deposit sample exceeds the soil Resident Receptor FWCUG (Figure 5-1).

- The reported mercury in the drainage pipe deposit collected from within the 15-inch drainage pipe has not been identified as potential contamination. Mercury was not identified as a potential contaminant based on results of a WOE evaluation. The WOE evaluation includes the following:

    1. The results of the SI data indicate that the mercury concentrations detected within the soil samples collected beneath and alongside of the drainage pipe were not above the Resident Receptor FWCUG. One of the five soil samples collected within the pipe trench near a flange of the 15-inch vitrified pipe had a mercury detection of 0.35 mg/kg, which is above background but below the Resident Receptor FWCUG.

2. The soil sample collected from 7 to 13 ft bgs was collected near this flange with the mercury detection above background, which indicates the mercury in the pipe is not impacting the environment outside the pipe.

3. The drainage pipe deposit containing mercury cannot migrate outside the 15-inch vitrified clay drain pipe as the discharge end is plugged with mortar and concrete and is no longer used for drainage.

4. The mercury concentrations reported in the subsurface soil surrounding the 15-inch pipe are below Resident Receptor FWCUG, which indicates that the drainage pipe deposit is not a source of mercury to the environment.

5. The volume of the deposit in the pipe is conservatively estimated to be approximately 2.1 cubic ft and to contain approximately 0.5 grams of mercury, which as shown by the subsurface soil data is not significant enough to be a source of contamination.

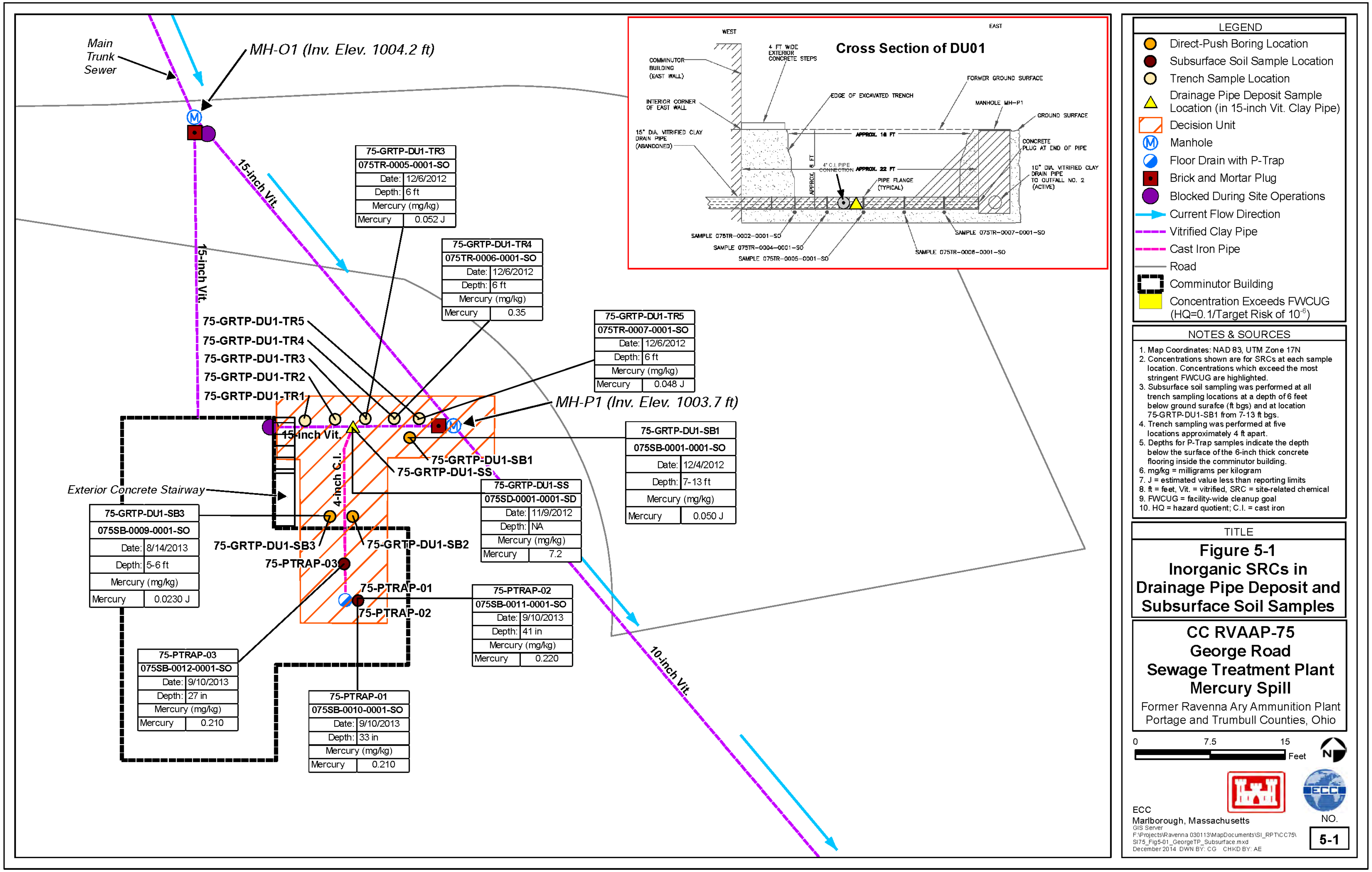
6. The reported mercury release was over 20 years ago, and there is no longer any use of mercury at the site that could continue to be released.

7. This deposit in the drainage pipe does not constitute an exposure point or exposure area, as the pipe is 5 ft bgs, and despite some visible surface cracking observed during the video inspection, is overall intact and prevents exposure to the environment.

The SI results indicate that the mercury reported in the deposit contained within the 15-inch drainage pipe is not considered a potential source of contamination to the environment outside of the pipe.

5.5 INVESTIGATION-DERIVED WASTE ANALYTICAL RESULTS

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


Main Trunk Sewer
MH-O1 (Inv. Elev. 1004.2 ft)
15-inch Vit.
15-inch Vit.
75-GRTP-DU1-TR3
075TR-0005-0001-SO
Date: 12/6/2012
Depth: 6 ft
Mercury (mg/kg)
Mercury 0.052 J
75-GRTP-DU1-TR4
075TR-0006-0001-SO
Date: 12/6/2012
Depth: 6 ft
Mercury (mg/kg)
Mercury 0.35
75-GRTP-DU1-TR5
075TR-0007-0001-SO
Date: 12/6/2012
Depth: 6 ft
Mercury (mg/kg)
Mercury 0.048 J
75-GRTP-DU1-TR5
75-GRTP-DU1-TR4
75-GRTP-DU1-TR3
75-GRTP-DU1-TR2
75-GRTP-DU1-TR1
MH-P1 (Inv. Elev. 1003.7 ft)
15-inch Vit.
4-inch C.I.
75-GRTP-DU1-SB1
75-GRTP-DU1-SS
75-GRTP-DU1-SB1
075SB-0001-0001-SO
Date: 12/4/2012
Depth: 7-13 ft
Mercury (mg/kg)
Mercury 0.050 J
75-GRTP-DU1-SS
075SD-0001-0001-SD
Date: 11/9/2012
Depth: NA
Mercury (mg/kg)
Mercury 7.2
Exterior Concrete Stairway
75-GRTP-DU1-SB3
075SB-0009-0001-SO
Date: 8/14/2013
Depth: 5-6 ft
Mercury (mg/kg)
Mercury 0.0230 J
75-GRTP-DU1-SB3
75-GRTP-DU1-SB2
75-PTRAP-03
75-PTRAP-01
75-PTRAP-02
75-PTRAP-02
075SB-0011-0001-SO
Date: 9/10/2013
Depth: 41 in
Mercury (mg/kg)
Mercury 0.220
75-PTRAP-03
075SB-0012-0001-SO
Date: 9/10/2013
Depth: 27 in
Mercury (mg/kg)
Mercury 0.210
75-PTRAP-01
075SB-0010-0001-SO
Date: 9/10/2013
Depth: 33 in
Mercury (mg/kg)
Mercury 0.210
10-inch Vit.
Cross Section of DU01
WEST
EAST
COMMINUTOR BUILDING (EAST WALL)
4 FT WIDE EXTERIOR CONCRETE STEPS
INTERIOR CORNER OF EAST WALL
15" DIA. VITRIFIED CLAY DRAIN PIPE (ABANDONED)
EDGE OF EXCAVATED TRENCH
FORMER GROUND SURFACE
MANHOLE MH-P1
GROUND SURFACE
APPROX. 18 FT
APPROX. 22 FT
4" C.I. PIPE CONNECTION
PIPE FLANGE (TYPICAL)
CONCRETE PLUG AT END OF PIPE
10" DIA. VITRIFIED CLAY DRAIN PIPE TO OUTFALL NO. 2 (ACTIVE)
SAMPLE 075TR-0002-0001-SO
SAMPLE 075TR-0004-0001-SO
SAMPLE 075TR-0005-0001-SO
SAMPLE 075TR-0007-0001-SO
SAMPLE 075TR-0006-0001-SO
LEGEND
Direct-Push Boring Location
Subsurface Soil Sample Location
Trench Sample Location
Drainage Pipe Deposit Sample Location (in 15-inch Vit. Clay Pipe)
Decision Unit
Manhole
Floor Drain with P-Trap
Brick and Mortar Plug
Blocked During Site Operations
Current Flow Direction
Vitrified Clay Pipe
Cast Iron Pipe
Road
Comminutor Building
Concentration Exceeds FWCUG (HQ=0.1/Target Risk of 10-6)
NOTES & SOURCES
1. Map Coordinates: NAD 83, UTM Zone 17N
2. Concentrations shown are for SRCs at each sample location. Concentrations which exceed the most stringent FWCUG are highlighted.
3. Subsurface soil sampling was performed at all trench sampling locations at a depth of 6 feet below ground surfaace (ft bgs) and at location 75-GRTP-DU1-SB1 from 7-13 ft bgs.
4. Trench sampling was performed at five locations approximately 4 ft apart.
5. Depths for P-Trap samples indicate the depth below the surface of the 6-inch thick concrete flooring inside the comminutor building.
6. mg/kg = milligrams per kilogram
7. J = estimated value less than reporting limits
8. ft = feet, Vit. = vitrified, SRC = site-related chemical
9. FWCUG = facility-wide cleanup goal
10. HQ = hazard quotient; C.I. = cast iron
TITLE
Figure 5-1
Inorganic SRCs in Drainage Pipe Deposit and Subsurface Soil Samples
CC RVAAP-75
George Road
Sewage Treatment Plant
Mercury Spill
Former Ravenna Ary Ammunition Plant
Portage and Trumbull Counties, Ohio
0 7.5 15
Feet
N
ECC
Marlborough, Massachusetts
NO.
5-1

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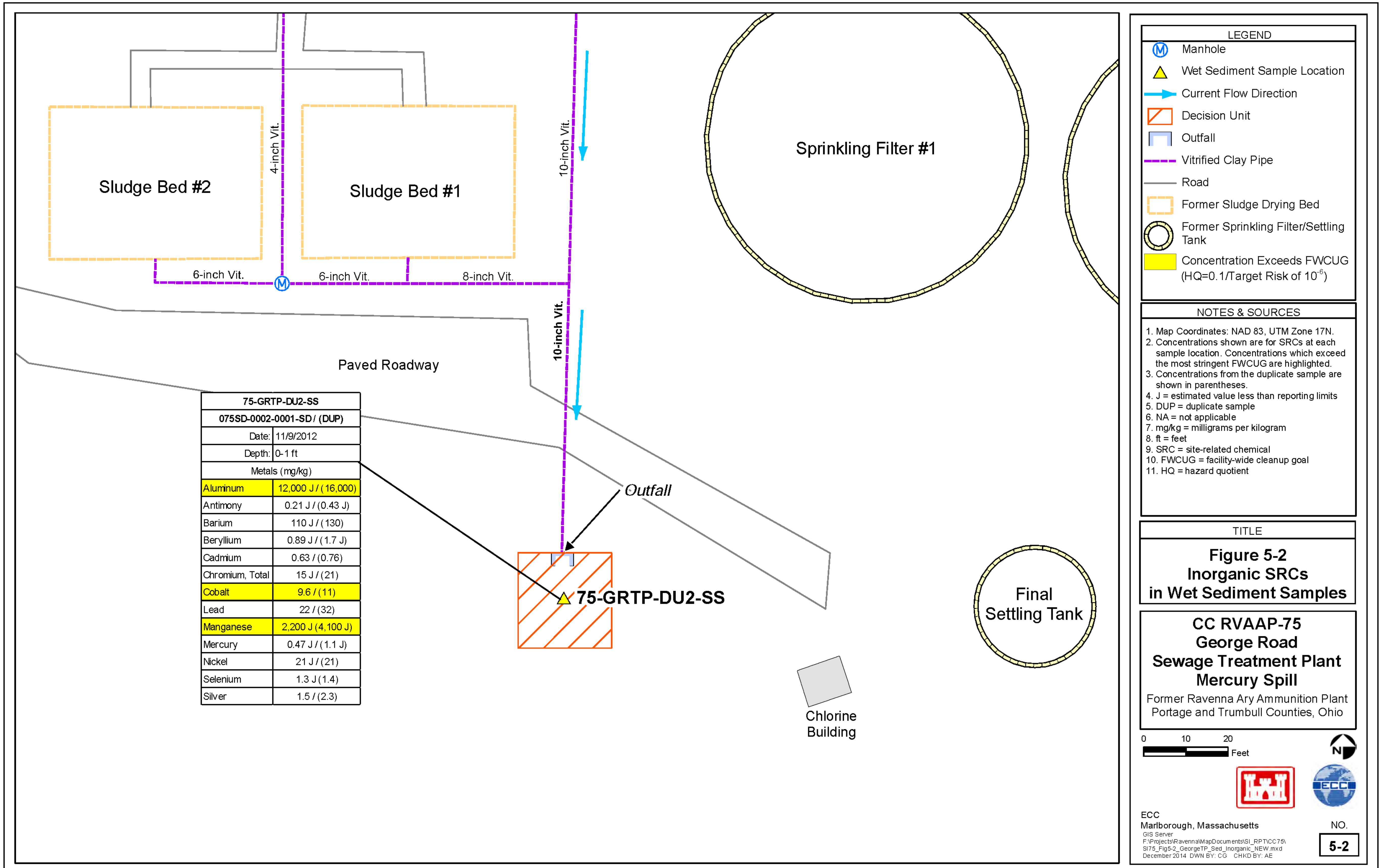

75-GRTP-DU2-SS	
075SD-0002-0001-SD / (DUP)	
Date:	11/9/2012
Depth:	0-1 ft
Metals (mg/kg)	
Aluminum	12,000 J / (16,000)
Antimony	0.21 J / (0.43 J)
Barium	110 J / (130)
Beryllium	0.89 J / (1.7 J)
Cadmium	0.63 / (0.76)
Chromium, Total	15 J / (21)
Cobalt	9.6 / (11)
Lead	22 / (32)
Manganese	2,200 J (4,100 J)
Mercury	0.47 J / (1.1 J)
Nickel	21 J / (21)
Selenium	1.3 J (1.4)
Silver	1.5 / (2.3)

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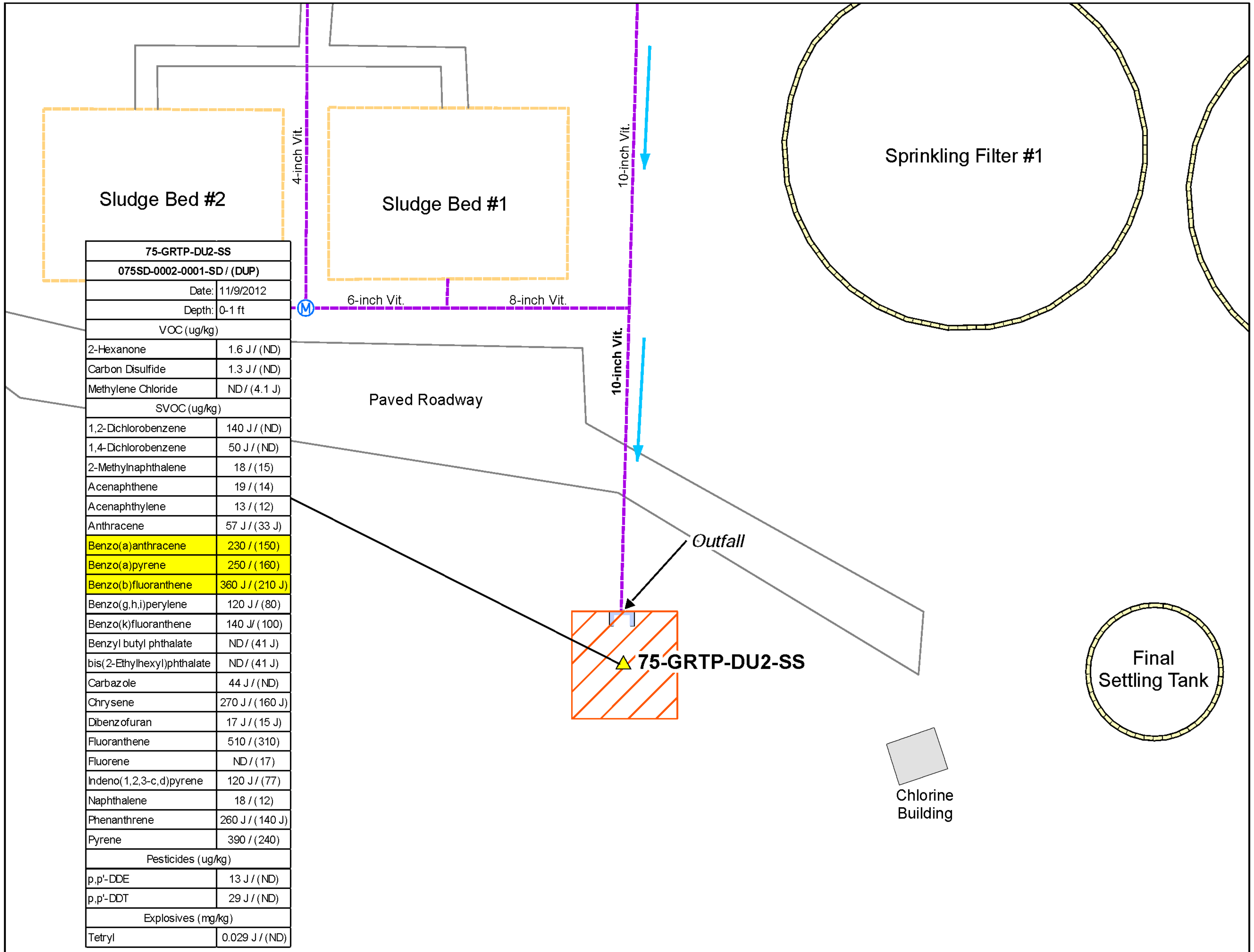

75-GRTP-DU2-SS	
075SD-0002-0001-SD / (DUP)	
Date:	11/9/2012
Depth:	0-1 ft
VOC (ug/kg)	
2-Hexanone	1.6 J / (ND)
Carbon Disulfide	1.3 J / (ND)
Methylene Chloride	ND / (4.1 J)
SVOC (ug/kg)	
1,2-Dichlorobenzene	140 J / (ND)
1,4-Dichlorobenzene	50 J / (ND)
2-Methylnaphthalene	18 / (15)
Acenaphthene	19 / (14)
Acenaphthylene	13 / (12)
Anthracene	57 J / (33 J)
Benzo(a)anthracene	230 / (150)
Benzo(a)pyrene	250 / (160)
Benzo(b)fluoranthene	360 J / (210 J)
Benzo(g,h,i)perylene	120 J / (80)
Benzo(k)fluoranthene	140 J/ (100)
Benzyl butyl phthalate	ND / (41 J)
bis(2-Ethylhexyl)phthalate	ND / (41 J)
Carbazole	44 J / (ND)
Chrysene	270 J / (160 J)
Dibenzofuran	17 J / (15 J)
Fluoranthene	510 / (310)
Fluorene	ND / (17)
Indeno(1,2,3-c,d)pyrene	120 J / (77)
Naphthalene	18 / (12)
Phenanthrene	260 J / (140 J)
Pyrene	390 / (240)
Pesticides (ug/kg)	
p,p'-DDE	13 J / (ND)
p,p'-DDT	29 J / (ND)
Explosives (mg/kg)	
Tetryl	0.029 J / (ND)

LEGEND

- Manhole
- Wet Sediment Sample Location
- Current Flow Direction
- Decision Unit
- Outfall
- Vitrified Clay Pipe
- Road
- Former Sludge Drying Bed
- Former Sprinkling Filter/Settling Tank
- Concentration Exceeds FWCUG (HQ=0.1/Target Risk of 10^{-6})

NOTES & SOURCES

1. Map Coordinates: NAD 83, UTM Zone 17N.
2. Concentrations shown are for SRCs at each sample location. Concentrations which exceed the most stringent FWCUG are highlighted.
3. Concentrations from the duplicate sample are shown in parentheses.
4. J = estimated value less than reporting limits
5. DUP = duplicate sample
6. NA = not applicable
7. mg/kg = milligrams per kilogram
8. ft = feet
9. SRC = site-related chemical
10. FWCUG = facility-wide cleanup goal
11. HQ = hazard quotient

TITLE

Figure 5-3
Organic SRCs
in Wet Sediment Samples

CC RVAAP-75
George Road
Sewage Treatment Plant
Mercury Spill

Former Ravenna Ary Ammunition Plant
Portage and Trumbull Counties, Ohio

0 10 20 Feet

ECC
Marlborough, Massachusetts
GIS Server
F:\Projects\Ravenna\MapDocuments\SI_RPT\CC75\SI75_Fig5-3_GeorgeTP_Sed_Organic_NEW.mxd
December 2014 DWN BY: CG CHKD BY: AE

NO. **5-3**

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Table 5-1: Site-Related Chemical Determination Subsurface Soil Samples, December 2012 and August-September 2013 at CC RVAAP-75

Chemical	Units	CAS Number	Frequency of Detect	Minimum Detect	Maximum Detect	Background Criteria[a]	SRC (Yes/No)	SRC Justification
Mercury	**mg/kg**	**7439-97-6**	**8/12**	**0.023**	**0.35**	**0.044**	**Yes**	**Exceeds Background**

Notes:
(a) Background concentrations for subsurface soil from final facility-wide background concentrations for Ravenna Army Ammunition Plant, published in the 2001 Phase II Remedial Investigation Report for Winklepeck Burning Grounds.
Bold indicates analyte identified as an SRC.
CAS = Chemical Abstract Number.
mg/kg = Milligram per kilogram.
SRC = Site-related chemical.

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Table 5-2: Site-Related Chemical Determination for Wet Sediment Samples, November 2012 at CC RVAAP-75

Method/Chemicals	Units	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-Trichloroethane2	µg/kg	71-55-6	0/2	None	None	None	No	Not Detected
1,1,2,2-Tetrachloroethane	µg/kg	79-34-5	0/2	None	None	None	No	Not Detected
1,1,2-Trichloroethane	µg/kg	79-00-5	0/2	None	None	None	No	Not Detected
1,1-Dichloroethane	µg/kg	159-59-2	0/2	None	None	None	No	Not Detected
1,1-Dichloroethene	µg/kg	75-35-4	0/2	None	None	None	No	Not Detected
1,2-Dibromoethane	µg/kg	106-93-4	0/2	None	None	None	No	Not Detected
1,2-Dichloroethane	µg/kg	107-06-2	0/2	None	None	None	No	Not Detected
1,2-Dichloroethene	µg/kg	156-60-5	0/2	None	None	None	No	Not Detected
1,2-Dichloropropane	µg/kg	78-87-5	0/2	None	None	None	No	Not Detected
2-Hexanone	**µg/kg**	**591-78-6**	**1/2**	**1.6**	**1.6**	**None**	**Yes**	**Detected Organic**
4-Methyl-2-pentanone	µg/kg	108-10-1	0/2	None	None	None	No	Not Detected
Acetone	µg/kg	67-64-1	0/2	None	None	None	No	Not Detected
Benzene	µg/kg	71-43-2	0/2	None	None	None	No	Not Detected
Bromochloromethane	µg/kg	74-97-5	0/2	None	None	None	No	Not Detected
Bromodichloromethane	µg/kg	75-27-4	0/2	None	None	None	No	Not Detected
Bromoform	µg/kg	75-25-2	0/2	None	None	None	No	Not Detected
Bromomethane	µg/kg	74-83-9	0/2	None	None	None	No	Not Detected
Carbon Disulfide	**µg/kg**	**75-15-0**	**1/2**	**1.3**	**1.3**	**None**	**Yes**	**Detected Organic**
Carbon Tetrachloride	µg/kg	56-23-5	0/2	None	None	None	No	Not Detected
Chlorobenzene	µg/kg	108-90-7	0/2	None	None	None	No	Not Detected
Chloroethane	µg/kg	75-00-3	0/2	None	None	None	No	Not Detected
Chloroform	µg/kg	67-66-3	0/2	None	None	None	No	Not Detected
Chloromethane	µg/kg	74-87-3	0/2	None	None	None	No	Not Detected
cis-1,3-Dichloropropene	µg/kg	10061-01-5	0/2	None	None	None	No	Not Detected
Dibromochloromethane	µg/kg	124-48-1	0/2	None	None	None	No	Not Detected
Ethylbenzene	µg/kg	100-41-4	0/2	None	None	None	No	Not Detected
Methyl Ethyl Ketone (2-Butanone)	µg/kg	78-93-3	0/2	None	None	None	No	Not Detected
4-Methy-2-Pentanone	µg/kg	108-10-1	0/2	None	None	None	No	Not Detected
Methylene Chloride	**µg/kg**	**75-09-2**	**1/2**	**4.1**	**4.1**	**None**	**Yes**	**Detected Organic**
Styrene	**µg/kg**	**100-42-5**	0/2	None	None	None	No	Not Detected
tert-Butyl Methyl Ether	µg/kg	1634-04-4	0/2	None	None	None	No	Not Detected
Tetrachloroethylene (PCE)	µg/kg	127-18-4	0/2	None	None	None	No	Not Detected
Toluene	µg/kg	108-88-3	0/2	None	None	None	No	Not Detected

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Table 5-2: Site-Related Chemical Determination for Wet Sediment Samples, November 2012 at CC RVAAP-75 (continued)

Method/Chemicals	Units	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	µg/kg	10061-02-6	0/2	None	None	None	No	Not Detected
Trichloroethylene (TCE)	µg/kg	79-01-6	0/2	None	None	None	No	Not Detected
Vinyl Chloride	µg/kg	75-01-4	0/2	None	None	None	No	Not Detected
Xylenes, Total	µg/kg	1330-20-7	0/2	None	None	None	No	Not Detected
Semivolatile Organic Compounds (µg/kg)								
1,2,4-Trichlorobenzene	µg/kg	120-82-1	0/2	None	None	None	No	Not Detected
1,2-Dichlorobenzene	**µg/kg**	**95-50-1**	**1/2**	**140**	**140**	**None**	**Yes**	**Detected Organic**
1,3-Dichlorobenzene	µg/kg	541-73-1	0/2	None	None	None	No	Not Detected
1,4-Dichlorobenzene	**µg/kg**	**106-46-7**	**1/2**	**50**	**50**	**None**	**Yes**	**Detected Organic**
2,4,5-Trichlorophenol	µg/kg	95-95-4	0/2	None	None	None	No	Not Detected
2,4,6-Trichlorophenol	µg/kg	88-06-2	0/2	None	None	None	No	Not Detected
2,4-Dichlorophenol	µg/kg	120-83-2	0/2	None	None	None	No	Not Detected
2,4-Dimethylphenol	µg/kg	105-67-9	0/2	None	None	None	No	Not Detected
2,4-Dinitrophenol	µg/kg	51-28-5	0/2	None	None	None	No	Not Detected
2,4-Dinitrotoluene	µg/kg	121-14-2	0/2	None	None	None	No	Not Detected
2,6-Dinitrotoluene	µg/kg	606-20-2	0/2	None	None	None	No	Not Detected
2-Chloronaphthalene	µg/kg	91-58-7	0/2	None	None	None	No	Not Detected
2-Chlorophenol	µg/kg	95-57-8	0/2	None	None	None	No	Not Detected
2-Methylnaphthalene	**µg/kg**	**95-48-7**	**2/2**	**15**	**18**	**None**	**Yes**	**Detected Organic**
2-Methylphenol (o-Cresol)	µg/kg	202-437-8	0/2	None	None	None	No	Not Detected
2-Nitroaniline	µg/kg	88-74-4	0/2	None	None	None	No	Not Detected
2-Nitrophenol	µg/kg	88-75-5	0/2	None	None	None	No	Not Detected
3,3'-Dichlorobenzidine	µg/kg	91-94-1	0/2	None	None	None	No	Not Detected
3-Nitroaniline	µg/kg	99-09-2	0/2	None	None	None	No	Not Detected
4,6-Dinitro-2-Methylphenol	µg/kg	534-52-1	0/2	None	None	None	No	Not Detected
4-Bromophenyl phenyl ether	µg/kg	101-55-3	0/2	None	None	None	No	Not Detected
4-Chloro-3-Methylphenol	µg/kg	59-50-7	0/2	None	None	None	No	Not Detected
4-Chloroaniline	µg/kg	106-47-8	0/2	None	None	None	No	Not Detected
4-Chlorophenyl Phenyl Ether	µg/kg	7005-72-3	0/2	None	None	None	No	Not Detected
Acenaphthene	**µg/kg**	**83-32-9**	**2/2**	**14**	**19**	**None**	**Yes**	**Detected Organic**
Acenaphthylene	**µg/kg**	**208-96-8**	**2/2**	**12**	**13**	**None**	**Yes**	**Detected Organic**
Anthracene	**µg/kg**	**120-12-7**	**2/2**	**33**	**57**	**None**	**Yes**	**Detected Organic**

Table 5-2: Site-Related Chemical Determination for Wet Sediment Samples, November 2012 at CC RVAAP-75 (continued)

Method/Chemicals	Units	CAS Number	Frequency of Detect	Minimum Detect	Maximum Detect	Background Criteria[(a)]	SRC (Yes/No)	SRC Justification
Semivolatile Organic Compounds (µg/kg)								
Benzo(a)anthracene	**µg/kg**	**56-55-3**	**2/2**	**150**	**230**	**None**	**Yes**	**Detected Organic**
Benzo(a)pyrene	**µg/kg**	**50-32-8**	**2/2**	**160**	**250**	**None**	**Yes**	**Detected Organic**
Benzo(b)fluoranthene	**µg/kg**	**205-99-2**	**2/2**	**210**	**360**	**None**	**Yes**	**Detected Organic**
Benzo(g,h,i)perylene	**µg/kg**	**191-24-2**	**2/2**	**80**	**120**	**None**	**Yes**	**Detected Organic**
Benzo(k)fluoranthene	**µg/kg**	**207-08-9**	**2/2**	**100**	**140**	**None**	**Yes**	**Detected Organic**
Benzoic Acid	µg/kg	65-85-0	0/2	None	None	None	No	Not Detected
Benzyl alcohol	µg/kg	100-51-6	0/2	None	None	None	No	Not Detected
bis(2-Chloroethoxy) Methane	µg/kg	111-91-1	0/2	None	None	None	No	Not Detected
bis(2-Chloroethyl) Ether (2-Chloroethyl Ether)	µg/kg	111-44-4	0/2	None	None	None	No	Not Detected
bis(2-Chloroisopropyl) Ether	µg/kg	108-60-1	0/2	None	None	None	No	Not Detected
Benzyl butyl phthalate	**µg/kg**	**85-68-7**	**1/2**	**41**	**41**	**None**	**Yes**	**Detected Organic**
bis(2-Ethylhexyl) Phthalate	**µg/kg**	**117-81-7**	**1/2**	**41**	**41**	**None**	**Yes**	**Detected Organic**
Carbazole	**µg/kg**	**86-74-8**	**1/2**	**44**	**44**	**None**	**Yes**	**Detected Organic**
Chrysene	**µg/kg**	**218-01-9**	**2/2**	**160**	**270**	**None**	**Yes**	**Detected Organic**
Cresols, m & p	µg/kg	8001-28-3	0/2	None	None	None	No	Not Detected
Dibenz(a,h)anthracene	µg/kg	53-70-3	0/2	None	None	None	No	Not Detected
Dibenzofuran	**µg/kg**	**132-64-9**	**2/2**	**15**	**17**	**None**	**Yes**	**Detected Organic**
Diethyl Phthalate	µg/kg	84-66-2	0/2	None	None	None	No	Not Detected
Dimethyl Phthalate	µg/kg	131-11-3	0/2	None	None	None	No	Not Detected
Di-n-Butyl Phthalate	µg/kg	84-74-2	0/2	None	None	None	No	Not Detected
Di-n-Octylphthalate	µg/kg	117-84-0	0/2	None	None	None	No	Not Detected
Fluoranthene	**µg/kg**	**206-44-0**	**2/2**	**310**	**510**	**None**	**Yes**	**Detected Organic**
Fluorene	**µg/kg**	**86-73-7**	**1/2**	**17**	**17**	**None**	**Yes**	**Detected Organic**
Hexachlorobenzene	µg/kg	118-74-1	0/2	None	None	None	No	Not Detected
Hexachlorobutadiene	µg/kg	87-68-3	0/2	None	None	None	No	Not Detected
Hexachlorocyclopentadiene	µg/kg	77-47-4	0/2	None	None	None	No	Not Detected
Hexachloroethane	µg/kg	67-72-1	0/2	None	None	None	No	Not Detected
Indeno(1,2,3-c,d)Pyrene	**µg/kg**	**193-39-5**	**2/2**	**77**	**120**	**None**	**Yes**	**Detected Organic**
Isophorone	µg/kg	78-59-1	0/2	None	None	None	No	Not Detected
Naphthalene	**µg/kg**	**91-20-3**	**2/2**	**12**	**18**	**None**	**Yes**	**Detected Organic**
n-Nitrosodi-n-propylamine	µg/kg	621-64-7	0/2	None	None	None	No	Not Detected

Table 5-2: Site-Related Chemical Determination for Wet Sediment Samples, November 2012 at CC RVAAP-75 (continued)

Method/Chemicals	Units	CAS Number	Frequency of Detect	Minimum Detect	Maximum Detect	Background Criteria[a]	SRC (Yes/No)	SRC Justification
Semivolatile Organic Compounds (µg/kg)								
n-Nitrosodiphenylamine	µg/kg	86-30-6	0/2	None	None	None	No	Not Detected
Pentachlorophenol	µg/kg	87-86-5	0/2	None	None	None	No	Not Detected
Phenanthrene	**µg/kg**	**85-01-8**	**2/2**	**140**	**260**	**None**	**Yes**	**Detected Organic**
Phenol	µg/kg	108-95-2	0/2	None	None	None	No	Not Detected
Pyrene	**µg/kg**	**129-00-0**	**2/2**	**240**	**390**	**None**	**Yes**	**Detected Organic**
Pesticides (µg/kg)								
Aldrin	µg/kg	309-00-2	0/2	None	None	None	No	Not Detected
alpha BHC	µg/kg	319-84-6	0/2	None	None	None	No	Not Detected
alpha Endosulfan	µg/kg	959-98-8	0/2	None	None	None	No	Not Detected
alpha-Chlordane	µg/kg	5103-79-9	0/2	None	None	None	No	Not Detected
beta BHC	µg/kg	319-85-7	0/2	None	None	None	No	Not Detected
beta Endosulfan	µg/kg	33213-65-9	0/2	None	None	None	No	Not Detected
delta BHC	µg/kg	319-86-8	0/2	None	None	None	No	Not Detected
Dieldrin	µg/kg	60-57-1	0/2	None	None	None	No	Not Detected
Endosulfan Sulfate	µg/kg	1031-07-8	0/2	None	None	None	No	Not Detected
Endrin	µg/kg	72-20-8	0/2	None	None	None	No	Not Detected
Endrin Aldehyde	µg/kg	7421-93-4	0/2	None	None	None	No	Not Detected
Endrin Ketone	µg/kg	53494-70-5	0/2	None	None	None	No	Not Detected
gamma BHC (Lindane)	µg/kg	58-89-9	0/2	None	None	None	No	Not Detected
gamma-Chlordane	µg/kg	5103-74-2	0/2	None	None	None	No	Not Detected
Heptachlor	µg/kg	76-44-8	0/2	None	None	None	No	Not Detected
Heptachlor Epoxide	µg/kg	1021-57-3	0/2	None	None	None	No	Not Detected
Methoxychlor	µg/kg	72-43-5	0/2	None	None	None	No	Not Detected
p,p'-Dichlorodiphenyldichloroethane	µg/kg	72-54-8	0/2	None	None	None	No	Not Detected
p,p'-Dichlorodiphenyldichloroethylene	**µg/kg**	**72-55-9**	**1/2**	**13**	**13**	**None**	**Yes**	**Detected Organic**
p,p'- Dichlorodiphenyltrichloroethane	**µg/kg**	**50-29-3**	**1/2**	**29**	**29**	**None**	**Yes**	**Detected Organic**
Toxaphene	µg/kg	8001-35-2	0/2	None	None	None	No	Not Detected

Table 5-2: Site-Related Chemical Determination for Wet Sediment Samples, November 2012 at CC RVAAP-75 (continued)

Method/Chemicals	Units	CAS Number	Frequency of Detect	Minimum Detect	Maximum Detect	Background Criteria[a]	SRC (Yes/No)	SRC Justification
PCBs (µg/kg)								
PCB-1016	µg/kg	12674-11-2	0/2	None	None	None	No	Not Detected
PCB-1221	µg/kg	11104-28-2	0/2	None	None	None	No	Not Detected
PCB-1232	µg/kg	11141-16-5	0/2	None	None	None	No	Not Detected
PCB-1242	µg/kg	53469-21-9	0/2	None	None	None	No	Not Detected
PCB-1248	µg/kg	12672-29-6	0/2	None	None	None	No	Not Detected
PCB-1254	µg/kg	52663-62-4	0/2	None	None	None	No	Not Detected
PCB-1260	µg/kg	11096-82-5	0/2	None	None	None	No	Not Detected
Explosives (mg/kg)								
1,3,5-Trinitrobenzene	mg/kg	99-35-4	0/2	None	None	None	No	Not Detected
1,3-Dinitrobenzene	mg/kg	99-65-0	0/2	None	None	None	No	Not Detected
2,4,6-Trinitrotoluene	mg/kg	118-96-7	0/2	None	None	None	No	Not Detected
2,4-Dinitrotoluene	mg/kg	121-14-2	0/2	None	None	None	No	Not Detected
2,6-Dinitrotoluene	mg/kg	606-20-2	0/2	None	None	None	No	Not Detected
2-Amino-4,6-dinitrotoluene	mg/kg	35572-78-2	0/2	None	None	None	No	Not Detected
2-Nitrotoluene	mg/kg	88-72-2	0/2	None	None	None	No	Not Detected
3-Nitrotoluene	mg/kg	99-08-1	0/2	None	None	None	No	Not Detected
4-Amino-2,6-Dinitrotoluene	mg/kg	19406-51-0	0/2	None	None	None	No	Not Detected
4-Nitrotoluene	mg/kg	99-99-0	0/2	None	None	None	No	Not Detected
Hexahydro-1,3,5-Trinitro-1,3,5-Triazine (RDX)	mg/kg	121-82-4	0/2	None	None	None	No	Not Detected
Nitrobenzene	mg/kg	98-95-3	0/2	None	None	None	No	Not Detected
Octahydro-1,3,5,7-Tetranitro-1,3,5,7-Tetrazocine (HMX)	mg/kg	2691-41-0	0/2	None	None	None	No	Not Detected
Pentaerythritol Tetranitrate	mg/kg	78-11-5	0/2	None	None	None	No	Not Detected
Tetryl	**mg/kg**	**479-45-8**	**1/2**	**0.029**	**0.029**	**None**	**Yes**	**Detected Organic**
Propellants (mg/kg)								
Nitrocellulose	mg/kg	9004-70-0	0/2	None	None	None	No	Not Detected
Nitroglycerin	mg/kg	55-63-0	0/2	None	None	None	No	Not Detected
Nitroguanidine	mg/kg	556-88-7	0/2	None	None	None	No	Not Detected
Metals (mg/kg)								
Aluminum	**mg/kg**	**7429-90-5**	**2/2**	**12,000**	**16,000**	**13,900**	**Yes**	**Exceeds Background**
Antimony	**mg/kg**	**7440-36-0**	**2/2**	**0.21**	**0.43**	**0**	**Yes**	**Exceeds Background**
Arsenic	mg/kg	7440-38-2	2/2	9	9.5	19.5	No	Below Background

Table 5-2: Site-Related Chemical Determination for Wet Sediment Samples, November 2012 at CC RVAAP-75 (continued)

Method/Chemicals	Units	CAS Number	Frequency of Detect	Minimum Detect	Maximum Detect	Background Criteria[(a)]	SRC (Yes/No)	SRC Justification
Metals (mg/kg)								
Barium	**mg/kg**	**7440-39-3**	**2/2**	**110**	**130**	**123**	**Yes**	**Exceeds Background**
Beryllium	**mg/kg**	**7440-41-7**	**2/2**	**0.89**	**1.7**	**0.88**	**Yes**	**Exceeds Background**
Cadmium	**mg/kg**	**7440-43-9**	**2/2**	**0.63**	**0.76**	**0**	**Yes**	**Exceeds Background**
Calcium **	mg/kg	7440-70-2	2/2	6,400	50,000	5510	No	Essential Nutrient
Chromium	**mg/kg**	**7440-47-3**	**2/2**	**15**	**21**	**18.1**	**Yes**	**Exceeds Background**
Cobalt	**mg/kg**	**7440-48-4**	**2/2**	**9.6**	**11**	**9.1**	**Yes**	**Exceeds Background**
Copper	mg/kg	7440-50-8	2/2	17	21	27.6	No	Below Background
Iron **	mg/kg	7439-89-6	2/2	19,000	20,000	28,200	No	Essential Nutrient
Lead	**mg/kg**	**7439-92-1**	**2/2**	**22**	**32**	**27.4**	**Yes**	**Exceeds Background**
Magnesium **	mg/kg	7439-95-4	2/2	2,800	5,600	2760	No	Essential Nutrient
Manganese	**mg/kg**	**7439-96-5**	**2/2**	**2,200**	**4,100**	**1,950**	**Yes**	**Exceeds Background**
Mercury	**mg/kg**	**7439-97-6**	**2/2**	**0.47**	**1.1**	**0.059**	**Yes**	**Exceeds Background**
Nickel	**mg/kg**	**7440-02-0**	**2/2**	**21**	**21**	**17.7**	**Yes**	**Exceeds Background**
Potassium **	mg/kg	7440-09-7	2/2	1,200	1,400	1950	No	Essential Nutrient
Selenium	**mg/kg**	**7782-49-2**	**2/2**	**1.3**	**1.4**	**1.4**	**Yes**	**Exceeds Background**
Silver	**mg/kg**	**7440-22-4**	**2/2**	**1.5**	**2.3**	**0**	**Yes**	**Exceeds Background**
Sodium **	mg/kg	7440-23-5	2/2	75	310	112	No	Essential Nutrient
Thallium	mg/kg	7440-28-0	2/2	0.15	0.21	0.89	No	Below Background
Vanadium	mg/kg	7440-62-2	2/2	15	20	26.1	No	Below Background
Zinc	mg/kg	7440-66-6	2/2	130	140	532	No	Below Background

Notes:
(a) Background concentrations for wet sediment from final facility-wide background concentrations for Ravenna Army Ammunition Plant, published in the 2001 Phase II Remedial Investigation Report for Winklepeck Burning Grounds.
Bold indicates analyte identified as an SRC.
** = Essential Nutrients.
µg/kg = Microgram per kilogram.
CAS = Chemical Abstract Number.
mg/kg = Milligram per kilogram.
PCB = Polychlorinated biphenyl.
SRC = Site-related chemical.
SVOC = Semivolatile organic compound.
VOC = Volatile organic compound.

Table 5-3: Site-Related Chemical Determination for Drainage Pipe Deposit Sample Result, November 2012 at CC RVAAP-75

Chemical	Units	CAS Number	Frequency of Detect	Minimum Detect	Maximum Detect	Average Result	Background Criteria[a]	SRC (Yes/No)	SRC Justification[b]
Mercury	**mg/kg**	**7439-97-6**	**1/1**	**7.2**	**7.2**	**7.2**	**0.044**	**Yes**	**Exceeds Background**

Notes:
(a) Background concentrations for subsurface soil from final facility-wide background concentrations for Ravenna Army Ammunition Plant, published in the 2001 Phase II Remedial Investigation Report for Winklepeck Burning Grounds.
(b) Drainage pipe deposit compared to subsurface soil background for advisory purposes to determine if deposit is attributable to surrounding soil
Bold indicates analyte identified as an SRC.
CAS = Chemical Abstract Number.
mg/kg = Milligram per kilogram.
SRC = Site-related chemical.

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Table 5-4: Summary of Analytical Results for Mercury Detected in Subsurface Soil Samples Collected in December 2012 and August–September 2013 at CC RVAAP-75

Sample Type:							Primary	Primary	Duplicate	Primary	Primary	Primary	Primary
Location ID:							75-GRTP-DU1-SB1	75-GRTP-DU1-TR1	75-GRTP-DU1-TR1	75-GRTP-DU1-TR2	75-GRTP-DU1-TR3	75-GRTP-DU1-TR4	75-GRTP-DU1-TR5
Field Sample ID:							075SB-0001-0001-SO	075TR-0002-0001-SO	075TR-0003-0001-SO	075TR-0004-0001-SO	075TR-0005-0001-SO	075TR-0006-0001-SO	075TR-0007-0001-SO
Lab Sample ID:							240-18441-20	240-18544-38	240-18544-39	240-18544-40	240-18544-41	240-18544-42	240-18544-43
Sample Date:							12/4/2012	12/6/2012	12/6/2012	12/6/2012	12/6/2012	12/6/2012	12/6/2012
Location Type:							Deep Soil Boring	Trench	Trench	Trench	Trench	Trench	Trench
Depth (ft):							7 - 13	6	6	6	6	6	6
		Facility-Wide Cleanup Goals			**USEPA RSL**								
			Resident Receptor										
Chemical (mg/kg)	**BKG**	**National Guard Trainee**	**Resident Child Farmer**	**Resident Adult Farmer**	**Industrial**	**Residential**							
Mercury	0.044	172*	2.27*	16.5*	4.30	1.00	**0.050 J**	ND	ND	ND	**0.052 J**	**0.35**	**0.048 J**

Sample Type:							Primary	Primary	Primary	Primary	Primary
Location ID:							75-PTRAP-01	75-PTRAP-02	75-PTRAP-03	75-GRTP-DU1-SB2	75-GRTP-DU1-SB3
Field Sample ID:							075SB-0010-0001-SO	075SB-0011-0001-SO	075SB-0012-0001-SO	075SB-0008-0001-SO	075SB-0009-0001-SO
Lab Sample ID:							240-28850-1	240-28850-2	240-28850-3	240-28007-1	240-28007-2
Sample Date:							9/10/2013	9/10/2013	9/10/2013	8/14/2013	8/14/2013
Location Type:							Directly Under P-trap	8 inches below P-trap	Directly under flange on discharge pipe	Soil Boring	Soil Boring
Depth (ft):							0-1	0-1	0-1	5-6	5-6
		Facility-Wide Cleanup Goals			**USEPA RSL**						
			Resident Receptor								
Chemical (mg/kg)	**BKG**	**National Guard Trainee**	**Resident Child Farmer**	**Resident Adult Farmer**	**Industrial**	**Residential**					
Mercury	0.044	172*	2.27*	16.5*	4.30	1.00	**0.210**	**0.220**	**0.210**	ND	**0.0230 J**

Notes:
Yellow shading of a result indicates concentration is greater than a FWCUG.
Bold indicates chemical detected.
All FWCUGs are carcinogenic FWCUGs (10^{-6} Risk), with the exception of the FWCUGs with an asterisk (*).
Asterisk (*) indicates non-carcinogenic FWCUGs (Hazard Quotient = 0.1).
BKG = Background.
DU = Decision Unit.
ft = Feet(foot).
FWCUG = Facility-Wide Cleanup Goal.
ID = Identification
J = Estimated value less than reporting limits.
mg/kg = Milligram per kilogram.
ND = Non-detect.
RSL = Regional Screening Level (USEPA 2014).
U = Non-detected concentration, below detection limit.
UJ = Not detected and reporting limit is estimated.
USEPA = U.S. Environmental Protection Agency.

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Table 5-5: Summary of Analytical Results for Inorganic Chemicals Detected in Wet Sediment Samples Collected in November 2012 at CC RVAAP-75

						Sample Type:	Primary	Duplicate
						Location ID:	75-GRTP-DU2-SS	75-GRTP-DU2-SS
						Field Sample ID:	075SD-0002-0001-SD	075SD-0003-0001-SD
						Lab Sample ID:	240-17467-2	240-17467-4
						Sample Date:	11/9/2012	11/9/2012
						Location Type:	Wet Sediment Outfall Area	Wet Sediment Outfall Area
						Sample Depth (ft):	0-1	0-1
		Facility-Wide Cleanup Goals			**USEPA RSL**			
			Resident Receptor					
Method/Chemicals	**BKG**	**National Guard Trainee**	**Resident Child Farmer**	**Resident Adult Farmer**	**Industrial**	**Residential**		
Aluminum	13,900	3,496*	7,380*	52,923*	99,000	7,700	**12,000 J**	**16,000**
Antimony	0	175*	2.82*	13.6*	41	3.10	**0.21 J**	**0.43 J**
Arsenic	19.5	2.78	0.524	0.425	2.40	0.61	**9.5 J**	**9.0**
Barium	123	351*	1,413*	8,966*	19,000	1,500	**110 J**	**130**
Beryllium	0.38	None	None	None	200	16	**0.89 J**	**1.7 J**
Cadmium	0	10.9	6.41*	22.3*	80.0	7.00	**0.63**	**0.76**
Calcium **	5,510	None	None	None	None	None	**6,400 J**	**50,000 J**
Chromium	18.1	329,763*	8,147*	19,694*	150,000	12,000	**15 J**	**21**
Cobalt	9.1	None	None	None	30.0	2.30	**9.6**	**11**
Copper	27.6	25,638*	311*	2,714*	4,100	310	**17**	**21**
Iron	28,200	184,370*	2,313*	19,010*	72,000	5,500	**20,000**	**19,000**
Lead	27.4	None	None	None	800	400	**22**	**32**
Magnesium **	2760	None	None	None	None	None	**2,800 J**	**5,600 J**
Manganese	1,950	35.1*	293*	1,482*	2,300	180	**2,200 J**	**4,100 J**
Mercury	0.059	172*	2.27*	16.5*	4.30	1.00	**0.47 J**	**1.1 J**
Nickel	17.7	12,639*	155*	1,346*	2,000	150	**21 J**	**21**
Potassium **	1,950	None	None	None	None	None	**1,400 J**	**1,200**
Selenium	1.7	None	None	None	510	39	**1.3 J**	**1.4**
Silver	0	3,105*	38.6*	324*	510	39.0	**1.5**	**2.3**
Sodium **	112	None	None	None	None	None	**75 J**	**310 J**
Thallium	0.89	47.7*	0.612*	4.76*	1.0	0.0078	**0.21 J**	**0.15**
Vanadium	26.1	2,304*	44.9*	156*	510	39	**20 J**	**15**
Zinc	532	187,269*	2,321*	19,659*	31,000	2,300	**140**	**130**

Notes:
Yellow shading of a result indicates concentration is greater than a FWCUG
Bold indicates chemical detected.
All FWCUGs are carcinogenic FWCUGs (10^{-6} Risk), with the exception of the FWCUGs with an asterisk (*)
Asterisk (*) indicates non-carcinogenic FWCUGs (Hazard Quotient = 0.1).
** = Essential nutrient.
µg/kg = Microgram per kilogram.
BKG = Background.
DU = Decision Unit.
ft = Feet.
FWCUG = Facility-Wide Cleanup Goal.
ID = Identification.
J = Estimated value less than reporting limits.
mg/kg = Milligram per kilogram.
NA = Not applicable.
RSL = Regional Screening Level (USEPA 2014).
U = Non-detected concentration, below detection limit.
UJ = Not detected and reporting limit is estimated.
USEPA = U.S. Environmental Protection Agency.

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Table 5-6: Summary of Analytical Results for Organic Chemicals Detected in Wet Sediment Samples Collected in November 2012 at CC RVAAP-75

						Sample Type:	Primary	Duplicate
						Location ID:	75-GRTP-DU2-SS	75-GRTP-DU2-SS
						Field Sample ID:	075SD-0002-0001-SD	075SD-0003-0001-SD
						Lab Sample ID:	240-17467-2	240-17467-4
						Sample Date:	11/9/2012	11/9/2012
						Location Type:	Wet Sediment Outfall Area	Wet Sediment Outfall Area
						Depth (ft):	0-1	0-1
		Facility-Wide Cleanup Goals			**USEPA RSL**			
		National Guard Trainee	**Resident Receptor**					
Method/Chemicals	**BKG**		**Resident Child Farmer**	**Resident Adult Farmer**	**Industrial**	**Residential**		
Volatile Organic Compounds (µg/kg)								
2-Hexanone	None	None	None	None	140,000	21,000	**1.6 J**	ND
Carbon Disulfide	None	None	None	None	370,000	82,000	**1.3 J**	ND
Methylene Chloride	None	None	None	None	310,000	36,000	ND	**4.1 J**
Semivolatile Organic Compounds (µg/kg)								
1,2 Dichlorobenzene	None	None	None	None	980,000	190,000	**140 J**	ND
1,4 Dichlorobenzene	None	None	None	None	12,000	2,400	**50 J**	ND
2-Methylnaphthalene	None	None	None	None	220,000	23,000	**18**	**15**
Acenaphthene	None	None	None	None	3,300,000	340,000	**19**	**14**
Acenaphthylene	None	None	None	None	None	None	**13**	**12**
Anthracene	None	None	None	None	17,000,000	1,700,000	**57 J**	**33 J**
Benzo(a)anthracene	None	4,770	650	221	2,100	150	**230**	**150**
Benzo(a)pyrene	None	477	65	22	210	15	**250**	**160**
Benzo(b)fluoranthene	None	4,770	650	221	2,100	150	**360 J**	**210 J**
Benzo(g,h,i)perylene	None	None	None	None	None	None	**120 J**	**80**
Benzo(k)fluoranthene	None	47,700	6,500	2,210	21,000	1,500	**140 J**	**100**
Benzyl butyl phthalate	None	None	None	None	910,000	260,000	ND	**41 J**
bis(2-Ethylhexyl) Phthalate	None	None	None	None	120,000	35,000	ND	**41 J**
Carbazole	None	None	None	None	None	None	**44 J**	ND
Chrysene	None	None	None	None	210,000	15,000	**270 J**	**160 J**
Dibenzofuran	None	None	None	None	100,000	7,800	**17 J**	**15 J**
Fluoranthene	None	None	None	None	2,200,000	230,000	**510**	**310**
Fluorene	None	None	None	None	2,200,000	230,000	ND	**17**
Indeno(1,2,3-c,d)pyrene	None	4,770	650	221	2,100	150	**120 J**	**77**
Naphthalene	None	None	None	None	18,000	3,600	**18**	**12**
Phenanthrene	None	None	None	None	None	None	**260 J**	**140 J**
Pyrene	None	None	None	None	1,700,000	170,000	**390**	**240**
p,p'-Dichlorodiphenyldichloroethylene	None	None	None	None	5,100	1,400	**13 J**	ND
p,p'-Dichlorodiphenyltrichloroethane	None	None	None	None	7,000	1,700	**29 J**	ND
Tetryl	None	None	None	None	120	12	**0.029 J**	ND

Notes:
Yellow shading of a result indicates concentration is greater than a FWCUG.
Bold indicates chemical detected.
All FWCUGs are carcinogenic FWCUGs (10^{-6} Risk), with the exception of the FWCUGs with an asterisk (*).
Asterisk (*) indicates non-carcinogenic FWCUGs (Hazard Quotient = 0.1).

μg/kg = Microgram per kilogram.
BKG = Background.
DU = Decision Unit.
ft = Feet.
FWCUG = Facility-Wide Cleanup Goal.
J = Estimated value less than reporting limits.
mg/kg = Milligrams per kilogram.
ND = Non-detect.
RSL = Regional Screening Level (USEPA 2014).
USEPA = U.S. Environmental Protection Agency.

Table 5-7: Summary of the Analytical Result for Mercury Detected in the Drainage Pipe Deposit Sample Collected in November 2012 at CC RVAAP-75

					Sample Type:		Primary
					Location ID:		75-GRTP-DU1-SS
					Field Sample ID:		075SD-0001-0001-SD
					Lab Sample ID:		240-17467-1
					Sample Date:		11/9/2012
					Location Type:		Deposit within 15-Inch Drainage Pipe
					Deposit Depth (ft):		0-1
		Facility-Wide Cleanup Goals[(a)]			**USEPA RSL**		
			Resident Receptor				
Chemical (mg/kg)	**BKG**	**National Guard Trainee**	**Resident Child Farmer**	**Resident Adult Farmer**	**Industrial**	**Residential**	
Mercury	0.044	172*	2.27*	16.5*	4.30	1.00	**7.2**

Notes:
(a) Drainage pipe deposit compared to subsurface soil FWCUG for advisory purposes only. Receptors are not exposed to deposits in buried pipes.
Bold indicates chemical detected.
All FWCUGs are carcinogenic FWCUGs (10^{-6} Risk), with the exception of the FWCUGs with an asterisk (*).
Asterisk (*) indicates non-carcinogenic FWCUGs (Hazard Quotient = 0.1).
BKG = Background.
DU = Decision Unit.
ft = Feet.
FWCUG = Facility-Wide Cleanup Goal.
ID = Identification.
mg/kg = Milligram per kilogram.
RSL = Regional Screening Level (USEPA 2014).
USEPA = U.S. Environmental Protection Agency.

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6. EXPOSURE PATHWAYS

6.1 SOIL EXPOSURE AND AIR PATHWAYS

6.1.1 Physical Conditions

The George Road Sewage Treatment Plant is located on Hiram Till glacial deposits. The soil type found at the CR site is the Mahoning silt loam, 2-6 percent slopes (USDA 2010, Figure 1-7). The inferred bedrock formation in the vicinity of the George Road Sewage Treatment Plant is the Pennsylvanian-age Pottsville Formation, Sharon Sandstone Member, informally referred to as the Sharon Conglomerate (Winslow and White 1966). The top of the Sharon Conglomerate bedrock at the George Road Sewage Treatment Plant is estimated to be 950 ft amsl, based on bedrock topography maps (Figure 1-4).

6.1.2 Soil and Air Targets

Current and future human and ecological (animal and plant) receptors may come into contact with surface soil or subsurface soil, if contaminants are present within either DU. Considering the design and location of the floor drain and drainage system through which the mercury would have travelled, any releases to soil would have been to subsurface soil. Potential for exposure to ecological receptors through the soil and air targets is limited.

The historical mercury spill was reportedly released to a closed piping system, which would effectively limit the chance of contact with human and ecological receptors. The estimated timeframe of any releases would result in attenuation of the contaminant in soil. The reported mercury concentrations in the subsurface soil sampled at this AOC were either below the FWCUGs or were non-detect. Based on the Residential Receptor's FWCUG, no potential contamination was identified in the subsurface soil or wet sediment. Mercury is not a potential contaminant at CC RVAAP-75.

Airborne contamination (e.g., windblown dust) and soil gas vapor are not considered a viable migration or exposure pathway at this AOC. However, during the SI activities, ambient air was continuously monitored for mercury vapors using a mercury vapor analyzer in the work zone area. The ambient air within the floor drain and the 15-inch drainage pipe into which the floor drain discharges was also screened using the mercury vapor analyzer prior to beginning any intrusive activities. All readings were non-detect.

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 organic soil gas vapor emissions.

6.1.3 Soil and Air Pathway Conclusions

The SI analytical results indicate that mercury was not detected above the FWCUGs in any of the subsurface soil collected at CC RVAAP-75. Therefore, the exposure pathways for soil and air are incomplete.

6.2 SURFACE WATER PATHWAY

6.2.1 Hydrological Setting

No surface water samples were collected as part of this SI as there are no surface waterbodies, perennial streams, or waterways at this AOC. Surface water within the Administration Area occurs intermittently as stormwater runoff overland, through constructed ditches and a limited storm sewer network throughout the area. Sediment within nearby conveyances appears to be dry sediment, as defined by RVAAP guidance, and is not typically inundated for more than 7 days at a time. The wet sediment pathway is discussed in Section 6.3.

Surface water flow may be a migration pathway for potential contamination to leave the CR AOC. Currently, the George Road sanitary sewer trunk line is plugged at MH-O1 (Figure 4-3), upstream from the plant, and at MH-P1. However, infiltrating surface water and groundwater flowing in the drain pipe downstream from MH-P1 is directed south toward the outfall area and thereafter to a drainage ditch.

From the outfall area, sanitary sewer discharge flows southeast along a drainage conveyance, exits the facility, and flows beneath State Route 5, approximately 200 ft to the southeast. There are no perennial surface water features in the immediate vicinity of the CR site. The closest perennial feature to receive drainage from the George Road Sewage Treatment Plant site is a tributary to the west branch of the Mahoning River located off of the facility, southeast of site.

6.2.2 Surface Water Targets

There are no perennial streams or surface water bodies located within the George Road Treatment Plant Mercury Spill AOC. Other than the sanitary sewer outfall noted above, there are no observed springs or groundwater discharge points to a surface water body in the immediate vicinity of the George Road Sewage Treatment Plant. Permanent surface water features are not present on the AOC. Therefore, there is no direct exposure pathway for human receptors or ecological targets to surface water at the site.

6.2.3 Surface Water Pathway Conclusions

There are no perennial surface water streams or wetlands in the immediate vicinity of CC RVAAP-75. Surface water flow is not a migration pathway for potential contamination related to the George Road Sewage Treatment Plant Mercury Spill as surface water is not present at the site.

6.3 SEDIMENT PATHWAY

6.3.1 Wet Sediment Characteristics

Wet sediment samples were collected at the outfall area (DU02) of the drainage system. The analytical results from this SI indicate that mercury is present in the wet sediment at DU02 at the outfall area at concentrations exceeding the background concentration of 0.059 mg/kg; however, the reported concentrations are below the FWCUGs for mercury in soil.

6.3.2 Wet Sediment Targets

The SI analytical results indicate that PAHs, benzo(a)anthracene, benzo(a)pyrene benzo(b)fluoranthene, were detected in the wet sediment samples at concentrations exceeding Resident Receptor FWCUGs at DU02 at the outfall area but these chemicals are not considered to be related to the historical mercury spill at this AOC.

6.3.3 Wet Sediment Pathway Conclusions

Mercury was not identified as a potential contaminant in the wet sediment collected in the outfall area at this AOC.

6.3.4 Drainage Pipe Deposit

The deposit in the 15-inch vitrified clay pipe (drain line) was sampled as part of this SI is not considered to be soil or wet sediment, but was compared to the FWCUG for subsurface soil, as there are no pipe deposit FWCUG.

Mercury was reported in the drainage pipe deposit sample collected from inside the communitor building discharge line (15-inch vitrified clay pipe) that leads to manhole MH-P1 at DU01 at a concentration of 7.2 mg/kg, which is above both the background value (0.044 mg/kg) for subsurface soil and the Resident Receptor FWCUG (2.27 mg/kg) for subsurface soil. The deposits within this 22-ft long, buried 15-inch vitrified clay pipe are not considered to be a potential source of contamination as the pipe is plugged at the terminus to manhole MH-P1 and currently not in use as part of the drainage system. Storm water is also blocked from entering this section of the drainage system. Therefore is no completed exposure pathway for inhalation, ingestion, or dermal contact to humans.

6.4 GROUNDWATER PATHWAY

6.4.1 Hydrogeological Setting

Section 1.4.4 presents the general hydrogeological setting for RVAAP. In April 2011, OHARNG installed two bedrock aquifer wells at the facility within the Sharon Conglomerate for use as an institutional groundwater supply. These potable wells are located near Buildings 1067 and 1068 within the Administration Area, which are approximately 2,000 and 2,550 ft from CC RVAAP-75 AOC, respectively. These groundwater supply wells are used solely for onsite activities and are not used for public distribution, livestock, or commercial groundwater potable supply. 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.

No monitoring wells in the facility-wide network are present at the George Road Sewage Treatment Plant. The nearest facility-wide monitoring wells are FWGmw-015 and FWGmw-016-004, located approximately 2,000 ft southwest of the George Road Sewage Treatment Plant. As no monitoring wells exist in the immediate AOC area, the depth to groundwater beneath the site is unknown and can only be estimated. Based on a review of the drilling logs prepared for this SI, the depth to water below the site is estimated to be between 10 and 15 ft bgs.

Available maps showing the generalized potentiometric surface of the unconsolidated aquifer and Sharon Conglomerate bedrock (SAIC 2011c) indicates the potentiometric surface in the unconsolidated aquifer is higher than the ground surface at the site, or approximately 1,010 ft amsl (Figure 1-9). Ground surface elevation is estimated to be approximately 1,008 ft amsl at DU01 and 990 ft amsl at DU02 (Figure 2-1). Based on the *Final Facility-Wide Groundwater Monitoring Program, RVAAP-66 Facility-Wide Groundwater Annual Report for 2013* (EQM 2014), the generalized potentiometric surface elevation of the Sharon Member bedrock aquifer is estimated to be at 988 ft amsl, as shown in Figure 1-10. The generalized regional groundwater flow direction (both aquifers) in the vicinity is to the southeast toward a tributary of the west branch of the Mahoning River located southeast of the CR site.

6.4.2 Groundwater Targets

Groundwater targets include human receptors that use groundwater for potable water supply, as well as ecological receptors and physical targets (e.g., springs) that may be affected by potential groundwater contamination on or adjacent to the AOC. The water table at CC RVAAP-75 is approximated between 10 and 15 ft bgs. Groundwater in the vicinity of the George Road Sewage Treatment Plant is not currently used by the Army or OHARNG. Future use of groundwater is anticipated at the facility. Future human receptors may be exposed to groundwater.

6.4.3 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-75 is being evaluated under the RVAAP-66 Facility-Wide Groundwater.

7. SUMMARY AND CONCLUSIONS

This section provides a summary of the findings and conclusions of this SI conducted by ECC at the CC RVAAP-75 George Road Sewage Treatment Plant Mercury Spill AOC. Subsurface soil, wet sediment, and one sample from the deposit within the drainage pipe were sampled as part of this SI. There are no wetlands, streams, or surface water onsite. Groundwater associated with CC RVAAP-75 is currently being addressed separately under the RVAAP-66 Facility-Wide Groundwater.

The reported mercury spill (a 1 pint jar of elemental mercury) was reported during interviews conducted during the HRR to have occurred within the comminutor building and entered into the floor drain and drainage system. Therefore, only subsurface soil by pipes, wet sediment downstream of the outfall headwall, and the deposit within the 15-inch drainage pipe were sampled as part of this SI, as potential locations that may have been impacted by the spill.

The following media samples were collected during this SI:

- Five subsurface soil samples were collected from beneath the 15-inch drain line leading from the comminutor building floor drain. These subsurface soil samples were collected between 5 and 6 ft bgs.

- Three subsurface soil samples were collected from beneath the floor drain's P-trap and discharge pipe associated with the floor drain inside the comminutor building into which the mercury reportedly spilled (SAIC 2011a).

- Two subsurface soil samples were collected from two soil borings located on either side of the 4-inch discharge pipe which runs from the floor drain P-trap inside the comminutor building to the 15-inch vitrified clay drain pipe. These samples were collected between 5 and 6 bgs.

- One deep subsurface soil sample was collected at depth of 7-13 ft bgs to inspect the soil to 13 ft bgs.

- One wet sediment sample was collected from the discharge location of the drainage outfall area in order to inspect the terminus area of the drainage system. The wet sediments within the discharge outfall area were analyzed for mercury.

- One discrete sample was collected of the drainage pipe deposit located within the 15-inch drain pipe. The deposit was sampled from the northeastern corner of the comminutor building.

Additionally, in order to determine the flow path of the mercury spill and the condition of the drainage system leading from the comminutor building, two video camera inspections were conducted as part of this SI.

7.1 SUMMARY OF RESULTS

The SI results are summarized for CC RVAAP-75 George Road Sewage Treatment Plant Mercury Spill as follows:

Subsurface Soil

- One SRC (mercury) was identified in the subsurface soil samples collected beneath the 15-inch vitrified clay pipe (drain line), beneath the floor drain P-trap, and beneath and adjacent to the 4-inch cast iron pipe.

- Mercury was not detected in concentrations exceeding the Resident Receptor FWCUG in any of the subsurface soil samples collected at this AOC. Mercury was not identified as a potential contaminant in the subsurface soil.

- The reported concentration of mercury (0.05 mg/kg) in the deepest subsurface soil sample collected between 7 and 13 ft bgs is less than the maximum contaminant level for protection of groundwater (0.1 mg/kg). Therefore, mercury is not considered a potential source for groundwater contamination at this AOC.

Wet Sediment

- SRCs were identified in the DU02 outfall area wet sediment samples as follows: 3 VOCs (2-hexanone, carbon disulfide, and methylene chloride); 22 SVOCs, primarily PAH compounds; 2 pesticides (p,p-DDE and p,p-DDT), 1 explosive (tetryl), and 13 metals including mercury.

- Three metals (aluminum, cobalt, and manganese) were reported in the wet sediment samples collected at DU02 outfall area. Aluminum and manganese were reported at concentrations exceeding the background concentrations and respective Resident Receptor FWCUG. Cobalt was reported greater than the background concentration; however, no FWCUG has been established for this chemical. These inorganic chemicals were not related to the elemental mercury spill at CC RVAAP-75 and were not identified as potential contaminants in the wet sediments collected from the outfall area.

- Three SVOCs (benzo[a]anthracene, benzo[a]pyrene, and benzo[b]fluoranthene) were reported in one of the two wet sediment samples and one SVOC, benzo[a]pyrene, was reported in only the second wet sediment sample collected at the outfall area (DU02) at concentrations exceeding the Resident Receptor FWCUG.

- The PAH compounds and metals reported in the two wet sediment samples collected from the outfall area are expected to be present at the active outfall area. The outfall area is the current terminus for the storm sewer network, receiving runoff from surrounding areas including rail beds, parking lots, and roads that contain PAH compounds. The active outfall area also potentially receives inorganic chemicals from mineral scaling deposits and metal pipe debris that may have accumulated in the sanitary and storm sewer pipes over time (SAIC 2012). These chemicals are not related to the spill of mercury at the George Road Sewage Treatment Plant. These organic and inorganic chemicals were not identified as potential contaminants in the wet sediments collected from the drainage outfall area.

Drainage Pipe Deposit

- One mercury sample was reported at 7.2 milligrams per kilogram [mg/kg] at DU01 in the drainage pipe deposit sample collected from inside the 15-inch vitrified clay pipe (drain line). Mercury was identified as an SRC, because it exceeded the background value of 0.044 mg/kg. Mercury also exceeded the Resident Receptor FWCUG (2.27 mg/kg) for soil. The mercury level was compared to the Resident Receptor FWCUG for soil, as there are no criteria for a drainage pipe deposit.

The conclusions of this SI are as follows:

- No organic or inorganic potential contaminants were identified in the subsurface soil or wet sediment sampled at this AOC.

- Mercury was reported at a concentration 7.2 mg/kg on the drainage pipe deposit sample located within the 15-inch vitrified clay pipe (drain line) that exceeds the Resident Receptor FWCUG (2.27 mg/kg). However, the mercury within the drainage deposit sample collected from within the enclosed 15-inch vitrified clay pipe (drain line) is not subsurface soil and is not a potential source of contamination to the environment, since there is no complete exposure pathway. This is supported by the following lines of evidence:

    1. The end of the drain line is plugged with concrete (at the junction with manhole MH-P1) preventing migration of the drainage pipe deposit, and this line is no longer used for drainage.

    2. The SI sampling results of the subsurface soil surrounding and beneath the 15-inch vitrified clay pipe (drain line) do not contain any potential contamination from the estimated 0.5 grams of mercury contained in the drainage pipe deposit.

- 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. Groundwater associated with CC RVAAP-75 is currently being addressed separately under the RVAAP-66 Facility-Wide Groundwater.

The results of this SI indicate that NFA is warranted at CC RVAAP-75 George Road Sewage Treatment Plant Mercury Spill.

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